DESIGN AND TECHNOLOGY
IN THE CURRICULUM

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Foreword

With the emphasis of the revised curriculum in Wales (2008) on developing skills rather than merely transferring facts – and an increasing focus on developing creative and critical thinking by means of questioning, planning, and problem-solving – design and technology is an ideal subject area for promoting such development. This is a curricular area that has always given a central place to the educational ‘process’ that underpins the introduction of the subject to pupils by encouraging them to be creative in a stimulating and innovative way. Indeed, the skills developed by pupils involved in the process of designing and making are in line with the Assembly Government’s definition of what lies at the heart of education:

The fundamental aim of education is to produce learners who are motivated and effective, increasingly responsible for their own learning, able to make full use of the new technologies and who will be able to learn and apply new skills effectively throughout their lives, whether in school, the workplace or at home.


This issue of Education Transactions offers a wide overview of different aspects of developing design and technology in the curriculum in Wales, England and Finland. In the first paper, Gwyn Pritchard analyses how the different stages of the process of designing and making in the primary classroom provide valuable opportunities for promoting the individual’s language development. By attempting to define and understand what lies at the heart of the design and technology experience, the paper comes to the conclusion that it is a rich creative process that transcends the mere manipulation of a variety of tools to create a product.

Bearing in mind that the work of the nineteenth century pioneer in craft education, Uno Cygnaeus, is associated with Jyväskylä in central Finland, it is most appropriate that three colleagues from the Department of Teacher Education at the University of Jyväskylä are the authors of the second paper. Aki Rasinen, Pasi Ikonen, and Timo Rissanen describe the
development of craft education to technology education in Finnish comprehensive schools since the 1970s and come to the conclusion that progression from theory to practice remains a challenge and that there is yet more work to be done in order to ensure that technology education earns its place in the country’s schools.

In the third paper David Barlex, Director of the Nuffield Primary Design and Technology Project, describes the rationale for setting up the Project in 1996 and analyses its impact on the teaching and learning of design and technology in primary schools. Although the main focus of the paper is on primary schools in England, the lessons learned have general application as it provides an effective pedagogy to which teachers with little previous initial training can respond in a positive manner.

The last paper, by Louise Davies, Deputy Chief Executive of the Design and Technology Association, elaborates on the activities of this professional organisation that represents all those involved in design and technology education in the UK. In addition to providing support, advice and practical guidance to all who work in the subject area, the Association also develops a strategic vision for the subject within the curriculum.

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1 Design and technology in the primary school: a means of developing language

Gwyn Pritchard

Abstract
This article is predicated on the hypothesis that design and technology is a rich medium for the development of children's language in the primary school. This hypothesis derives from the author’s wide experience over many years of working with both trainee and experienced teachers. The examples cited in the article are drawn from work with pupils and students accomplished through the medium of Welsh.

Introduction
It is difficult to encompass a definition of technology within a few words. One attempt to capture its essence has expressed it as a medium to create, develop, conserve and, even, to destroy the environment.

For the purposes of this article we shall rely on the Open University's definition of technology. This definition was developed by reflecting on the American Apollo project in the 1960s. It was argued that the tendency to interpret technology only in terms of machines provided a restricted picture. Whilst recognising that the Apollo programme used sophisticated machinery, the ability to send man to the moon and back depended on other factors as well. The full picture could only be understood by taking these additional factors into account.

Firstly, President John F. Kennedy had set a goal for man to reach the moon by the end of the sixties. The goal had been divided into a number of practical tasks, such as designing and testing a lunar vehicle. Secondly, there were people, including
skilled scientists and engineers, who brought a third element to the project, that of specialist knowledge. However, as individuals (there were over 40,000 working on the project at one time) they would have been unable to complete the task independently. Social organisation was therefore needed as a fourth component to administer and manage the whole project. NASA was the project management body. By combining these disparate elements, the Open University formulated the following definition:

Technology is the application of scientific and other knowledge to practical tasks by organizations that involve people and machines (Open University, 1996:12).

Does this definition help us to understand the nature of technology in the classroom? Perhaps not, at first sight, but the definition correlates well with previous statutory requirements covering design and technology in the National Curriculum in Wales, stipulating that pupils should:

- clarify the requirements of the task in hand
- develop their design and technology capability through combining their Designing and Making skills with Knowledge and Understanding in order to design and make products
- be given the opportunity to work independently and in groups.

(National Assembly for Wales, 2000a:8-9)

These basic principles support each other and emphasise that classroom experience of design and technology is a richer experience for the pupil than merely manipulating a variety of tools to create a product. We do not intend to expand generally on the merits of the subject within the wider curriculum but, rather, to concentrate on the contribution of design and technology to the development of children’s language in the classroom. With that aim in mind, we need to be conversant with the nature of design and technology in relation to how it is has been taught on a daily basis in the primary school.

Whichever way we wish to interpret the content of the Curriculum 2000 document, it was also expected that pupils would enjoy the experiences detailed in 1995 by the Welsh Curriculum and Assessment Authority (ACAC) by:
• generating ideas and clarifying the task
• developing and communicating ideas
• planning
• working with materials
• evaluating

(ACAC, 1995:8-13)

This provides a framework, which we can refer to as a process, for planning design and technology experiences in the classroom. Whether we refer to it as a design process, a creative process or a technological process, the critical point is the acknowledgement and understanding that there is a process involved. It is a way of thinking that allows the hand, the eye, the mind and the heart jointly to design and make. As the curriculum continues to be revised, the terminology may change but, in essence, this process remains at the core of design and technology. It is also a flexible process: ‘The creative process of designing and making . . . is iterative but involves a series of identifiable activities’ (The Design and Technology Association, 1996:3.1).

**Generating ideas and clarifying the task**

By adopting the view that this area of the curriculum is a vehicle to promote the development of an individual’s language, it becomes necessary to show how the experiences within the process support this view. We begin by showing how ‘generating ideas and clarifying the task’ encourages language development.

The development of craft education over the last century, particularly in the secondary sector, saw a significant turning point in the 1970s. During the first half of the century, the main aims of teaching methods were to train pupils to read a drawing, to practise the associated crafts, to appreciate the importance of accuracy and to attain high craft skills. Each pupil in the class would make the same thing, be it a toast rack or a stool. However, from the 1970s onwards, design became an integral part of the course, and schemes of work sought to ensure that pupils had the opportunity to think for themselves. Pupils were now encouraged to develop their own personal designs before practising the craft of ‘making’.
The role of teachers of metalwork and woodwork was to prepare a drawing of the objects they wanted their pupils to make. By contrast, posing a problem or, using the terminology of the period, setting a design brief was the task of teachers of craft, design and technology – quite a challenge. By and large it was comparatively easy for teachers to prepare a drawing that would induce a response from pupils, via the techniques that teachers wanted them to encounter; it was quite a different matter for teachers to prepare a design brief to achieve the same aims. As a consequence, they needed to develop the skill of preparing briefs that would elicit creative responses within given restrictions.

Another significant and exciting development emerged during the 1990s. Teachers were asked to present situations that would allow pupils to identify specific needs and opportunities as a basis for design and technology activity. In other words pupils were now expected to produce their own design briefs. 'Pupils should be able to identify and state clearly needs and opportunities for design and technological activities though investigation of the contexts of home, school, recreation, community, business and industry' (Department of Education and Science and the Welsh Office, 1990:3).

Further revisions to the National Curriculum in 1995 represented a change of direction, if not a step backwards. Pupils were no longer required to 'identify needs and opportunities for design and technology activities'. The responsibility for defining the task for pupils was transferred back to teachers – at least, that was the interpretation that followed the strict letter of the statute. However, by interpreting the statutory requirements as a supportive framework it may be argued that there was still an opportunity for teachers, as they attempted to teach differentially, to vary their methods of motivating individual pupils in their classes.

There have therefore been numerous developments in teaching methods. However, each method retains a central core that the step of ‘generating ideas and clarifying the task’ is rich in the possibilities of promoting the individual’s language development. As part of the process of crystallising
Design and technology in the primary school

needs, pupils come face to face with a variety of experiences that raise their awareness of the requirements before progressing to consider possible solutions.

At Key Stage 1 (KS1) a story can offer a starting point for identifying a need to design and make a particular object for one of the story’s characters. For example, ‘teddy’ needs something that will help to move toys around the room. Discussing this with the teacher and amongst themselves provides a means whereby pupils may conclude that some form of vehicle is needed and that more than one particular type of vehicle would be suitable. Such experiences provide ideal contexts to develop children’s ability to express themselves orally.

A story as an initial motivator can also be an opportunity to teach pupils to listen carefully and, since the need to ‘generate ideas and clarify the task’ arises naturally from the story, teachers have the opportunity to discover if individuals have understood its content and are able to apply it to an appropriate end. After all, an appreciation of the reasons why teddy needs something to move the toys is a necessary precondition before the child can start successfully on the process of designing. The quality of the response shows the full extent of the understanding.

