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REPOSITORY RECORD

Anning, Angela, E. Jenkins, and S. Whitelaw. 2019. "Bodies of Knowledge and Design-based Activities".  
figshare. <https://hdl.handle.net/2134/1473>.

# Bodies of knowledge and design-based activities

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## Abstract

*The Design Council funded a small-scale project to investigate the relationship between bodies of knowledge and design-based activities. The project team was based at the School of Education, University of Leeds. It was co-directed by Professor Edgar Jenkins and Angela Anning. The research fellow was Sarah Whitelaw. The team worked closely with a group of primary and secondary teachers in the investigation. A report on the project was delivered to the Design Council in April 1996. The paper reports on some of our findings.*

*The research consisted of a literature review, accessing the view of professional designers through interview, and dialogue with and classroom observations of practising teachers of Design and Technology.*

*Issues that will be discussed in the paper are:*

- *the complexity of defining what children need to know in order to be able to design*
- *the problems associated with comparing workplace practices with school learning*
- *the need to identify and teach designerly behaviours in schools.*

*In the conference presentation these issues will be illustrated with case study material.*

## The research question

In the January 1995 version of the National Curriculum for Design and Technology (DFE/Welsh Office, 1995), the programme of study for each of the four key stages is prefaced by the following statement

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

These Designing and Making Skills, and the Knowledge and Understanding are specified for each of the key stages. For example, the Designing Skills appropriate to key stage 1 require that pupils be taught to:

- draw on their own experience to help generate ideas
- clarify their ideas through discussion
- develop their ideas through shaping, assembling and rearranging materials and components
- develop and communicate their design ideas by making freehand drawings, and by modelling their ideas in other ways e.g. by using actual materials and components

with temporary fixings

- make suggestions about how to proceed
- consider their design ideas as these develop, and identify their strengths and weaknesses

The Making Skills, and Knowledge and Understanding are specified in similar detail. What is not specified, however, are the ways in which the various skills, knowledge and understanding might be combined to develop technological capability. It is aspects of the relationships between these various elements of design and technology capability that this paper seeks to explore. In particular it seeks to examine the relationships between bodies of knowledge (knowledge and understanding) and designerly thinking within the context of design and technology teaching in primary and secondary schools.

The research question is: What do pupils and their teachers need to know and be able to do in order to engage in design-based activities? This question was addressed by a research project funded by the Design Council based at the School of Education, University of Leeds. The research approach to the question was triangulation, based upon a

literature review, close collaboration with teachers of Design and Technology in primary and secondary schools, and consultation with professional designers.

### Some issues arising from the literature

#### *Bodies of knowledge*

Teachers are still grappling with the implications of conceptualising a Design and Technology curriculum. Their confusion is translated into mixed messages to pupils both about the purposes of design-based activities in schools and the processes by which they are expected to reach outcomes. Kimbell, Stables and Green (1996) suggest that success in the development of design and technology courses was, in the early years, limited to those

teachers who understood the new opportunities on offer within Design and Technology (p.33).

Many teachers, confronted with the new demands of the Technology Order, retreated to elements of their existing practices to help them come to terms with the new and unknown. This 'eclectic pillaging' from disciplines resulted in conceptual confusion and set up tensions in classrooms at the delivery point of the new curriculum.

The traditions of Craft, Design and Technology education are almost diametrically opposed to those in Art and Design (Northing, 1989). In CDT, the emphasis is on clearly prescribed tasks, correct technical competence in craft skills and the safe handling of tools and equipment. CDT workshops in schools were characterised by a culture of corporate, industrial and engineering practices based on craft apprenticeship traditions. Art and Design emphasises open-ended tasks focusing on creativity, the exploration of media and the use of technical aids only as a means of achieving aesthetic outcomes. Art departments in schools are characterised by an individualistic culture emanating from traditions of individual artists or craftspeople often working self-employed and alone in studios.

Layton (1993) has suggested that whilst there was an initial assumption that "mastery of the processes of 'doing science' will benefit 'doing

technology", there are fundamental differences between the disciplines. The science curriculum has a dual tradition requiring pupils to learn clearly specified scientific concepts and to test hypotheses by the set piece 'experiments' rehearsed by previous generations of students. This sits uneasily in schools with a broader interest in establishing the generic skills of problem-solving within a technology curriculum (Hennessey, McCormick and Murphy 1993).

Anning's (1994) study of technological capability in Design and Technology in young children suggested that teachers have reworked the succession of centrally imposed National Curriculum Technology Orders into their own practical, operational versions, drawing on what seemed the 'best fit' with their familiar ways of teaching. They have not had the time, in the midst of chaotic curriculum reform, to reflect on what specific features of designerly thinking and behaviour they should be promoting in their classrooms.

