Drawing Compared with Model Making as a Design Technique

A research report that suggests that wider use should be made of model making as a design technique

R. Stewart
formerly of Ellesmere Port Grammar School, Cheshire.

Of all techniques to express and communicate ideas drawing would seem to be most extensively used. Its advantages are at once apparent and quickly stated. It is cheap, a simple pencil being the only essential tool required, a sheet of paper the only material. Even the most complex work can be carried out with modest equipment. Through the use of line and tone in a sketch a designer can quickly represent any object that exists or that he wishes to bring into existence. Extremely large and elaborate objects can be represented within a small area, and yet the true size can be read by means of dimensions and scales. The results are permanent, easy to duplicate and require no special maintenance.

But these evident advantages recommend themselves most strongly to those who are skilled in the language of drawing. When pupils, inexperienced in the language and unskilled in its execution, are asked to interpret their ideas, to visualize them and communicate them, by means of drawing the disadvantages often appear formidable. Firstly, the visualization and construction of realistic sketches, relying on accurate relationships between parts and overall proportions, is no easy task and requires a good deal of practice.

Secondly, the appearance of a three dimensional object when represented on paper is different from its true form. If a visually realistic and readily understandable picture is to be given then true shapes as seen from different directions have to be turned into apparent shapes. But if a designer wishes to accurately convey information about shape and size he must draw several views showing the true shapes.

At this point accepted practice is to prepare a drawing in orthographic projection. The designer has to form a mental picture of the object before it exists and express this image in terms of a number of views. Anyone wishing to execute the design then has to study the separate views and reassemble them into the solid form. To construct mental pictures in this way is no easy task. Indeed, in the nineteenth century orthographic projection was regarded as much as an intellectual exercise for the scholar as a tool for the craftsman. The situation is complicated by the practice, in this country, of arranging several views according to first angle projection. Although soundly based upon the concept of projection, in this system the views are arranged in opposite positions to that which an observer might expect; the top view of an object being placed underneath the front view. Increasingly the trend is to adopt the more straightforward third angle system used by the Americans, but at present a design is often presented by a confusing amalgam of both systems.

Yet no matter how accurate the final drawing whether projection or freehand sketch – it remains, in essence, something composed of a number of lines. Not only is it a structural equivalent of the product but it is actually a symbolic representation of its

medium. An object has mass, texture, colour and shadows. It is not a blank space bound with thin, dark lines. Designing requires one to think in terms of the medium, but the language of drawing imposes its own mode of thinking – in terms of the line.

There is, too, an inherent danger in the attempt to design a three-dimensional object by drawing a number of two dimensional elevations. Three-dimensional things can only be experienced fully, and the relationship between parts understood properly, by being worked 'in the round'.

The actual development of a design illustrates further limitations to drawing as a design technique. The very fact that solid material is not used puts the designer at a serious disadvantage for product design is inherently related to materials; their characteristics may have a profound affect on the final form. In some cases the material not only suggests the form but also indicates the subject of a design as in some sculptural and carved work. A carver, for example, might wittle away casually at a piece of material until a form begins to emerge; released, or perhaps suggested, by the material.

Naturally, not all designing could proceed in this matter. Many materials are resistant and therefore difficult to work; they are often expensive, the product might be large and elaborate and have to fulfil a number of requirements. It is in such cases that models prove to be a suitable compromise between extremes. A model combines the tangible realism and accuracy of the solid material form with something of the speed and economy of the drawing, particularly if an easily worked substitute material is used. The simplest models might be regarded as sketches in the round.

The appeal of the model to children is something very basic. Their toys – the clockwork train, the doll, the tea set – are, in fact, models to which they may become so attached that they are often carefully preserved into adulthood. Even from infancy children begin to create their own models, using very basic materials like sand or mud or simple blocks.

At the opposite end of the scale models play an extremely important part in many industries. Examples from the motor industry, aircraft and shipbuilding spring to mind as well as their use in townscape planning and production flow planning. By virtue of being able to work 'in the round' models are not only superior for developing the form of a particular design but are also a convenient and readily understandable means – and far less ambiguous than a drawing – for the communication of an idea. The fact that a model closely resembles the form and substance of the proposed design means that colleagues and clients can immediately understand salient features. Cut-away models like sectional drawings are very useful for showing hidden details or working parts and may on occasion be superior even to the real thing for explaining how a mechanism works.