At Key Stage 2 (KS2) oral work can be the key to pupils’ attempts to explore needs and to suggest initial ideas. However, there are also opportunities to extend linguistic experiences by creating situations that require pupils to extend their background reading as well as to respond in writing. Richard Sykes emphasises that the full richness of the reading experience is linked to a realisation of a need to acquire knowledge: ‘The chief stimulus to active reading is that of having genuine need to find out by reading’ (Sykes, 1988:11). Pupils find themselves in this situation as they gather together considerations and needs at the start of a design and make task.

‘Help the Aged’ is an example of a theme that can be appropriate for design and technology activities at KS2. Following initial discussion with the teacher pupils may realise that further fact finding is necessary before finally deciding on the nature of the product to be designed. That is, relevant
information needs to be gathered to establish the main needs of elderly people. The next step may be to consult the elderly within the school’s catchment area by a variety of means, such as by corresponding with local societies and organisations, preparing a questionnaire to be distributed to elderly people, inviting a specialist to the school, reading background material and recording the material collected. Following such an exercise, the overall needs are analysed as a basis for forming conclusions.

Communication skills are clearly central to all these steps. These skills allow pupils to decide finally on the nature of the task, to gain a full appreciation of the requirements and to suggest a variety of design options. Using these communication skills assists pupils to develop linguistically as well as to develop the ability to ‘generate ideas and clarify the task’ in the context of a design and technology task. They encounter a variety of communication experiences that will vary across the differing components of the task. For example: ‘Children might be speaking and listening to a variety of different people as part of their work, i.e. each other, the teacher, teacher assistants, visiting experts or possible users of their products. This will require children to communicate in different ways using appropriate methods of expressing themselves and accurate vocabulary. For example, the style of language used in class brainstorm will be different from asking questions in a survey or from presenting their work in a class assembly’ (The Design and Technology Association, 1999:10).

In this context chatting with the elderly provides an opportunity to allow pupils to understand the difference between talking socially and talking in formal contexts. Opportunities also arise to emphasise to the children the importance of accuracy in language when asking questions and discussing with others.

The context provides another opportunity, whose richness is also worth emphasising. In a period of social change as well as changes in methods of communication, it is sometimes suggested that the quality of Welsh oral language has deteriorated. It is also claimed that some particularly rich idiomatic language is the preserve of the older generation.
Recalling that our focus is the needs of the elderly one may imagine that opportunities will arise to hear a variety of idioms as a natural part of the children’s conversations with individuals. The English near equivalents of such idioms may include the following:

- In the old days I used to be able to scuttle around the house.
- The fact that I can’t do everything I used to these days rubs salt into the wound.
- I love to sit soaking up the sun.
- I have a bee in my bonnet about keeping the place tidy.
- You’ve hit the nail on its head, that’s exactly right.
- or
- You’re spot on, that’s exactly what I need.

In discussion, the designer and the client are responding to a real situation. For example, the pupil wants to identify needs while the elderly woman has the opportunity to explain some of the disadvantages of ageing and the problems that come in its wake. Inviting an adult to the school to discuss the past is a common experience but this is an example of talking about the here and now and to listen to an individual’s needs that may, in turn, lead to a greater understanding between two generations.

The nature of the situation may also bring the pupils face to face with completely new idioms and sayings but, because they occur within a real setting, there is a chance that they will arouse a curiosity, not only in relation to design but also as an incentive to explore a variety of similar idioms to be used both orally and in writing.

**Developing and communicating ideas**

What is meant by ‘developing and communicating ideas’ as part of the process? At KS2 pupils were required to prepare a specification (the main needs), to research the background using a variety of information sources and to develop and generate ideas.

The National Curriculum Focus Statement for Welsh and English at KS2 stated that ‘[p]upils should be taught to
communicate and organise information effectively in writing’ (National Assembly for Wales, 2000b:41 and 59). The whole process of designing offers numerous opportunities to present and organise information but forming a specification presents a particularly rich opportunity. The pupil refers to the specification before beginning to design and cross-refers to it regularly as a reminder of the requirements when moving on to ‘develop and communicate ideas’. The specification can be viewed as a motivator to assist the individual when designing and, consequently, the information contained within it needs to be presented clearly and succinctly. This is a golden opportunity to teach pupils to consider formulating the content in parallel with the purpose and to ‘communicate and organise information effectively’.

Research and background reading are essential since the accumulated knowledge forms the necessary foundation on which to develop design ideas. This forms a contextualised opportunity to teach pupils to use a wide range of resources including reference books, ICT materials, catalogues and magazines. By collating key facts, they will have opportunities to acquaint themselves with information-organising methods, such as library systems. Appropriate vocabulary is developed as part of the process of background reading, for example, in finding out how some products work or exploring the properties of particular materials and how they should be manipulated. It may be surmised that, by researching the background, pupils will come across some unfamiliar technical terms and will need to discover their meaning. Such terms will become absorbed into their natural vocabulary as part of a natural process: terms such as wheel and axle, structure, gear, cam, pulley and dowel.

Sketches, drawings, notes, models, use of construction kits and the computer are all ideal media to develop and refine ideas but another medium to communicate ideas that should not be overlooked in relation to ‘developing and communicating ideas’ is the medium of talk.

In his research into the links between language and technical ability, Peter Medway argues that the use of language,
particularly oral language, is central to the whole process. He observed and recorded the work of a group of architects in a company in Canada and, amongst his findings, he refers to a factor that is particularly relevant to our argument:

What the apparently rather outlandish concept of the 'virtual building' can contribute to our way of thinking about architecture is the insistence that what gets made by the architect, that which is more conventionally called the design, is not simply a representation of the eventual configuration of material in space; it is also, as with a real building, a structure of meanings, associations, evocations and allusions, its significance deriving from narratives of reasoning, imagining and evaluation. Thus the drawing represents only one aspect of the design that gets made and needs to get communicated. It is to the extent that the virtual building goes beyond what can be shown in lines, planes and numbers that language is essential to both parts of the operation (Medway, 1994:103-4).

Considerable use is made of oral language in explaining and evaluating ideas, both within industrial and educational settings. In the classroom, for example, sketches can convey the essence of emerging ideas, with oral language allowing further probing and explaining, why? how? where? and so on. ‘Developing and communicating ideas’ is the ideal context within which to induce discussions as teachers encourage pupils to think for themselves. This is a golden opportunity to develop oral language in particular since the expression of ideas arises naturally from real situations and is extended because of the need to explain ideas as well as to elaborate on particular technological concepts.

Here is a sketch by a five-year-old pupil showing the details of a fire engine he wanted to build:
The sketch was central to the child’s design but the opportunity was also taken to encourage the child to enlarge further by talking about some of his ideas. Whilst explaining, opportunities arose to ensure that the pupil understood some basic concepts and to extend his imagination. The following few examples of the child’s responses illustrate the situation’s clear potential:

- It’s a big fire engine, so I need three cardboard boxes.
- The boxes have to be strong.
- I want two lights, one in front and one behind.
- Two doors – one for each side.
- A water pipe like a circle the same size as a biro.
- Cut across above, cut across below, we can then make a flap.
- A noise from the light, because it’s in a rush to put out the fire.

By encouraging the child to respond, opportunities arose to teach him to understand and use mathematical language relating to number, shape and forms. He also had the opportunity to use appropriate vocabulary to describe the properties of one of the materials involved in the design. This example satisfied some of the mathematics and science National Curriculum requirements through design and technology.

**Planning and working with materials**

The next experience we shall address within the process is ‘planning and working with materials’. This experience not only provides an opportunity for the individual to ‘make’ but it is also an opportunity to promote language development. In the following example a class of KS1 pupils was working with its teacher and the author and had designed and made a puppet show. The project had provided a range of language opportunities for the children, including discussing their design ideas, composing a simple script to present a story as a puppet show and performing the show to an audience of peers. In addition, the opportunity was taken to ask the various groups within the class to describe, step by step, how they set about making their particular puppet. By detailing (below) the responses of one of the groups we can see how,
for example, opportunities arose to develop their vocabulary and to record systematically. It was also noted that they were required to use a particular style, as also observed by Bob and Jane Seberry when they initiated a similar project in a school in the south of England to design and make a puppet show based on a Japanese folk story: 'This stage of the process generated another form of writing which had a different style and purpose – one where sequencing, clarity and precision of language were very important' (Seberry and Seberry, 1998:179).

The pupils had designed and made a puppet in the form of a horse and had recorded as follows:

**How to make a horse puppet**
1. Measure the big cardboard tube.
2. Saw the big cardboard tube.
3. Measure the small cardboard tube.
4. Saw the small cardboard tube.
5. Glue the small cardboard tube to the body.
6. Saw wood to make four legs.
7. Glue the four legs.
8. Cut the head from cardboard.
9. Put the head on the neck.
10. Put the string on the head and in the body.
11. Glue the card circles on the front and back.
12. Glue hair on the head, neck and body.
13. Glue a woollen tail on the body.

Using ICT it would also have been possible for the pupils to share their experiences 'publicly' thus extending the language opportunities even further. It would, for example, have been possible to provide a platform for their account on the web, such as via the Nuffield Primary Design and Technology Project website (www.primarydandt.org) but this avenue was not pursued at this stage in the work of this particular school.

