

# Examining GCSE Design and Technology – Insights from the Nuffield Design and Technology Project

## Abstract

This article looks critically at the ways in which design and technology is currently examined at GCSE level. It identifies two key elements, technology for citizenship and designer maker capability, and explores how these might be assessed. It discusses the issue of group work in examined projects and questions the place of written examinations in assessing designer maker capability. It presents a preliminary analysis of 1998 higher tier examination papers in terms of eight question types discussed in the *Nuffield D and T KS4 Teachers' Guides*. Finally, the article makes a plea for an assessment scheme that matches the requirements of teaching designer maker capability and technology for citizenship.

## Some background considerations

Design and technology is a relatively new subject although one with a long and intriguing history, with influences from a variety of traditions – craft, home economics, art and design, technical and vocational education and technology education. The professional association for teachers of design and technology, DATA, is itself only nine years old and the current form of this journal, in which all articles are refereed is only three years old. The work of those who designed the first set of design and technology Orders provided a robust rationale for its inclusion in the curriculum. In the Parke's Report (ref 1) the unique reason for teaching it to children and young people is given as follows:

"What is it that pupils can learn from design and technological activities which can be learnt in no other way? In its most general form, the answer to this question is in terms of capability to operate effectively and creatively in the made world. The goal is competence in the indeterminate zones of practice."

Initially this was almost incomprehensible to many teachers and over six years a range of revisions has led to a much more pragmatic (some would say limited) definition (ref 2):

"Pupils should be taught to develop their design and technology capability through combining their Designing and Making skills with Knowledge and Understanding in order to design and make products."

It is worth reviewing initial rationale in the light of politicians' and industrialists' comments on the requirements for our nation to compete in global markets.

"The new workplace is characterised by ambiguity and unpredictability. In order to cope, staff need skills such as resilience, judgement and the ability to think in a much more creative way." Amin Rajan, Chief Executive, Create (ref 3)

"I believe it is time to show a fresh face to the world and reshape Britain as one of the 21st century's most forward thinking and modern nations. I challenge companies to demonstrate that the UK can lead the world by creating products and services that exemplify our strengths in innovation, creativity and design."

Rt Hon Tony Blair, Prime Minister, Great Britain (ref 4)

We are now in a position to regard design and technology as a coherent subject in its own right, concerned with developing designer maker capability in the young, whatever materials and components are used for the designing and making.

There is, however, an important additional dimension to this subject, almost hidden within the programme of study, which relates to the role of understanding technology as part of citizenship education.

## "8. Quality

Pupils should be taught to distinguish between quality of design and quality of manufacture, and use further criteria and techniques that help them judge the quality of a product, including:

- a how far it meets a clear need
- b its fitness for purpose
- c whether it is an appropriate use of resources
- d its impact beyond the purpose for which it was designed
- e how far it meets manufacturability and maintenance requirements." (ref 2)

Section d, asking students to consider impact beyond intended use, opens a veritable moral minefield. 'Who wins?' and 'Who loses?' from the introduction of a technology, the power bases of the winners and losers

**David Barlex**

*Director, Nuffield Design and Technology, London*

and the possibilities of losers influencing winners are the very stuff of participatory citizenship.

Citizenship is gaining in significance due to the increasing importance given to spiritual, moral, social and cultural development in the school curriculum.(ref 5) Design and technology has a natural role to play in this area of the curriculum.

These two important elements should clearly have an influence on both what and how we choose to assess. On **what** we assess because we want to be sure we are assessing what we think is important in design and technology – the assessment must be valid. And on **how** we assess because we want our assessment methods to be understood by teachers and candidates as well as being reliable and consistent. And of course we want it to be easily manageable.

#### Assessing students' designing and making

There is general agreement that students' ability in designing and making should be assessed – the 'what' of assessment is not contested. It is in considering the 'how' that interesting issues arise. It is well known that the physical artefact produced by a student tells only a partial story. The struggle of bringing ideas in the mind to the reality of the product easily remains hidden to the untutored eye and is almost inevitably mysterious to those who have not worked with the young person doing the designing and making. It is here that the argument for a design folder is at its strongest – to provide evidence of that struggle, evidence of the intellectual and practical endeavours that turn ideas into products that can be used and evaluated.

What would I want to see in a student's work? Here is my wish list:

- the individual signature of the child should be clear – designing is a personal activity
- an intelligent use of strategies for designing should be obvious – there are different ways of designing for different purposes and these should be obvious

- an appropriate use of communication techniques should be apparent – different techniques for different purposes
- an intelligent use of researched information should be clearly visible
- a rational use of technical information should be in evidence.