#### *Pedagogy*

The lack of a coherent theoretical explanation of the complex relationship between knowledge and design-based activities (DES/ WO 1988; Penfold 1988; Kimbell, Stables and Green 1996) and the differing positions which design education experts hold on the structure and nature of designing and problem solving (Hennessey, McCormick and Murphy 1993) have given teachers little help in trying to clarify their thinking about how best to *teach* design.

In their confusion they have sought guidance from government, academic and commercial sources of expertise. The National Curriculum D&T Order (DfE/WO 1995) identified two broad strands within the Programmes of Study: 'designing skills' and 'knowledge and understanding' but no exemplars were offered to demonstrate how the strands were to be brought together in design-based activities. Separating out the domains of what children need to know - designerly thinking - from what they need to be able to do - designerly behaviour - is a pragmatic device to simplify the complexity of the Design and Technology curriculum, but this is problematic when it

comes to devising design-based activities. Similarly GNVQ course outlines offered broad areas of skills, knowledge and understanding as discrete areas of learning which teachers were expected to combine into their own curriculum planning (NCVQ 1995).

The practice/knowledge interface is a distinctive feature of designing. Their separation leads teachers to conceptualise and plan for them separately. There is evidence that the 'psychological dualism' which Tomlinson and Swift (1992) identify as a feature of western culture has a strong impact on the way teachers design curriculum activities. Tomlinson and Swift define this dualism as

a stance which seems deeply embedded in Western language and culture, which separates mind and body, polarises thought and action, assimilates the cognitive to the conscious and sometimes reifies action into blind behaviour.

In contrast in the models of design and technology offered by, for example, APU (1987), DES/WO (1989) and Kimbell et al (1991), teachers were encouraged to see the process of doing and knowing as an iterative cycle of knowledge in action, ensuring that the activities and tasks set provide pupils with opportunities to develop both designerly thinking and behaviour. Donald Schön's (1990) seminal work on reflection in action provided a useful model. DATA, the Design Council, Nuffield and RCA, respected sources of curriculum materials for teachers, *have* offered practical examples of how to combine the two strands.

In particular the Nuffield Project clarified for teachers the need to make clear links between the knowledge and skills which children need to be taught and the sequences of learning activities teachers should set up through which children will be taught them. David Barlex has pointed out that a useful distinction for teachers is

*knowledge of the problem* - usually acquired through researching the brief - who it is for, what are their needs, where it will be used, where it will be sold,

number of units to be produced etc. - and *knowledge for the solution* - which for particular sorts of materials/technologies/products can be readily identified and taught'. (Unpublished letter, 11.7.96)

### Influences from the workplace

Design and Technology teachers have looked towards professional designers' practices for inspiration. Reporting their experiences of working with designers in the classroom, Harding (1995) and Davies (1996) point to several 'key features' of the way designers operate in the workplace that are applicable to promoting design capability in schools:

- discussion at all stages of the design process
- continual reference back to the project aims
- on-going evaluation
- sketching as 'visual notetaking'.

However, curricular organisation, timetabling, examination and assessment requirements and lack of resources provide constraints in schools different from those in the workplace. Geertz (1993) and Schoenfeld (1991) have demonstrated that the way students use tools (such as dictionaries, calculators, historical documents etc.) are inevitably informed by a 'school' culture and its constraints rather than by the way they are used in 'real life', authentic work practices. In schools, activities are targeted at individual learners with resources shared between twenty or more pupils and problems are artificially constructed. In the 'real' world of work, 'experts' work in a purpose-made environment, with resources committed to their specialised needs, on real problems in order to earn a living.

Medway (1992) and Barlex (1995a) have alerted us to problems inherent in using the practices of work-based 'experts' to guide the design-based activities offered to students in schools. Medway points out that school technology tasks incorporate a range of activities which in the work place would be shared amongst members of a team - designers, model makers, production engineers, marketing people. Barlex reminds us that most professional designers operate within a limited field:

This field may be defined in a variety of ways:

by means of a manufacturing technique -  
so some product designers specialise in  
designing items produced largely by  
injection moulding

by means of a particular function of  
outcome e.g. furniture, seating, lighting

by means of a particular way of working  
e.g. electrical, mechanical, electronic.

Trying to define what children need to know at various levels of capability for design activities in schools is complex and drawing directly on workplace practices may provide teachers with some confidence and guidance in teaching design. But at another level trying to define the processes of design in 'real world' of work is equally complex. As David Perry (1995) pointed out

The central issue is that designing is of its essence eclectic. The total body of knowledge and skills of human kind are therefore potentially relevant to any designing endeavour.

It is only when we have clearer definitions and descriptions of how design works in the 'real world' of work that teachers can select which features of their practices can be usefully translated into promoting designerly thinking and behaviour in school contexts.