Returning to the puppets, recording the 'making' was itself a valuable experience, but the author was also aware that lively language was being generated as the pupils jointly designed and cooperated to make the puppets. However one needs to be cautious to avoid concluding that language oppor-
tunities only arise as a result of the cooperative effort. Whilst
the latter is certainly a factor, it may also be argued that the
‘making’, of itself, is also a key factor. To illustrate this viewpoint
we consider a group of KS2 pupils responding to the theme
‘The Slate Quarry’.

In choosing such a theme it is clear that pupils need to be
prepared to appreciate the essence of the subject if the past is
to become alive for them. For example, the author is a native
of Carmel, a slate-mining village in the Nantlle Valley. Conse-
quently he remembers quarries such as Dorothea, Pen yr
Orsedd and Moeltryfan being worked as going concerns. As a
child he recalls local characters such as Dafydd Lloyd, Bryn
Derwen, and Harri Jôs, Ty’n Gadlas, milking two or three cows
each morning before going to work and again every evening.
He recalls related noises such as the sound of blasting the rock
face, and the clickety-clack of the miners’ hobnailed boots as
they walked to and from the quarry. Even though these
experiences were part of his childhood, he finds it hard today
to appreciate fully the working conditions and the atmosphere
of the quarries. If this is difficult for the author, how much
more difficult is it for today’s primary school children?

It may be that, in middle age, he resembles one of Gwyn
Thomas’s ‘voices’ remembering ‘... the sound of slates
scraping the night’ (translated from Thomas, 1967:11) and
consequently sets a considerable score on securing a variety of
methods to transmit the richness of this inheritance and the
need to do so with sensitivity and creativity. Whilst recognising
that more traditional media such as prose, poetry and film are
ideal to create an atmosphere, practical activity also has a
complementary part to play. This can be exemplified by a
particular primary school project coordinated by the author.
Year 5 pupils had visited a slate quarry and a slate museum at
which considerable emphasis had been placed on the
atmosphere of the quarry and the particular character and feel
of slate as a medium. They had noted the colours and
patterns, had felt the cold, and sometimes wet, hard, smooth
face of the slate and had listened to the sounds of slates being
split and the scraping noise of slate against slate. Following
the visit, the pupils had responded by trying to convey the atmosphere via a two-dimensional representation before moving on to a three-dimensional construction.

Following the decision to work three-dimensionally, the opportunity arose, as the pupils planned their practical work, to extend their awareness of the character of slate and to discuss health and safety issues and general working conditions in the quarry. A quarrymen’s shed was recreated in the classroom and the ‘making’ consequently reinforced other methods and media – prose, poetry and film – to raise the pupils’ awareness of the conditions. It may therefore be argued that similar practical experiences can further enrich linguistic expression, both orally and written: practical ‘doing’ promotes and enriches linguistic composition.

In another example at a different school, Year 6 children had produced creative work based on a practical experience. The class had designed and made objects to measure time using candles, sand and water. The design and make stages had already produced linguistic responses in this example by the factual recording of how the devices worked. However it was decided to move forward a further stage by encouraging the whole class to exercise their imaginations. The pupils were invited to give specific attention to the noises particular to the various devices.

In two devices the transfer of water from one container to another to measure time had been used. In the first, the water flowed fairly quickly, creating a ‘drrrrr’ sound as it hit hard against the bottom of a plastic yoghurt pot. One of the pupils responded to the situation as follows (in free translation):

The sound of the humming of busy bees
Drumming in droning droves.

The ‘making’ of the device had drawn attention to the quality of the sound made by the water as it flowed from one container to the other, with the alliteration of the consonants (d and r) reinforcing that sound.
In the second device much larger containers had been used and the water flowed at a slower rate between them. As a result, the previous ‘drrrrr’ sound was replaced by something more akin to ‘glug glug glug’. Over recent years we have become aware on different occasions of ecological disasters resulting in oil pollution of the sea. Television has brought these events to our homes and the graphic pictures have impressed themselves on our memory. But in addition to the effect on our visual memory, our aural memory may also have been affected. Can you remember the sound of the black, forbidding sea? It clearly made an impression on this pupil, whose work may be freely translated as:

The sound of waves breaking on the beach,
  Different to last night’s sea,
  Full of oil destroying nature in its wake.

The piece contrasts the busy, lively sea and the waves breaking as white foam on a local beach, with the polluted sea on the television news glug-glugging its contents on the shore.

The response in the next example was stimulated by one group’s design using a candle to measure time. In a busy classroom we can imagine the candle being blown out frequently as children passed by. It would not be surprising under such circumstances for children to feel frustrated at these constant interruptions to the group’s experiment. When the opportunity arose, one member of the group responded in verse to the experience of ‘making’ under these circumstances:

  Night spirits hovering
  Midnight on the old clock,
  Its wax like colour-less blood,
  A gust in the air
  The flame shakes,
  The flame goes out on the mantelpiece.
  Now part of the darkness.

Meaningfully structured, the ‘making’ is a rich medium within which to promote the individual’s language development. However, it should be emphasised that the breadth of our interpretation of design and technology is a key factor when evaluating that potential.
This may be elucidated further by interpreting design and technology in the spirit of an observation in the Gittins Report in relation to art and, by extension, suggesting that design and technology is a ‘dialogue between the individual and his material, between inner feeling and outer expression’ (Department of Education and Science, 1967:337).

Evaluating

In the spirit of the interpretation that design and technology provides an opportunity for an individual, should he or she wish, to express internal feelings using a variety of materials, we move on to discuss the experience of evaluating.

Over many years the author has had the pleasure of working with students and teachers in a variety of design and technology courses. A sample of relevant examples from these courses may illustrate how ‘evaluating’ can be used to promote the individual’s language development.

In the first example we turn to the work of a student who was brought up on a farm in Ceredigion. Whilst at college his family was building an extension to the farm house and, consequently, he decided to design a surface suitable for supporting a telephone in the extension. He also decided to base his design on the shape of a plough and quickly decided that it would be a carved piece of furniture. One of the reasons for carving the piece was that he was eager to represent the traditional shape and form of a plough, whilst also wishing to make an item of furniture that would fit in well with the modern style of the extension.

The sketches for his initial ideas were characterised by a feeling of mysticism, particularly in the way the various parts blended together. This feeling evoked the experience of walking in a forest and coming face to face with old trees, particularly trees that have fallen and whose branches intertwine. Such an experience can give you goose pimples because the silence and isolation of the forest creates an atmosphere from the dim and distant past, not of our modern world. The student’s design reminded the author of such experiences, the shape and form of the plough creating an atmosphere that bridged
the past, present and future. Ever since man has populated the earth he has ploughed the land and will continue to sow and to harvest so long as the human race lives on. In particular the design evoked in the author the strict-metre poetry of Dic Jones, himself a poet/farmer of national repute. The student had composed through technology, the poet through verse.

Tra bo dynoliaeth fe fydd amaethu,
A chyw hen linach yn ei holynu,
A thra bo gaeaf bydd cynaeafu
A byw greadur tra bo gwerydu,
Bydd ffrwythlonder tra pery – haul a gwlith,
Yn wyn o wenith rhag ein newynu.

(Jones, 1969:18)

[This verse is a eulogy to the constancy and permanence of the skills associated with farming, so long as the human race lives on.]

We suggest that there are opportunities in the classroom for the one medium to support the other. Expressing internal feelings by external means, the individual may strive to do so in words that articulate his inner thoughts with the same sensitivity as he may apply to design and make. It is that sensitivity that characterises the artist’s attempt to interpret his creations.

This leads us to consider the comments made by Eleri Mills regarding her embroidery ‘Spoon’:

Inside and outside, domestic objects signify familial connections, a
sense of order and correctness, a chain of events and history, and a chain of people going back into the past. Yet alongside this is the continual link with the world outside, and other, ‘greater’ things going on . . . . (Ruthin Craft Centre, 1995:37).

Here are two further examples of evaluation. Firstly, a student working with plywood, copper and aluminium to express *A Day in the Ogwen Valley*:

As part of her evaluation, the student expresses this view:

I believe that I have created an interweaving piece that also expresses a feeling of happiness and peace of mind. My favourite section is the one that depicts the strength of the mountains, which also creates a sense of comfort and home security. Were I to do it again I would change some aspects. For example, I would place the mountains in a circle, so as to exploit a circle’s particular significance. Circles don’t have angles, and are thereby different to squares, rectangles or triangles; there are no blind spots in circles, just as there is no uncertainty in peace of mind.

In the second example a teacher on an INSET course uses a range of materials to interpret R. Williams Parry’s poem *Efionydd*, which reflects on the ‘perfect peace’ to be found in an avenue of trees in contrast to the ugliness of the effect of industrialisation on his own slate-mining community. She reports:

This is R. Williams Parry’s paradise, perfect peace and contentment. Here he felt safe; in this place amongst sturdy trees he found his own personal inner peace. Not Morgan Llwyd’s religious inner peace nor John Gwilym Jones’s inner peace, but an
agnostic stillness in the centre of the world of nature where he felt content and comfortable.