Overall I want the student to tell a clear, internally consistent and coherent story of the decisions they made in designing and making the product. I want evidence of designerly behaviour. I want to see a balanced combination of:

- technical and aesthetic creativity
- sensitivity to user needs
- appreciation of market forces
- understanding of and skill in manufacturing.

The Examination Boards were asked to provide the following information:

- 1998 full course lower tier paper for all focus areas plus marking scheme
- 1998 full course higher tier paper for all focus areas plus marking scheme
- the 1998 syllabi that refers to these examinations
- instructions and mark schemes for full GCSE course work submissions for 1998.

Northern Examinations and Assessment Board, Midland Examining Group and London Examinations (EdExcel) supplied all this information. Southern Examining Group supplied only the syllabus. In addition Northern Examinations and Assessment Board provided course work guidance for pupils' materials.

How do the current Examination Boards' course work requirements compare with my wish list? I ask this question because several of the Nuffield Area Field Officers have written reports with comments about the uniformity, anonymity and 'safeness' of much GCSE course work. The students had been well taught, they followed the requirements of

Table 1 Coursework requirements for full course GCSE D&T syllabuses

Focus areas	Northern Examination and Assessment Board	Southern Examining Group	Midland Examining Group	London Examinations (EdExcel)
resistant materials technology	<p><b>Common across all focus areas:</b></p> <ul style="list-style-type: none"> <li>design and make activity</li> <li>design folio</li> <li>product</li> <li>evidence of:</li> </ul>	<p><b>Common across all focus areas:</b></p> <ul style="list-style-type: none"> <li>design and make a product</li> <li>40 hours curriculum time</li> <li>marking criteria</li> </ul>	<p><b>Common across all focus areas:</b></p> <ul style="list-style-type: none"> <li>design and make activity</li> <li>40/50 hours curriculum time</li> <li>design folder</li> <li>quality product</li> </ul>	<p><b>Common across all focus areas:</b></p> <ul style="list-style-type: none"> <li>design and make a product, not less than 30 hours</li> <li>design folder</li> <li>practical outcome</li> </ul>
food technology	<p>Description of problem</p> <p>Research</p>	<p>Formulation of the design brief and specification</p> <p>Research and investigation</p>	<p>related to industrial/commercial practices including appropriate applications of systems and control</p>	<p>investigation of a product, not less than 10 hours</p> <p>illustrated report</p>
textiles technology	<p>Analysis</p> <p>Specification</p>	<p>Generation of Ideas</p> <p>Selection and development</p>	<p>assessment objectives:</p> <p>Identifying a need or opportunity leading to a brief</p>	<p>assessment objectives:</p> <p>Developing ideas</p>
graphic products	<p>Generation of ideas</p> <p>Development of solution</p> <p>Planning and production of outcome</p> <p>Evaluation</p>	<p>Planning and organisation</p> <p>Production/outcome</p> <p>Evaluation</p> <p>Communication skills</p>	<p>Research into a design brief resulting in a specification</p> <p>Generation of ideas</p> <p>Product development</p>	<p>Communication</p> <p>Evaluation</p> <p>Materials, tools and equipment</p> <p>Industrial practices</p>
electronic products	<ul style="list-style-type: none"> <li>series of questions dealing with key issues and pointers towards overarching issues</li> <li>spelling, punctuation and grammar criteria</li> </ul>	<ul style="list-style-type: none"> <li>spelling, punctuation and grammar criteria</li> </ul>	<p>Product planning and realisation</p> <p>Evaluation and testing</p>	<ul style="list-style-type: none"> <li>spelling, punctuation and grammar criteria</li> </ul>
systems and control technology	<p><b>Differences between focus areas:</b></p> <p>Time requirements:</p> <p>Resistant materials technology, textiles technology and electronic products 40-50 hours supervised time</p> <p>Graphic products 40 hours supervised time</p> <p>Food technology 25 hours supervised time</p> <p>Systems and control: minor project 15 hours supervised time, major project 40-50 hours supervised time</p>			

the assessment scheme to the letter. The better candidates got the better grades but the work generally lacked flair, personal signatures were not much in evidence at any level of achievement. There is evidence that teachers give Key Stage 3 students more autonomy designing and making assignments than Key Stage 4 and some have argued that this is due to the course work assessment requirements for Key Stage 4. (ref 6)

All the Examination Boards give guidance about both design portfolios and made outcomes to be submitted for GCSE course work. The main features of course work requirements as included in the syllabus for each Board are summarised in Table 1.