### **Promoting and developing design capability in schools**

Two of the aspects of promoting and developing design capability investigated in the project will be discussed in relation to designing in schools and in the workplace: research and development in designing and using knowledge of equipment and materials.

### **Research and development in designing**

Progression and development in the use of information sources is grounded in the early years upon children's personal experience and the teacher's expertise in promoting exploratory talk and information retrieval skills.

Sources of information are potentially unlimited but commonly include:

- a variety of media e.g.- books, videotapes, compact discs, diagrams, photographs

- experts - eg within local or national associations, within particular sectors of the community
- first-hand experience derived from, e.g. visits to museums, shopping centres, garden centres, homes for the elderly, playgrounds.

One of our professional designers, a corporate wear designer, stressed how diverse sources of information were for designers. She emphasised the importance of students developing enquiring minds.

Fabric can lead you off on a route and if you don't realise what fabric can do, how it reacts then ... really the only route to that type of knowledge is hard slog, go visit people, get people in, get people talking to you, get people experiencing it, get people feeling at garments. I don't think students feel at garments; enough its 'well no I didn't go in to that shop, I couldn't afford it' ... well forget that ... get into the changing room and try on the garments. How does it react on your body? What does it do? Play about with them ... make them more discovering.

From our discussions with teachers and our observations in schools, it was clear that a range of information sources was made available to children, both at point of need for a particular project or for general reference.

"I have a whole range of things the children can use; books, useful objects, building bricks and construction kits, colouring materials, papers, card, glues, all sorts of things ... there's always children's work on display ... and there are three of us ... but it depends on the task, I don't let them have access to everything all the time." (KS1 teacher)

The provision of a resource bank ameliorates problems experienced by some children when 'research' is set as homework. Children are frequently asked to seek information for homework and, unsupervised, they may fail to track down the detailed knowledge (e.g. of consumer considerations, of materials, processes and ergonomics) that might be of real benefit in making design decisions. The ability to research and refine ideas independently was seen to be more evident in girls than boys.

"some of them must spend hours and hours on this work at home... I sometimes wonder how they find the time with all their other work... it's a huge workload which some of them take on." (Secondary teacher)

The support, or lack of it, from parents, and variation in the availability of materials and assistance were also seen as significant, particularly for children at GCSE level. Projects in classrooms which gave children an opportunity to use existing knowledge were therefore seen as essential. For example in a KS1 project on toys, in particular teddy bears, the teacher commented that she thought:

that children would be familiar with these and would have their own experiences to draw on as a starting point.

Children were taught how to gain information by handling examples of things they were being asked to make, by disassembling objects, by working with construction kits, by feeling materials to gain a sense of some of their properties and by handling tools to find out what they will do. Older pupils were encouraged to build on these direct experiences, to combine a range of evidence or sources, and to develop skills used in gathering information from people as consumers.

One of the professional designers, a mechanical engineer now involved in industrial designing, whom we interviewed suggested that it is building an information bank of experience which allows a designer to make decisions about quality, purpose and function.

"Experience tells you when something is right, the more you look at things the more you can see the difference between something that is well made or not well made, that's fit for its purpose and good to look at as well; you have to learn to look at things like that."

Children need to be provided with lots of 'looking' and investigating experiences at all stages of compulsory schooling.

### **Using knowledge of equipment and materials**

The professional designers - a mechanical engineer, a graphic designer, a corporate wear

designer and a furniture designer/maker - in our study affirmed the need for technical expertise and familiarity with the properties of materials.

The industrial designer, working mainly with small components or electrical equipment, told us:

Without fundamental knowledge of materials you won't have any understanding ... without the ability to determine when something's going to break ... you're not going to be able to design many types of brackets, although it has to be said that I don't sit down and do a set of calculations for every bracket I design because more often than not the amount of load your applying is so small you don't need to do that, but that's down to experience and knowledge and at least I have the ability to do the calculations if I need to.

The furniture designer in the project accessed specialist expertise for information or knowledge about materials: 'I can always find out from experts or specialists. I can't know everything but I do know where to go to find out, and who to ask.'

In schools, it is often the teacher who acts as the expert or specialist, as in the case of a KS1 'seamster' project.

"In the sea monster project where they were joining paper I provided them with a range of materials to work with, paper clips, paper fasteners, tape, glue, so that they could see how different types worked ... they all used a number of different methods in their work."

A key stage 2 teacher described how she developed skills and knowledge in young pupils by planning the projects carefully:

"I decide what skills I want to develop in a particular project, what equipment I want them to learn how to use, what materials I want them to work with... it's part of an overall plan which covers the whole school, then I know what they've covered and what I can build on... some projects are more open than others, but at this stage I'm building skills and teaching how to use equipment safely."

In the conference presentation these two aspects of design capability and the role of drawing and modelling and evaluating will be illustrated with case study material.

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