This particularly sensitive poet rarely felt like this. He derived no joy from the sea or from the mountains, only in this special and perfect place, leading nowhere in particular, but which was for him a safe haven far from the ugliness of industrialised life and inhabited by kindred spirits. Encompassed by trees as dependable companions, R. Williams Parry had found his own inner peace.

The evaluation had led this teacher to a personal interpretation and to a deeper appreciation of the poem. In this context, evaluation, part of a process central to designing and making, had strengthened the understanding. Expressing internal feelings by external means had led to the sensitivity of linguistic expression in both examples.

Conclusion
This article has enabled the author to reflect on a period of teaching design and technology that encompassed changes in its content and emphasis as well as changes in its status within the National Curriculum. Whilst it is difficult to encompass all these changes within the limits of a single article, one feature remained invariant, that of the nature of the process itself. As noted above, this process was used to provide a framework within which to present design and technology in the classroom and the article shows how experiences within the process may be used to enrich an individual’s language development.

As a revised National Curriculum is introduced progressively from 2008 it is reassuring to note that that process continues as a fundamental component of the new regulations:

In design and technology, learners design and make products through the iterative process of creating and developing ideas, designing products, planning, making and reflecting on their decisions and outcomes in terms of their finished product (WAG, 2008: 6).

In summary, we can see that design and technology provides opportunities for individuals to follow a ‘process’ as
part of designing and making that promotes a dialogue between the individual and his or her materials and, when opportunities arise, between internal feelings and external expression. While the ‘process’ is central to providing these experiences the breadth of our interpretation of design and technology is also critical. The needs of the National Curriculum provide a framework to assist us to develop this interpretation but this can be, at best, only a guide. This guide can motivate us to design creatively experiences that will in their turn inspire equally creative responses by pupils. By providing these experiences in the classroom we suggest that they make a natural contribution to the individual’s language development.

Discussion questions
1. Would a better title for this article be ‘Design and technology in the primary school: a means of developing oral language’?
2. Is an understanding of the processes of designing and making essential if teachers are to take advantage of opportunities to develop children’s language via design and technology activities?
3. Do some aspects of the design process lend themselves better than others to the development of an individual’s language?

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Bibliography
Department of Education and Science (1967) Primary Education in


National Assembly for Wales (2000a) Design and Technology in the National Curriculum in Wales. Cardiff: ACCAC.

National Assembly for Wales (2000b) Key Stages 1 and 2 of the National Curriculum in Wales. Cardiff: ACCAC.


2 From craft education towards technology education: the Finnish experience

Aki Rasinen, Pasi Ikonen and Timo Rissanen

Abstract
In this article the development of craft education to technology education in Finnish comprehensive schools is described and analysed. In particular, attention is given to the influence of successive National Board of Education Framework Curriculum documents\(^1\) in terms of the development of technology as a concept and the implementation of policy within individual schools. The article concludes that progression from theory to practice remains a challenge.

Introduction
Finnish technology education dates back to 1866 when craft education was accepted to be one of the compulsory subjects in the school curriculum. Uno Cygnaeus, founder of Finnish general education, considered ‘technological’ content an important part of craft education. Cygnaeus emphasised dexterity, design and aesthetics but also consideration, innovation and creativity. He also underlined the importance of realising the connections between natural sciences and craft education (Kantola et al, 1999:7).

The main features of the current Finnish education system that are pertinent to this article are as follows. Up until the 1970s, compulsory education was provided in the six-year folk school (for 7-13 year olds). After four years of folk school, a part of each age group (chosen on the basis of performance on academic tests) moved up to the secondary school, which
was divided into the five-year lower secondary school (11-16) and the three-year upper secondary school (16-19). In the 1970s, this system was changed and a nine-year school system (grades 1-9) common to the entire 7-16 age group (the comprehensive school) was created as an integration of the folk school and lower secondary school. A class teacher teaches all or most subjects for the first six years. During the last three years separate subjects are usually taught by different subject teachers. In this article the term ‘comprehensive education’ therefore refers to the whole of the compulsory period of education, for children from 7 to 16 years old. This education is provided in primary schools, otherwise referred to as comprehensive schools. At the end of compulsory schooling pupils enter upper secondary schools or vocational schools.

There have been many pedagogical and administrative changes in general education since Cygnaeus’ time, but, as noted above, one of the most significant took place at the beginning of the 1970s when the folk school and lower secondary school system was abolished and comprehensive primary schools were introduced. A significant reform was introduced in teacher education in 1979. Since then all comprehensive school teachers, both class teachers (teaching mainly grades 1-6) and subject teachers (teaching mainly grades 7-9), have been trained up to master’s level. In practice this means that teachers must complete a master’s degree before they are formally competent to teach.

In this article, we discuss changes in Finnish technology education in comprehensive schools since 1970 from the point of view both of changes in the curriculum and also developments concerning gender equality, pedagogy, teacher education, society, and the concept of learning. The text draws on a paper presented at the 15th international PATT conference held in Haarlem, the Netherlands in April 2005 (Rasinen et al, 2005).

**Technology education and craft education**

Craft education and technology education have seldom been compared in research literature. Comparisons have mainly been made between technology, science and mathematics.
The clear reason for this is that in the United Kingdom and the United States, for example, craft education has developed into technology education. Alamäki argues that, in many other countries as well as, technology education has evolved from craft education (Alamäki, 1999:37). He also argues that, because technology education is still evolving, it has absorbed a wide range of techniques and ideas across the spectrum from craft at one end to applied science at the other. Järvinen (2004:45) and Järvinen and Karsikas (2004:8) reinforce this view and claim that technology education cannot be monopolised by either craft or science education because it involves an amalgam of ideas from mathematics, the sciences, arts, crafts and genuinely innovative problem solving.

The question of definitions continues as an underlining theme. For example, some Finnish authors have defined technology as an umbrella concept that includes craft education, while others regard craft education as an umbrella concept that includes technology education. In the Finnish context, Alamäki (1999:14) explains that ‘käsityö’ (craft) is the official name and overall term for a subject group that encompasses the two areas of the school curriculum described as ‘tekninen työ’ (technical work) and ‘tekstiilityö’ (textile work). He states that ‘käsityö’ in the Finnish educational context has no direct English equivalent but implies a combination of craft, design and technology education (Alamäki, 1999:173). He also notes that ‘the contents and processes of the Finnish ‘tekninen työ’ correspond to the international view of technology education’. However, changing the title of the subject does not necessarily result in a change in learning. What matters are the content and methods of teaching. The objectives and content of craft education have to evolve in order to fulfil the aims of technology education.

Experts in craft education and technology education, whether from Finland or elsewhere, agree that an essential part of learning is the creative planning and production process. Kojonkoski-Rännäli (1998:368) distinguishes between the craft production activity and the technological production activity. According to her, hands-on methods are used in craft
whereas, in technology, methods of modern technology are used. Dyrenfurth, on the other hand, claims that hand skills are also an essential part of technology (Dyrenfurth, 1991:31).

In this article we adopt a broad view and consider that the thinking processes involving active use of the brain underpin all work done by hand. Technology is seen as *logos* (the basic underlying principle) of *tekhné*, where technology is not restricted to modern technology, but is seen from a wide perspective – from traditional to modern. According to von Wright (1987:32-33), technology is based on the scientific knowledge of the *logos* which is the basis of *tekhné*, that is, the knowledge of the rational principles (‘natural laws’) applied by technicians while working. *Logos* is related to expressions such as: understanding, realising, having a good command of the concepts, comprehending the phenomena at hand (von Wright, 1987:23). It is therefore important that, in addition to merely producing individual artefacts, one part of the making process is knowledgeable control of both planning and executing the plans in practice.

The 1970 Framework Curriculum and the 1970 Curriculum

*Absence of technology as a concept*

In 1970, the Finnish Ministry of Education published two memoranda to guide teachers in transferring from the old parallel school system to the comprehensive school system. The 1970 Framework Curriculum document (FC, 1970 I) set out details and information covering the following aspects of the curriculum: rationale and philosophy; aims and objectives; implementation and development; teaching methods; learning materials; differentiation; assessment; extramural activities; counselling; organisation of the work; and, co-operation between school and home.

The 1970 Curriculum detailed the attainment targets and content for different school subjects. For craft education it listed, grade by grade, the required techniques (measuring, marking, sawing etc.), the related materials (planks, metal rods, plastics etc.), and the objectives in relation to the level of
mastery of those techniques, coupled with practical suggestions for appropriate projects. It also gave information on different working, learning and teaching methods, on methods of assessment and on ways to achieve integration. Craft education was divided into two sub-areas: technical craft and textile craft. The document emphasised that the division between these two should no longer be directly linked to gender, but that girls and boys should be able to study both textile craft and technical craft. All pupils were to study the same programme from grade one to three, and then to choose one of the two subject areas for grades four to seven. For the duration of the spring term (January – May) in grade six, pupils were to change their subject area (FC, 1970 II). Nevertheless, in practice, the authors have noted that the statistics held by schools would appear to suggest that boys mainly opted for technical craft classes as their first choice and girls opted for textile craft classes. By and large, it also appeared that girls showed more inclination to opt for greater variety than did boys.