Invariably the assessment criteria are linked to a seemingly linear set of stages in a designing and making process. There is usually a caveat about flexibility, for example:

#### **Northern Examinations and Assessment Board**

These are not necessarily consecutive stages of designing, although in much design work they do follow logically from one another. Design requires a flexible approach which allows all aspects to be considered and reconsidered whenever it is appropriate.

#### **Midland Examining Group**

It is appreciated that for assessment purposes, the criteria have been written in a linear form. It may be that within focus areas of design and technology some stages may interrelate and be cyclical in approach.

Even with these caveats it is easy to see how this can become a series of ritualistic hoops to be jumped through; where the activity has lost dynamic purpose as far as the student is concerned and has become reduced to 'what I must put in my folder'. From the teachers' view point structuring the folder according to the assessment criteria makes the assessment much easier to manage.

Nick Givens, Nuffield Area Field Officer for the South West, writes passionately about this:

"Our problem always has been, and remains, that of finding efficient painless ways of generating EVIDENCE that doesn't stifle the creativity. So the ritualisation of designing, the conversion of the design folio into a product and the inflexible narrow interpretation of what constitutes design, represent a major problem. There needs to be scope for pupils to model and record their thinking in a variety of ways AND orders. We can't carry on letting a narrow view of what constitutes EVIDENCE-of-design dictate the nature of design." (ref 7)

Only if there is the possibility of diverse response will students be able to respond from within themselves and reveal their personal designing signatures. Is it too much to ask for a broad sweep approach to 'telling the story of your designing and making' with general guidelines indicating the areas of consideration – the balanced combination of features referred to above? The production of such portfolios would cease to be a chore, they would be working documents and lay the foundation of skills for life.

#### **What about group work in examined projects?**

I know that many examiners feel strongly that the candidates are individuals and should be assessed as such but I believe that one of the most important qualities of an individual is his or her ability to work as part of a group or team. The Project has promoted opportunities for this in all the focus areas identifying those parts of a designing and making assignment where students working on the same line of interest<sup>1</sup> can co-operate – research activity, brainstorming, reviewing progress, evaluating. But for those who see the design and technology endeavour as naturally a team based activity – all the senior designers from a range of highly successful design consultancies who made presentations to the examiners at a recent QCA meeting (ref 8) – this falls short of the mark.

So I wonder if it is possible to have lines of interest where group work is the natural way of working and to give some students this option with the inducement that their certificate will indicate their ability to work well in a group. I believe industry and commerce

<sup>1</sup>The capability tasks are organised into lines of interest where each line of interest represents a product type. These have been chosen to include both familiar and unfamiliar product types. In work with resistant materials the lines of interest are body adornment, seating, storage, lighting, automata, toys and games, testing equipment. In work with textiles the lines of interest are items for protection, for the theatre, for fashion accessories, to reflect street style, for interiors, bags and carriers, tents and kites.

Table 2 Types of written answer questions discussed in Key Stage 4 Teachers' Guides

**Question type 1 about knowledge definitions (what?)**

The candidate is expected to show understanding of key terms, principles and concepts. The question will be written in a form which requires candidates to *recognise or give an example* which illustrates the meaning, but does not expect candidates to be able to recall and state a definition.

**Question type 2 about knowledge of purpose (why?)**

The candidate is expected to show understanding of:

- why things are done in a particular way (why do it in that way?)
- why actions or decisions are significant or important (why would you do 'x'? or why is it like that?)
- why decisions are appropriate or have been made (why has it been made from 'x'?).

The question will be written in a form which asks the student to explain or justify.

**Question type 3 about knowledge of method (how?)**

The candidate is expected to describe or explain showing understanding of:

- processes, materials and techniques (how could I make this design from particular materials?)
- the application of technological principles (show how you would do 'x' or make 'x' happen?)
- the application of design strategies (how would you research, analyse, review, make decisions, plan, test, evaluate, etc.).

The question will be written in a form which asks students to describe using a suitable mode of response, such as notes and diagrams, grid/matrix or flow chart etc.

**Question type 4 about speculating about change (what if?)**

The candidate will be asked to predict the results of given changes in circumstances or variables, including:

- the direct consequences of things (what would happen if you did 'x'?)
- the effect on connected things (if you changed "x" then what effect would this have on "y"?).

