Teaching and learning how to design in schools

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A key area of enquiry within a small scale project, based at the University of Leeds, funded by the Design Council (Anning, Jenkins and Whitelaw 1996) was 'What do pupils and their teachers need to know and to be able to do in order to engage in design-based activities?' We worked closely with a group of primary and secondary teachers to try to find some answers. These deceptively straightforward questions taxed all of us. The discussion below does not imply criticism of colleagues' practice. It simply illustrates some of the dilemmas of teaching design in schools.

The 1995 Design and Technology Order reduced the programmes of study to two areas of skills – designing and making – underpinned by knowledge and understanding. It is clear that 'doing' technology requires a complex combination of designerly thinking and behaviour, but many teachers, particularly in primary schools, have no clear model of how designing works. In the Order the identification of strands in designing skills from Key Stages 1 to 4 is helpful. For example, one strand in Designing Skills progresses from:

- develop and communicate their design ideas by making freehand drawings and by modelling their ideas in other ways (Key Stage 1)

- explore, develop and communicate aspects of their design proposals by modifying their ideas in a variety of ways (Key Stage 2)

- generate design proposals that match stated design criteria and modify proposals to improve them (Key Stage 3)

- (to know) how graphic techniques, IT equipment and software can be used in a variety of ways to model aspects of design proposals and assist in making decisions (Key Stage 4)

Johnsey's (1995) useful review of theoretical models of the design process available to teachers points out their overall similarities as well as their distinctive features. The

problem has been a lack of guidance based on empirical evidence of how real children and their teachers cope with teaching and learning design to help teachers deliver the programmes of study

What do teachers need to know and be able to do?

In order to teach *designing* effectively teachers need to have a personal, even if rudimentary, understanding of how design processes work. In training they are likely to be offered theoretical models based on designing as an iterative process of 'interaction between head and hand' (Kimbell 1993) or as a loop process as in the Curriculum Matters series on Craft Design and Technology (DES 1987). Nevertheless, the model that has been most influential is the four attainment target cycle of the original 1990 Technology Order: identifying needs and opportunities, generating a design, planning and making, and evaluating. The mind-set established by this innovative document has been long-lasting and encourages teachers to structure designing activities as sequential rather than iterative processes.

Secondly, teachers need an understanding of how to apply this personal knowledge to planning curriculum activities. There was a desperate lack of curriculum support materials to help primary and secondary teachers to implement the statutory orders. There was endless reinventing of wheels as teachers sat down in groups or as individuals to try to plan activities which involved design opportunities for their pupils. Latterly, the Nuffield and RCA materials for secondary teachers and DATA guidance for both phases have provided long awaited, good quality curriculum materials.

Thirdly, teachers need pedagogic subject knowledge. Primary teachers have always claimed the high moral ground in basing children's activities on experiential learning and placing a high value on practical work. However, evidence from research in primary classrooms indicates that they spend little time interacting with children when they are engaged in practical work and that their pedagogic style does not necessarily modify from didactic, if informal, tactics even when they do engage with children who are

working in small groups or alone on technological activities. Secondary teachers brought into the 'new' discipline of design and technology a diverse mixture of pedagogic practices derived from home economics, craft design technology, business studies, information technology or art.

Fourthly, teachers need an understanding of how children learn in and through a subject. Research evidence (other than through the APU work at Goldsmiths), rather than assumptions about how children learn design skills, was thin on the ground when designing was introduced as a statutory activity for all children in schools.

The conceptual confusion of teachers has resulted in children receiving curious 'messages' in design and technology lessons. For example, on the one hand children have been encouraged to work towards a quality, crafted end product based on the well-honed, convergent traditions of technology and on the other to find creative or novel solutions to a design problem based on the divergent traditions of art – all this often within the same design and make task. We have often asked the impossible of young and inexperienced designers.