Technology as a concept was not explicitly referred to in the 1970 Curriculum. However, ‘technical craft’ included technique as a specific concept and one of the general objectives in technical craft studies was to become acquainted with a range of technical processes. For example, the pupils’ own input to design was regarded as an important process and the nature of machinery and electronics was regarded as having a technological base. By contrast, the sections devoted to ‘textile craft’ did not refer explicitly to technical processes in the same way. Nevertheless, the 1970 Curriculum and Framework Curriculum document, for its time, was a very radical, professional and ambitious publication, with its sights firmly set for the future. Even today, after three further national framework curricula, the text of the 1970 curriculum remains relevant.

The Framework Curriculum for comprehensive schools 1985

Introduction of technology as a concept

Since the publication of the 1970 Curriculum document there
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has not been a statutory national curriculum as such in Finland. Rather, the documents published since 1970 have been presented as ‘Framework Curricula’, and both municipalities and schools have planned their own curricula following these national frameworks. This pattern can be attributed to a number of factors, including the decentralisation of educational management, reform in teacher education, and the need to plan the curriculum to fit local circumstances. In the 1980s the inspection system was abolished and new posts, described as instructors and supervisors, replaced inspectors. Their role was not to ensure teacher compliance – to check that teachers were doing their job – but to assist and help teachers in planning, developing and organising in-service education.

Schools and municipalities were guided in the development of their own curricula, broadly following the national frameworks. Teachers were highly educated, the attainment of a master's degree being a necessary qualification, and were considered as being capable of developing their own curricula.

In 1985, after 15 years experience of the comprehensive school system, a Framework Curriculum for Comprehensive Schools (FC, 1985) was published by the National Board of Education. This document introduced six general aims. Of particular relevance to the development of technology education, one of these aims promoted gender equality. In this document, enhancing gender equality at school meant offering the same possibilities to both boys and girls (FC, 1985:13). There are specific references in the document to discussions in the Finnish parliament about promoting gender equality and the legal requirement that schools should promote equality between sexes.

The National Board of Education devolved responsibility to the municipalities to decide how to organise craft education. From grade one to grade three all pupils were required to study both textile and technical work. However, the curriculum topics at grades one and two were mainly oriented to textile work. From grades four to six, parts of the curriculum were common to all pupils but other parts allowed a choice of either technical or textile work. At grade seven technical work and
textile work were common to all pupils, but municipalities were given the option, should they so wished, to supplement the common studies with differentiated teaching in technical and textile work (FC, 1985:206-07).

For the first time in the history of the development of curriculum guidance in Finland, the concept of technology was introduced, but not defined. However, the concept is to be found only under ‘Craft, technical work and textile work’, where the document states that technology is the starting point of technical abilities, planning, and implementing (FC, 1985:206). It goes on to state that, during technical work lessons, pupils should also learn to manage technology (FC, 1985:208).

The Framework Curriculum on craft, technical work and textile work introduced general aims and provided guidance on how teaching should be organised. The specific objectives related to technical work and textile work were then introduced together with content lists, grade by grade. The content related mainly to the use of different techniques, such as cutting, sawing and soldering. The influence of this type of curriculum planning is still apparent today in some school curricula. The document also provided information on how to differentiate the curriculum in different municipalities, how to assess, and guidance regarding opportunities for integration. Although the general aims related to the development of problem-solving and planning skills, the specific objectives were merely a list of different techniques (FC, 1985:208-13). This approach to the curriculum can be characterised as behaviouristic. It had been written from the point of view of teachers rather than pupils. Expressions such as ‘pupils will be taught to turn wood’ (FC, 1985:208-13) characterise the tone of the document.

In practice, it was common for schools to continue to differentiate pupils after grade three to attend either textile or technical work groups. In most cases these groups were formed on the basis of gender. However, in many cases pupils were also offered an opportunity to spend a short period of three to six weeks working in the area of craft other than their main area.
The Framework Curriculum for comprehensive schools 1994

Technology is included in the general aims

As a further step in the development of Finnish general education in schools, technology was now specifically included in the general aims of the curriculum. For the comprehensive school, the national guidelines stated that the technical development of society made it necessary for all citizens to have a new kind of readiness to use technology, in its manifest applications, and to be able to exert an influence on the direction of technical development. Furthermore, it stated that students, irrespective of gender, must have the opportunity to acquaint themselves with technology, to understand its potential and to avail themselves of its advantages. Particular importance was ascribed to the need to take a critical look at the effect of technology on the interaction between people and nature, to be able to make use of the possibilities offered by technology and to understand their consequences (FC, 1994:11-12). However, the document did not provide specific guidance on how to study technology.

The Framework referred to technology specifically under the section on chemistry, stating that ‘pupils should be able to acquire such a terminology that they are able to discuss questions concerning nature, environment, and technology’ (FC, 1994:86). Under craft, the technological aim was that pupils should acquire knowledge of both traditional and modern technological materials, as well as a knowledge of tools and techniques that can be applied in daily life, further studies, jobs and hobbies (FC, 1994:105-06). Despite this stated aim, the content of technical work lessons in Finnish comprehensive schools at the end of the 1990s was mainly restricted to woodwork. To a certain extent elements of electricity and electronics, work in plastic work, and service and repair work were also taught, but a lack of financial resources and ideas were identified as the most significant obstacles to the development of technology education during this period (Alamäki, 1999:136). In informal discussions between teachers and teacher educators, technical work education in
schools was reported as comprising mainly copying and reproducing processes, such as replicating wooden and metal items, and using non-modern, design-oriented processes (Alamäki, 1999:39). According to Kankare (1997:156-57, 176-77) woodwork was the main preoccupation of Finnish technical craft teachers, although most teachers did not want to divide the content according to materials, but considered the subject area in an holistic manner. Sanders (2001:50) also found in the USA that most technology education teachers still kept to traditional general technology education and woodwork courses.

Although the 1994 Framework Curriculum document states that ‘craft, technical work and textile work form an entity at primary and junior secondary level that is meant for all pupils regardless of gender’ (FC, 1994:104), the document allowed schools to emphasise one of the two craft domains. This meant in practice that most schools continued to divide pupils into either textile work or technical work after grade three.

The 1994 document is the first to introduce the notion of cross-curricular subject areas. Ideas concerning holistic teaching and integration had been introduced previously – in both the 1970 and 1985 documents – but without specifying subject areas to include cross-curricular work.

**Framework Curriculum for comprehensive schools 2004**

*The human being and technology – a new cross-curricular theme*

A further step forward was taken in 2004 in that, for the first time in the history of Finnish general education curriculum planning, a revised Framework Curriculum for comprehensive schools introduced technology as part of a specific cross-curricular theme:

- *the human being and technology.*

The other six themes are:

- development of personal identity
- cultural identity and internationality
- communication and media skills
• committed citizenship and entrepreneurship
• responsibility for the environment, well-being and sustainable development
• safety and traffic behaviour.

(FC, 2004:36–41)

No specific subject areas are allocated to these themes. Rather, the underpinning aim of cross-curricular themes is that all school subjects should take note of these themes in formulating their particular objectives and content.

The title ‘the human being and technology’ is taken to imply that the meaning of technology in everyday lives and the dependency of human beings on modern technology should be studied. Work within this theme therefore includes acquiring a basic technology know-how and, coupled with an appreciation of the development and effect of technology, is intended to guide pupils to make informed choices and to consider ethical, moral and equality questions related to technology. Teaching should also improve pupils’ ability to understand how different devices, equipment and machines work and how to use them.

The document suggests integration between different school subjects. It is based on a constructivist learning concept where the learner is active and target-oriented. The objectives are stated from the learners’ point of view, not as teachers’ activities.

The stated objectives include:

A pupil will learn:
• to understand technology, the development of technology and its impact on different fields of life, different sectors in society, and on the environment
• to use technology in a responsible and critical manner
• to use information technology equipment, programs and networks for different purposes
• to state one’s opinion concerning technological choices, and to consider the effects of today’s decisions about technology on the future.

The core contents include:
• technology in everyday life, in society and in local trade and industry
the development of technology and factors affecting the development in different cultures and different fields of life during different eras

- the development, modelling, and assessing of technological ideas and the life-span of a product
- the use of information and communication technology and information networks
- the ethical, moral, well-being, and equality concerns related to technology
- future society and technology.

(FC, 2004:40-41)

**Technological studies within craft**

In the Framework Curriculum, references to technological studies can be found only under science (particularly physics) and to a considerable extent under craft (particularly technical work). The subject groups for other subjects have not incorporated the technology-linked cross-curricular theme ‘the human being and technology’ within their texts. However, the instructions from the National Board of Education are that schools have to indicate clearly in their curricula how these cross-curricular themes are included in different school subjects and they have to be evident in school activities (FC, 2004:36). The Framework Curriculum does not stipulate how this should be done, and this is left to individual schools to consider and decide. The authors studied a random sample of 50 Finnish municipal curricula, covering about 400 schools. Their analysis concludes that ‘the human being and technology’ cross-curricular theme is almost always confined to information and communication technology. This indicates that the theme has not been understood in its broadest sense, but has been narrowly conceived.