The question will be written in a form which asks the student to *suggest what would happen if*.

**Question type 5 about creative problem-solving**

The candidate will be asked to develop a *personal response* to a short technical design problem.

The question will be written in a form which requires students to *suggest* possible solutions, *compare* their alternatives, select and *justify a recommended solution*.

**Question type 6 about design strategies**

The candidate will be asked to use design *strategies* on a short design scenario.

The question will be written in a form which requires the student to *use a given strategy* to carry out design analysis, development or evaluation.

Strategies could include:

- clarifying briefs – turning an open ended brief into a more specific form
- writing specifications – turning a headline specification into a more detailed form
- attribute analysis – analysing possible product characteristics
- brainstorming – completing a started brainstorm or organising a random list from brainstorm to show categories and links
- impact of design and technology – interrogating a completed winners and losers chart
- user trip – interpreting user views and opinions.

**Question type 7 about presenting and interpreting information**

The candidate will be asked to make sense of design and technology research data.

The question will be written in a form which requires a student to:

- *present* the information clearly
- *interpret* the data and reach conclusions.

**Question type 8 about interpreting a short case study**

The candidate will be asked to use comprehension skills, design *strategies* and *knowledge* to demonstrate their *understanding* about design and technology activity from the world outside school.

The question will be written in a form which requires the student to:

- *find a piece of information* from the text
- *explain* something that is described in the text
- *make judgements* about the quality and effects of the design and technology described.

would welcome this. Interestingly the acquisition of much vaunted 'key skills' seen as essential to national prosperity can be shown to occur quite naturally within group based working within design and technology (ref 9). Yet another reason why industrial and commercial support should be forthcoming.

Here are two examples from commercial graphic products. First the Star Trek *These are the Voyages* pop up book. It consists of four double pages. Each double page spread is a master work of cardboard engineering and would constitute a major project in itself. Designing and making such a book as a whole represents a real challenge for a group of four students with opportunities for both conventional and ICT based designing and making. Second the Marvel Comics *Super Heroes GIANT Board Game* book – 6 different games, each with its own rules in an A2 format card book complete with electronic dice. Even without the electronic dice, and it has to be admitted that this feature is extremely irritating, the production of such a giant book is a delightful challenge for a small group of 16 year olds. Clearly we don't want copies of these products but they do represent interesting product types suitable for group designing and making.

It is not a big curriculum development exercise to identify a range of product types for each focus area that is suitable for group or team work and to develop them into full blown designing and making assignments. The Nuffield Design and Technology Project has already developed a 14 point framework for describing capability tasks (the designing and making assignments of the National Curriculum) (ref 10). Identifying a set of features that are important for group work and could form the basis for assessment is not a difficult exercise. The literature already contains well developed examples (ref 11 and ref 12). I think that this is an endeavour that could attract industrial sponsorship and I suggest that DATA, the Nuffield Design and Technology Project in co-operation with one or more Examination Boards, seek such sponsorship.

#### What about a written examination?

First I must ask 'Do we really need one?' Is it important to examine across the entire programme of study/syllabus? Or should we

be interested in what students do with what they have been taught. It is obvious that they are unlikely to use all the syllabus in a single capability task – but does that matter? Second I ask 'Does it have to be like this?' If we decide that it is important to test their subject knowledge in a context outside their own designing and making then it is important that this is done efficiently and effectively – not, I suggest, as a design on paper exercise. The Key Stage 4 Teacher's Guides in the Nuffield Design and Technology Project materials identify a range of question types that can be used for a written examination (see Table 2). If we really do need such a written paper – and I'm not convinced that we do – then I would like to see these question types taken into account.

One way of starting a discussion about this issue is to examine the current higher tier full course papers for two different focus areas from different boards for the presence of these different questions types. In one sense this is an unfair analysis as the question papers were not necessarily designed to meet the criteria of including a spread of different question types but the analysis will reveal the question types currently prevalent in GCSE written papers. The results of this analysis plus comments are available upon request from the author at Nuffield Design and Technology, 28 Bedford Square, London WC1B 3EG.

Inspection of these results shows that there is only minimal comparability between the question type profile of the different focus areas within a single examination board (with the exception of electronic products and systems and control). Inspection shows that there is some similarity in the question type profile between the examination papers from different examination boards for the same focus area. The limited presence and absence of question types is noteworthy. Type 1 questions dealing with knowledge but without requiring detailed recall are almost completely absent. Type 4 questions about speculating are almost completely absent. Type 6 questions about strategies are scarce. Type 7 questions about presenting and interpreting information are almost completely absent. Type 8 questions requiring the interpretation of case studies are completely absent.