What do children need to be able to do?
Teasing out the implications of the Order, what children need to be able to do in *learning to design* is to:

- research
- image
- represent
- communicate
- cooperate
- make/do
- evaluate

applying knowledge and understanding and skills of:

- information retrieval/selection
- looking/imagining
- drawing/modelling
- presentational skills
- teamwork
- handing tools and equipment
- materials/components
- systems/control
- structures
- products/applications

All these aspects of children's capability need to be planned for, taught and resourced with equal commitment by teachers, but our experience was that coverage was patchy and often dependent on the nature of the pedagogic habits from their past experiences of teaching carried forward by the children's teacher into each technology session. There is only space to point selectively to the kinds of dilemmas the project teachers and their pupils were confronting in learning about designing.

Information retrieval/selection
We talked to a number of designers during the course of the project. They all emphasised the importance of children having the skills of locating and retrieving information to inform their design decisions. Collecting relevant information was partly about developing intellectual curiosity. A textile designer talked about encouraging children to "open up their minds to absolutely anything ... going to the theatre, films, exhibitions, museums ..." and "get them into changing rooms to try garments on. How does it react on their bodies? Play about with fabric ... make them more discovering". It was also about knowing where to go for information. This requires explicit training rather than leaving it to the serendipity of finding things out for 'homework' exercises. A furniture designer, when asked about the value of students learning about materials, replied that what mattered was knowing how to find out about them. As he argued: "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." For primary classrooms where resources were sparse, and secondary schools where the time for research was often limited by timetabling constraints, the issue of providing data banks of information specific to a task –

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possibly from work done by children for previous projects – was crucial. An extract from the Welsh Order for Design and Technology argues that:

> "Expecting children to design in a vacuum is unreasonable and strangles creative opportunities. When adults are designing they provide themselves with the right atmosphere, materials, surroundings and associated resources with which to work and be stimulated" (Curriculum Council for Wales 1993: 7)

Looking/imagining

Teaching children to look closely at artefacts and systems – through product analysis or observational drawing – and to be able to talk or write about what they have learned are also key areas of capability. One of our teachers said emphatically "Children need to be taught how to look." There is a need to get a delicate balance between encouraging children to bring knowledge gained from analysis of the real world and its products together with the ability to imagine creative, novel outcomes to design problems. At primary level, teachers were often unable to focus children clearly on the parameters of a design problem. Without clear teacher instructions the children's imagined solutions were so fantastic as to be totally unrealisable. In contrast to this, in secondary design and make tasks the parameters were often so clearly defined in the teacher's instructions that children had few opportunities to use their imaginations in working towards design solutions. In both phases a crucial factor was for teachers to encourage children to ground designs in a firm grasp of the materials they planned to use for the making phase of the task.

Drawing/modelling

The designers were clear that the ability to visualise or create images in the mind's eye and then to deploy these imaginings into drawn or modelled form was at the heart of design capability. An industrial designer with a mechanical engineering background said: "I think it's the ability to conceptualise that makes a designer. There are plenty of people who can be taught to draw, to be engineering draftsmen, but ... some of them are very poor designers... they have no concept, no natural ability." Children were rarely being introduced systematically to different genres of drawing as tools for different designerly processes. They were not offered models of sketch-pad scribbles, annotated drawings or story boards as a tool for clarifying their own emergent ideas. Nor were children given clear information about the formal conventions and purposes of engineering diagrams, technical drawings or CAD designs. In many cases children devoted hours to the more decorative, presentational aspects of design drawing, often when technical detail significant to the manufacture or modelling of a product was either missing or, worse still, incorrect. For young children it was often more enabling to offer them activities where they could design/model with materials and then to present their designerly thinking in drawings later. The teachers agreed that formal instruction in drawing – one minute sketching, disassembly and annotated drawing activities, scale and orthographic drawing exercises – was necessary. Emerging ideas are often best communicated through models, prototypes or mock-ups. However, the purpose of model making in classrooms was often unclear. The teachers gave (and consequently children received) mixed messages. For example, when designing a pet shelter or a toy, it was not made clear whether children were expected to make a model, a prototype or a version of the 'real' thing? Lack of clarity from teachers left the children to make best guesses as to the purposes of their modelling and again often resulted in more attention being paid to decorative than functional purposes.

References
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