Technology education objectives under craft education are as follows:

Pupils should:

- familiarise themselves with everyday technology
- familiarise themselves with Finland’s and, to an appropriate extent, other nations’ design, craft and technology culture for building their own identity and their own design activities
• familiarise themselves with the know-how connected to traditional and modern technology that can be applied in daily life, further studies, in future jobs, and hobbies
• learn to state their opinion on the development of technology and the meaning of it for the well-being of human beings, society and nature.

(FC, 2004:241-42)

By comparing the objectives with the content of technical work and textile work, it is clear that all the technological objectives cannot be achieved by studying only one sub-area. However, most of the municipalities included in the study had decided, against the regulations of the Framework Curriculum, to differentiate pupils after grade four into technical work or textile work.

Overview and conclusions
Craft education has had a well-defined place in Finnish general education schools since the time of Uno Cygnaeus. During the agricultural era a strong culture of producing artefacts was established. This tradition seems to be so strong that, regardless of social changes and the introduction of new curricula, old ideas of production are still implemented in many schools. A critical analysis of the basics of studying technological content appears to be missing. One consequence is that techniques and tools that are no longer relevant in today’s society are still studied. In addition, methods based on copying rather than innovative learning are still prevalent. Implementation of technology education as part of craft education (or any school subject) has not yet been successful in many Finnish schools.

According to the latest National Framework Curriculum, technology has to be studied by all pupils at all levels. As long as technology is a cross-curricular theme, different subjects should consider how it should be incorporated within their compass. There should be continuing consultation and strong co-operation between different subject areas and, where it is advisable, integration should be sought. Technology education is mainly evident within the objectives and content of craft
education. Therefore, teachers of this subject area should take main responsibility for making sure that all pupils study technology and should co-ordinate technology-related activities at school level. A number of studies (Alamäki, 1999; Kankare, 1997; Rasinen, 2000) show that, to develop the subject area, learning materials and in-service education have to be improved. Further, they suggest that significant in-service education programmes with new learning materials should always be available when new ideas are introduced into the curriculum. New aims and objectives do not, of themselves, provide teachers with sufficient tools to be able to develop up-to-date technology education. As the sample of 50 municipal curricula shows, the human being and technology cross-curricular theme has not been understood in most of the schools included in the study. Unless sufficient emphasis is put on educating teachers, who should be implementing the new curriculum, old routines may persist year on year. Otherwise, schools have to wait for a newly educated teacher to bring in the new ideas.

The approved Framework Curriculum already provides a blueprint whereby schools can offer technology education to all pupils. In practice, however, this does not always happen. We conclude that, to guarantee more efficient learning, the subject area of ‘technology’ should be introduced.

1The Framework Curriculum documents are referenced here according to their dates of publication as, for example, FC, 1985.

**Bibliography**


3  Nuffield Primary Design and Technology Project: a retrospective

David Barlex

Abstract
The Nuffield Primary Design and Technology Project was established in 1996. In this paper, the Director of the Project describes the rationale for its genesis, outlines the progress made by the Project and analyses its subsequent impact on the teaching of design and technology in primary schools. The lessons learned have general application, although the main focus of the paper is on primary schools in England.

Introduction
In England and Wales design and technology, as an area of the curriculum, has its roots in the long history of ‘practical subjects’, both in secondary schools — woodwork and metalwork for boys, domestic science for girls — and in primary school activities to fill a wet Friday afternoon. Its emergence as a more ‘respectable’ part of the curriculum was heralded by the introduction of the National Curriculum in 1988.

Design and technology thereby acquired a firmer rationale and absorbed the trappings of more established ‘academic’ areas of the curriculum. Aims and objectives with associated attainment targets, levels of achievement and programmes of study became part of the vocabulary of what had previously been a relatively loose collection of craft-based skills. Moreover, the wider dimensions of design, influenced by industry and business, provided a way to link the subject with the higher-level skills of problem solving and evaluation.

This posed a particular challenge to primary schools, whose teachers had not, in general, been exposed to this level of thinking about design and technology in their initial teacher
training or in subsequent professional development. In such circumstances it was hardly surprising that an Ofsted report in 1996 captured an air of despondency concerning primary design and technology:

Many teachers are not sure what to assess or how to assess their pupils’ attainment and progress in design and technology. As a result, in nearly half of schools, teachers are unable to plan activities which build successfully on earlier knowledge, or provide a programme which supports the progressive development of skills . . . . Few teachers have any initial training in design and technology and arrangements for in-service professional development are generally inadequate. This results, overall, in low levels of teacher expertise (Ofsted, 1996:2).

It was within this atmosphere that, in that same year, the Nuffield Foundation Trustees agreed to fund an initial exploratory phase of a project, whose aim was to consider the implications of introducing design and technology into the primary school curriculum. This first phase, lasting one year, was to explore the prevailing situation. Subsequently, within a second phase, the objectives were expanded to develop appropriate approaches to teaching and learning design and technology in the primary school and to produce associated resources that would enable primary teachers to be effective in the classroom. A demonstration of this effectiveness would be needed, it was argued, to convince head teachers of the value of design and technology and to meet the needs of subject leaders who had responsibility for training their colleagues. A third phase would be concerned with further dissemination of the lessons learned and the provision of wider training.

The development of the Nuffield Primary Design and Technology Project over the first ten years of its progress is outlined in this paper, culminating in an analysis of its overall effectiveness. The immediate focus of the paper is on the experience gained in schools in England but the lessons learned have wider application.

**Project development and evaluation**

The Project began its work in 1996, led by a Director, and with a small team of supporting staff. At about the same time, the Department for Education and Employment in England began
a process that led, in 1997, to the introduction of a *Literacy Strategy*, followed shortly the following year by a *Numeracy Strategy*. There was a statutory expectation that, from September 1998, primary schools would teach a daily literacy hour and, from September 1999, a structured daily mathematics lesson of 45 minutes to one hour for all pupils. In Wales neither of these initiatives was accorded statutory status by the Welsh Assembly Government, but schools were advised to take account of the principles underlying both strategies in developing their curricular planning.

In both countries, but more especially in England, these measures, taken together, put significant time constraints on the primary curriculum and made it ever more difficult for schools to allocate reasonable amounts of time to the so-called practical/creative subjects. Where design and technology was taught, a common pattern was to timetable it in short hour-long lessons, once a week for half a term, followed by art for the other half term. Some schools tried to meet their statutory obligation to provide design and technology lessons by other means, such as by arranging a practical activity week at the end of the summer term.

Whilst the literacy and numeracy strategies were bedding down, the Nuffield Project commissioned a wide range of primary design and technology experts to develop units of work, using the following questions as starting points:

- what sort of products will children enjoy designing and making?
- which people will children enjoy designing and making products for?
- what sort of products will children be able to design and make with the resources available in schools?
- what sort of products will teachers feel comfortable teaching children to design and make?

The Project argued that these questions were much more appropriate starting points than an analysis of the statutory requirements. By identifying and meeting the needs of the child and the teacher the Project would avoid developing activities and approaches that lacked relevance, were too costly, were too complicated or had only limited appeal. Once
appropriate activities and approaches were developed it proved an easy matter to audit them against the programme of study and show that they did indeed meet statutory requirements. This approach, based on good practice rather than dry statute, became a hallmark of the Project overall.

The Open University conducted an independent initial evaluation of this aspect of the Project. Its findings were based on the work in three classrooms in two schools located in urban settings in the north-west of England and involved both KS1 and KS2 children. This small-scale evaluation was able to analyse the materials and their use in the classroom in depth as a basis for drawing out some initial principles.

Data was collected through video and audio recording of classroom activities and interviews with teachers, head teachers, subject leaders and children. There were two important findings that suggested that the approach being taken by the Project was appropriate. Firstly, the evaluation reported that ‘children as young as five are well able to undertake design decisions if the context is appropriate to their experiences, if the decisions are not too extensive in number and type and if account is taken of their relatively limited manipulative skills’. This was encouraging as the Project already had anecdotal evidence indicating that some teachers believed primary school children could not design. Secondly, ‘the initial conception of the materials and their structure is appropriate and effective. With further refinement the materials will represent both a major curriculum development but more importantly a major in-service support for use by teachers with colleagues in school.’ This too was encouraging as one of the major hurdles to enabling design and technology in primary schools was seen as the lack of in-service programmes.

The materials were subsequently revised in the light of this evaluation and a unit of work was assembled that comprised a number of ‘Small Tasks’ focussing on the knowledge, understanding and skills likely to be needed in the successful completion of a design and make ‘Big Task’.

A further evaluation was undertaken in 1998, also by the Open University, using the revised materials in the same two pilot schools. The findings of this evaluation were also very encouraging, and included:
all the activities were enjoyed by teachers and children
the layout was considered to be ‘user friendly’ and easy to use
teachers were pleased with the learning outcomes achieved through the activities
the structuring of the activities into Small Tasks to support a Big Task was highly commended by experienced and inexperienced teachers alike
the Nuffield structured approach to design and technology was making a significant contribution to primary pedagogy, recognised and welcomed by experienced teachers
the materials were able to support less experienced teachers and raise challenges for experienced teachers.