### Examining technology for citizenship

Now I ask "What about a written examination that tests technology for citizenship as a counterpoint to designer maker ability tested through project work?" This would be a very interesting exercise. The questions need NOT, and I stress this, be answered by essays. They could involve reading about technology in action and answering questions exploring value judgements of differing complexity. Candidates could be required to use a range of evaluation strategies as part of this. Some questions could involve interpreting images by annotating. Of course there will need to be precautions taken here. At a recent Nuffield Area Field Officer meeting Torben Steeg voiced a concern "It's important that expertise in this area is as the result of teaching, not simply a casual read of *The Guardian*." The challenge here is to both syllabus and examination question designers. However, it is important not to be over conventional in designing either the questions or the teaching materials as indicated by a recent Design Council discussion paper (ref 13).

"Many of today's young people prefer to receive their messages about life in visual form. They have the ability to decipher messages quickly from visual imagery. This has huge implications for education and training. To be more effective, teaching may need to be more visually based; literacy may need to be more visual than written."

### Concluding remarks

If we are interested in an education that values and promotes designer maker ability and technology for citizenship then we should use appropriate assessment techniques – project work for the former, structured questioning for the latter. Design and technology teachers know how to teach and assess project work; it is one of their strengths and, with established moderation procedures, we know that their professional judgement can be trusted – "It suggests that given appropriate training it is possible to pick out and agree on a measure of consolidated holistic capability." (ref 14). Teaching technology for citizenship is less certain territory which is why a robust examination supported by appropriate training and good curriculum materials will be needed. This is

not beyond current resources; the good curriculum materials already exist, (Nuffield case studies) there is a large and growing body of expertise in this area of the curriculum (ref 15) and Examination Boards have an established track record in providing in service training. So I believe we are in a strong position to match the assessment techniques we use to our educational aims and intentions.

### References

- 1 *National Curriculum Design and Technology Working Group Interim Report* (1988) Department for Education and Science and the Welsh Office
  - 2 School Curriculum and Assessment Authority (1995) *Design and Technology in the National Curriculum* London School Curriculum and Assessment Authority
  - 3 Amin Rajan, Chief Executive, Create, in *Design and Key Skills*, Design Council 1998
  - 4 Rt Hon Tony Blair, Prime Minister, Great Britain in *Millennium Products*, Design Council 1998
  - 5 See for example *The Promotion of Pupils' Spiritual, Moral, Social and Cultural Development* (November 1997) QCA Draft Guidance for Pilot Work
  - 6 Preliminary finding of Nuffield Design and Technology National Survey 1998 (unpublished results)
  - 7 Givens, N. in *Nuffield D&T Project Response* (July 1998) to the National Advisory Committee on Creative and Cultural Education
  - 8 GCSE D&T Focus Area Forum meetings organised by QCA: meeting 1 24 Nov. 1997 at Cambridge Consultants; meeting 2 13 March 1998 at Pankhurst Design Developments
  - 9 See, for example, the Summer 1998 issue of *Update the Nuffield Design and Technology Newsletter* which took key skills as its theme
  - 10 Barlex, D. *Nuffield Design and Technology Product Design Teacher's Guide* Addison Wesley Longman 1996 or Barlex, D. *Nuffield Design and Technology Textiles Teacher's Guide* Addison Wesley Longman 1996
  - 11 Barlex, D., Project Work, Unit 5, *Open University Advanced Diploma in Technology in Schools*, Open University Press, 1988
  - 12 Denton H. G. *Group task management: a key element in technology across the curriculum* DATER 1989 page 46- 51
  - 13 Leading the way: What can future generations learn from the start of the new Millennium? Design Council 1998
  - 14 Kelly, V., Kimbell, R., Stables, K., Wheeler, T., Wosniak, A., *The Assessment of Performance in Design and Technology*, SEAC 1991
  - 15 See for example *Validate News*, the newsletter of Values in Design and Technology Education available from Validate, c/o Mike Martin, University College Chester, Chester, CH. Tel 01244 375444, Fax 01244 373379, E-Mail m.martin@chester.ac.uk
- There is a website at [www.chester.ac.uk/technology/validate.htm](http://www.chester.ac.uk/technology/validate.htm)