The evaluation also made suggestions for improving the materials, to ensure that:

- exploration of user needs is integrated into the unit
- children have the opportunity to reflect upon, justify and record their design decisions
- teachers are aware of the design opportunities inherent in the unit.

These suggestions informed both the appearance and content of the final publication.

In 1999, whilst the second evaluation was taking place, the Project launched its website www.primarydandt.org. This was envisaged as a support for teachers and it made available the trial units of work being developed by the Project, together with examples of classroom work based on those units, to a wide range of schools. The site quickly became heavily used rising to an early peak of an average of over a hundred users daily (Barlex, 2001a).

The website has been through several iterations since its launch and currently offers a range of facilities, including a newsletter, articles of interest to primary teachers and information about conferences, consultants, places to visit, suppliers, and relevant websites. Its resources section includes free downloads of: units of work for both KS1 and KS2; Project reports and additional resources produced by the Project since the publication of the primary solutions pack; and, an archive of successful pilot units that could not be included in the published pack. It also features teacher responses to the units, from schools in the UK as well as from overseas. Finally, it
provides a suite of interactive tutorials to provide extra guidance on teaching the primary solutions units.

The Project continued to make the units of work available on the website even though they would also be available on a CD ROM as part of a published pack. The units of work downloaded from the site grew steadily, peaking in 2005 at a total over the year of almost 140,000 units. Overall there have been almost 640,000 downloads over a six-year period.

Case studies
The two pilot schools were located within the same local education authority in the north-west of England. Both were 5-11 schools, School A having approximately 300 pupils and School B over 450 pupils.

The Project worked closely with the two head teachers who had indicated their interest in design and technology but were concerned with the lack of appropriate teaching materials and support. It also worked closely with individual teachers in both schools and adopted two different approaches to developing effective practice amongst teachers who had little if any previous experience of design and technology.

The head of School A was concerned that the impact of teaching literacy and numeracy on the curriculum had led to a steep decline in the amount of time available for design and technology. She was also aware that the amount of time that was available was highly fragmented. This had led to a situation in which the standard of design and technology was well below an acceptable level.

The head decided that a radical approach was needed, one in which children and their teachers had enough time to become intensely involved in designing and making and to have this experience often enough for the children to make progress. In October 2000 she chose to suspend the timetable for three consecutive days each term and to dedicate those days to design and technology.

The teachers used pilot versions of the Nuffield design and technology units. The two design and technology subject leaders were able to use the units as a basis for discussion with teachers in deciding how best to adapt each unit to the
needs of the children and the expertise of the teacher. Class teachers were able to use the units with classroom assistants and parent helpers.

The head commented on progress using this immersion approach as follows: ‘The first three-day event was nerve wracking, tiring but successful. It was particularly rewarding to see the children become so involved. We learned three important lessons: avoid being over-ambitious, target parent help where it is most needed, and take care to ensure all resources are in place. The second three-day event went very much as planned with the children eagerly anticipating more designing and making. Staff took the third three-day event at the end of the summer term, after an Ofsted inspection, in their stride. It was particularly pleasing to see that the children had made significant progress over the year; drawings of design intentions were matching made outcomes, manual dexterity had improved, and constructive evaluation of design decisions was becoming the norm.’

The head of School B used Nuffield design and technology pilot units as the basis for a ‘buddy’ system to help his teachers with design and technology. He opted for a flexible one session a week model in which two teachers (the design and technology subject leader and one other) were paired in order to support each other. As these teachers worked together and gained confidence he planned to extend this system to involve two more teachers and then four more so that, within a relatively short space of time, there would be seven teachers plus the subject leader, who could work with other teachers in the school in providing good design and technology lessons for all pupils.

The head commented: ‘This roll out and ripple approach enabled the school to start with confident staff and gradually impact on the whole school in a planned way. This will result in a whole school approach that is understood and implemented by everyone including teaching assistants.’

This combination of a buddy system and the Nuffield units has become a major element of the continuing professional development provided by the school, which links directly with the school’s Improvement Plan.
The approach adopted by School A led the Project to consider the importance of time allocation to design and technology, not only the overall total amount of time available but also the extent to which that time was fragmented. By contrast, School B’s approach led the Project to acknowledge the importance of support for teachers in gaining confidence to teach the subject. The Project was already clear that intellectual resources would be needed in the form of units of work that teachers could use flexibly in teaching the subject and practical resources in the form of tools, consumable materials, equipment and stimulus materials. The Project realised there was the need to enhance teachers’ expertise and saw the comprehensive website that was being developed as an important way to achieve this.

These features came together conceptually by identifying the Project’s four ‘ingredients’ necessary for success: expertise, resources, support and time. This idea was presented to teachers in diagrammatic form in which these four components formed the vertices of a tetrahedron, each depending on the other for mutual support. The Project was able to use this simple model in talking to subject leaders, head teachers, and school governors enabling them to audit their provision and make adjustments where necessary.

**Project publication**

The Project evaluation confirmed the success of the approach and the associated materials. Dissemination of these materials depended critically on establishing a dependable publishing facility. Previous Nuffield projects had used commercial companies to publish and market materials used by teachers and pupils, including the publication by Longmans of the Nuffield secondary design and technology materials (Barlex, 1995). However, such projects covering the primary phase tended to focus on core areas of the curriculum and thereby had a virtually guaranteed level of sale. A foundation subject such as design and technology, with limited curricular time, couldn’t compete, at least not without compromising its basic objectives. As a consequence, an alternative publishing route had to be found.
In consultation with a graphic designer and the development of the final products in electronic format in-house the Project entered into an agreement with the Design and Technology Association (DATA) for their marketing. The Project provided electronic copy of units of work, adapted to take account of feedback from both the independent evaluation and the pilot schools, and DATA financed the production of these units to sell them on a cost-recovering basis. This proved to be a fruitful partnership between an educational charity (which did not need to make a profit) and a professional association (which might actually make a profit from a small investment). The partnership enabled the provision of curriculum materials and professional support at a time when commercial publishers were unable to do so. This was the first time that a project at the Nuffield Curriculum Centre had produced high quality material for publication without the involvement of a commercial publisher.

The contribution of the graphic designer (David Mackerall) proved to be critical. The team shared with the designer the findings of the Project, including not only the success of the pilot materials and approach but also the assumption that the majority of primary teachers lacked confidence in the extent of their knowledge of design and technology, and were thereby understandably reluctant to become involved in its teaching. It was also agreed to develop a common structure for the units of work, enabling teachers to become familiar with the key features of the pack quickly and efficiently. As a result, the designer developed an attractive, accessible, highly visual product that subject leaders could use to support their colleagues and that teachers would find easy to use with little in-service training. The product pack, entitled primary solutions in design and technology, was conceived as consisting of a CD-ROM, containing 24 printable units of work in full colour and an interactive introduction to the Project and guide to the website, a short teacher’s guide and a sample unit – all enclosed in a slim elegant card folder. This could be produced and sold by DATA at a competitive price.

The cover of each unit displays the target year for which the content is suitable, the teaching time required, and a photograph of a piece of work completed by an adult in
response to the unit. In practice this proved to be a strong motivating stimulus for teachers.

Each unit is divided into six main sections: the learning context; tasks for learning; design decisions; teaching the unit; resources and links; and copiable sheets for pupils. Each of these sections has a clear rationale, as follows.

*Learning context* contains the design context which sets the scene for the task and describes those features likely to be of particular appeal to children. It also identifies the learning intentions of the unit and the session in which the learning takes place.

*Tasks for learning* lists the Small Tasks, with a suggested timing, through which the children acquire the knowledge, understanding and skills required to tackle the Big Task independently. It also describes the Big Task with suggested timing for the designing and making, the evaluation and the unit review. This is accompanied by a photograph of a piece of work made by an adult with a comment on the designing and making skills used.

*Design decisions* lists each of the design decisions the children are required to make with a statement of when the required learning takes place and when the decision dependent on the learning is made. The decisions are illustrated with several options for each of the decisions to give a visual overview of the designing required.

*Teaching the unit* describes one way of teaching the unit on a lesson-by-lesson basis. The narrative for each lesson includes descriptions of the teacher input and pupil response supported by icons showing whether the children work as a whole class, in groups or as individuals. This is supported by a listing of the resources needed for the lesson in terms of stimulus materials, consumables and tools plus a health and safety check ensuring that pupils can identify hazards and control risks. A separate section is devoted to extension work, enabling the teacher to steer abler children towards tackling the extension work at the very beginning of the Big Task. This section finishes with two sorts of lesson. The first is an evaluation lesson, which describes how the children working collaboratively can both value positive aspects of their work
and critically identify features that would benefit from improvement. The second is a Unit Review lesson, which enables the class to put their work on any one unit into the context of their overall progress in design and technology. This enables the children, usually working in groups, to identify both the positive aspects of their work and those areas in need of improvement and to go on to set targets for their next design and technology unit.

*Resources and links* summarises the vocabulary that has been introduced in each of the lessons and the resources needed for each lesson. It also summarises links to other subjects. These are kept to a realistic minimum so that any links identified are worth pursuing. If the children need to use knowledge or skills already learned in another subject, then links with that subject may enable the teacher to assess the depth of this learning and reinforce it. Alternatively, the link may provide a ‘friendly’ introduction to a difficult topic in another subject.

*Copiable sheets for pupils* include a specification sheet to enable pupils to clarify their design intentions and an evaluation sheet that enables pupils to consider the performance of what they have designed and made in the light of these original intentions.

The *primary solutions in design and technology* pack was launched in 2000. Full details are available on [www.primarydandt.org](http://www.primarydandt.org).

**Dissemination and influence**

Effective dissemination of the Project’s work is crucial to its success. Such dissemination is necessarily based on a network of collaborative links. As an example, the Project has formed strong links with primary design and technology teachers in Wales through in-service training activities led jointly by the Project Director and the Cardiff Advisory Service. This work developed a very powerful model for one-day experiential in-service training. After a short introduction to the ‘Small Task/Big Task’ pedagogy and the unit structure, teachers tackle a KS1 task followed by a KS2 task. They thereby experience a progression of design-and-make activities, as a
basis for reflecting on their own practice and the design and technology curriculum in their school. For example, the teachers might begin by tackling the Year 2 unit *How will your roly poly move?* in which they have to design and make a simple push-along toy (a roly poly) that amuses children both in its appearance and in the way it moves. They could then tackle the Year 5 unit *How will your beast open its mouth?* in which they design and make a model animal with a moving mouth. This unit involves a much broader range of design decisions and a more demanding technical understanding. The results of such a session are shown on the cover. Teachers display considerable creative variation and are almost invariably sufficiently confident to run twilight sessions for their colleagues on return to their own schools, based on these and other primary solutions activities.

This pattern of activity has also been used by the Project Director for in-service training at Techniquest, an educational charity established in 1986 based in Cardiff. Techniquest’s mission is to engage people with science and science-related areas such as mathematics, engineering and technology.

By comparison with many other areas of the curriculum, design and technology education is under-researched (Harris and Wilson, 2003). The Nuffield Project has contributed significantly to addressing this issue, by strengthening practitioner networks, by linking with other government agencies, by stimulating regional seminars and conferences, and by promoting international links. The following details provide some further examples of this activity.

The experience of the Project had indicated the importance of head teachers in securing a place in the curriculum for design and technology. In response, the Project forged strong links with the National Primary Heads Association, gave a presentation at its 2003 conference and set up a head teacher working group to articulate the benefits of design and technology for the primary curriculum from the head teacher perspective. This group subsequently influenced England’s Primary National Strategy, and examples of good practice in teaching primary design and technology were published in Primary Strategy Excellence and Enjoyment publications (Department for Education and Skills, 2004).
The Project also worked closely with the Qualifications and Curriculum Authority (QCA) in England using the Nuffield approach to support the adaptation of QCA Units of Work with the classroom experience being documented and posted as reports on the Project website (see www.primarydandt.org/resources/reports,1162,NA.html).

In cooperation with DATA, the Project organised two seminars (in 2002 and 2004) for those involved in primary initial teacher education who had a special interest in design and technology. The reports of both seminars are available at www.primarydandt.org/resources/reports,1162,NA.html?pageNo=3. As a consequence, four regional research groups were set up with the aim of using data about primary practice in design and technology collected by pre-service teachers in training. The four groups cover: central England; north-west England; south-east England; and, Wales and south-west England. The most active of these groups, that covering south-east England, presented its findings at the DATA International Research Conference in 2006 (Rutland et al, 2006). Further events are planned to enable the regional groups to share their findings and develop publications.

An important aspect of the Project’s work during development and aftercare has been collaborating with design and technology educators in other countries. The closest international ties have been made with Queen’s University in Kingston, Ontario, Canada. At Queen’s a Project Director for an elementary science and technology programme was charged with developing curriculum materials by means of in-service activity with teachers. This is an extremely demanding and difficult way to approach curriculum development. The Director applied the Nuffield ‘Small Task/Big Task’ approach to both the science and technology units. He renamed Small Tasks ‘Support Tasks’. In technology lessons the Big Task was to design and make a product of some sort. In science lessons the Big Task was to answer a Big Question. The Director and his team of teachers were able to produce 14 units of works across grades 1 – 6 for the Ontario elementary science and technology curriculum and develop a powerful means of in-service training (Welch et al 2000a and 2000b; Welch, Barlex and Mueller 2001; Mueller and Welch 2006).
The Nuffield Project also developed links with Oulu University in Finland and the Centre for School Technology Education at Linkoping University, Sweden. Both have developed materials from the Project to use as part of their in-service and pre-service activities.

The Project maintained its profile with members of the primary design and technology research community by means of regular presentations at the biennial conference organised by the Centre for Research in Primary Technology (Balchin and Barlex 2005; Barlex 1999, 2001b and 2003).

Recent developments
The Project continues to seek further opportunities, both to extend its network of collaborations and to provide a framework of aftercare to schools.

Specifically, the Project has collaborated with the Royal Academy of Engineers to provide a primary solutions style unit to engage Year 6 pupils with an environmental issue. The unit is called *Is the motor car a blessing or a curse?* and contains three challenges:

- develop a presentation to the parents of the children who attend your school to inform them of the impact of the motorcar on our lives and challenge them to suggest ways in which they can help tackle the problems
- develop a presentation to your local authority to inform them of the impact of the motorcar on our lives and challenge them to suggest ways in which they can help tackle the problems
- develop a presentation to young engineers and scientists to inform them of the impact of the motorcar on our lives and challenge them to suggest technical developments that will help tackle the problems.

The unit is available as a free download on the Project website.

The Project is also currently collaborating with the TECHLINK project funded by the Medlock charity. This project supports the formation of partnerships between primary and secondary schools and involves some 60 secondary schools and over 250 primary schools across 21 Local Authorities in the south-west of England. A key feature of the project is providing primary schools with appropriate CAD (computer-
aided design) software to drive simple CAM (computer-aided manufacturing) machines. Many primary solutions units can be enhanced through this approach so this collaboration extends the useful life of the published materials. The aim is to produce upgraded units and make them freely available on the Project website.

It is now seven years since the Project was published and its emphasis is now on supporting those teachers who use its approach and materials, mainly through the website but also by the Project Director providing in-service training sessions and keynote lectures. In the immediate future it is the intention of the Project to hold a series of regional events for other professional development providers to induct them into the use of the primary solutions pack for in-service training. In this way the further dissemination of the approach and the pack coupled with an enhanced awareness of the website can be achieved.

Conclusions
The approach developed by the Nuffield Primary Design and Technology Project has gone some way to addressing the issues highlighted at the beginning of this paper regarding the air of despondency highlighted by Ofsted in 1996. It has provided a pedagogy that has been shown to be effective and to which teachers with little if any previous initial training can respond positively. The demands of the Big Tasks across a sequence of units provide a developmental framework requiring the acquisition of a hierarchy of both practical and intellectual skills. The showcase of pupils’ work on the website is inclusive and, quite deliberately, its content is not restricted to ‘the best of the best’. This enables teachers to appreciate a reality of classroom practice to which they can aspire. The use of the primary solutions pack as the basis for in-service training sessions provides teachers with the opportunity to carry out designing and making as if they were the pupil, to enter into the mind and hands of the child, and then reflect on the implications of this for the teaching needed in their own school. This provides an experiential model of professional development that is extremely powerful.
Bibliography


4 The Design and Technology Association

Louise Davies

The Design and Technology Association is a professional organisation representing all those in the UK involved in design and technology (D&T) education and its associated subject areas. It is an independent charity financed through membership fees, support from charitable foundations, industrial sponsorships and income generated through project management, publications, courses, conferences and consultancy.

The Association provides support, advice and subject leadership for those involved in D&T education, whether they work in a primary or secondary school, a special school, a university or training institution, a local authority or as a consultant.

A large and growing membership of over 6,000 helps the Association to develop and present a strategic vision for the subject, representing the views of the subject community to policy makers, together with government agencies and partners. Within the UK's devolved framework of government, the avenues of representation include those available within all four countries in the UK.

The teaching of D&T prepares pupils to participate in rapidly changing technologies, learning to think creatively. The subject encourages pupils to become problem solvers, both as individuals and in groups, identifying needs, wants and opportunities and responding to them by making products and developing systems. Practical skills are combined with an understanding of aesthetics, social and environmental issues, as well as industrial practices. In the learning process pupils can reflect on and evaluate present and past D&T, its uses and effects.
Through D&T, all pupils can become discriminating and informed users of products, and develop the skills necessary to become innovators themselves.

With a commitment to securing, developing and augmenting D&T in all sectors of education and society, the Association aims to achieve this by:

- developing a curriculum which engages young people in designing and making in order to create quality products and prepare them for citizenship in a technological society
- engaging young people in investigating and evaluating products and their applications and through looking at the associated values
- enhancing the quality of teaching and learning in D&T
- developing positive links with other curriculum areas, especially science, mathematics and art and design
- working with industry and commerce to ensure that the benefits of such experiences permeate the curriculum at all levels
- influencing society around us and bringing increased recognition of those involved in designing and making.

The Association is based in Wellesbourne in Warwickshire and draws its membership from across the UK. Further details are available on its website at www.data.org.uk.