Of course, copies of models cannot be rapidly duplicated like drawings nor can they be stored with the convenience of drawings. Nevertheless, photographs can be taken and copied and this provides a convenient way of recording ideas developed in experimental work, the 'sketch' model having served its useful function and no longer required. More detailed models are often so meticulously executed that photographs can be taken to be of the final design. But an individual does not necessarily need specialist training to produce a presentable model. Quite outstanding work can be done by the young. Indeed, the popularity of model-making amongst children must to some extent reflect the degree of success they are able to achieve.

Model-making in schools

Because product design is inherently tied up with materials, with their visual, structural and working properties, it is necessary that pupils be allowed to gain experience of real materials. Yet handicraft teachers are often reluctant to allow pupils to experiment freely with the materials and processes of the heavy crafts. Wood and metal are intractible and expensive and related techniques are often dangerous and complex.

Models can prove to be indispensable in such a situation, especially if easily worked substitute materials are used. From the teacher's point of view materials such as cardboard are not only cheap but can be acquired in all forms and sizes. The pupils themselves can readily obtain boxes, tubes, postcards and corrugated cardboard. Other materials such as clay can be used over and over again and the equipment required may be actually less than that to prepare a working drawing.

However, it is to the child that the advantages are really apparent. Whilst he can experiment freely, the material will still provide a degree of guidance. Naturally, a soft material such as clay will not have the same structural properties as the more intractible materials it is made to represent but visually it can represent a similar form. And with a material such as cardboard methods of marking out, cutting and joining are not unlike those of wood and metal.

A special advantage of modelling over drawing is that it allows the sense of touch to be exploited. As early as 1892 Saloman, in describing the Sloyd approach, recommended that pupils should be allowed to manipulate and handle a prepared example of what was to be made next rather than work from a drawing.[1] Child psychologists have since emphasised the importance of sensori-motor activity. Piaget, for example, has demonstrated that the manipulation of objects and materials is an important basis for mental action. It has been shown also that some individuals tend to be more dependent upon touch than others. Lowenfeld distinguished between 'visual' and 'haptic' types. Whereas the former uses his eyes as the main intermediaries for his sense impressions, the latter relies upon touch. Lowenfeld considered that the haptic individual would be deprived of a specific creativeness if deprived of kinaesthetic experience.[2] More recently Torrance in certain experiments on creativity found a significant relationship between the degree of manipulation of objects and the quantity and quality of inventive response. Pupils were required to invent improvements to toys in order to make them more fun to play with. Those pupils who handled the toys the most gained the highest scores and those who handled the toys least gained the lowest.[3]

Over the years several craft educationalists have recognised the importance of modelling e.g. Zanker emphasised the need to experiment with materials and models in the development of a design.[4] Obviously the design technique adopted will be influenced by the nature of the work. With more complex designs, as in industry, drawings and models may be used intelligently together. Statements such as the following from *Education Through the Use of Materials* should in future lead to the development of a more flexible approach based upon a sound knowledge and understanding of child psychology and the creative process:

Problems, like children, vary in nature, and rigidity of approach might inhibit the

flow of ideas. It is necessary, therefore, to adopt methods which will allow students to sort out their own ideas within a framework that ensures an analytical view has been taken of the problem ...

... However, for many children the visualization of a finished job is difficult. The situation is made more demanding if methods by which students can relate their ideas are restricted to the conventional means of technical drawing and sketching, which are frequently beyond the ability of a number of pupils. Written and spoken media may also present barriers to expression. Consequently it is often desirable to make available a wide range of easily worked materials, such as card, wire, and balsa wood, which enable the individual pupils to try out ideas in model form before committing themselves to final construction.[5]

An Experiment

Bearing these points in mind, the writer hypothesised that in school handicrafts design solutions developed by modelling would be functionally more effective, more appropriate to the final material, and more suited to construction by a pupil in the workshop than solutions developed by drawing. A woodwork and metalwork design test were devised to check this hypothesis. A pilot study with forty pupils indicated that the hypothesis was justified and the main experiment then proceeded with 274 pupils.[6] This sample consisted of one hundred first year grammar school pupils, one hundred first year secondary modern school pupils, and seventy-four fourth year grammar school pupils taking woodwork or metalwork to external examination level. Half the sample took part in the woodwork design test and half in the metalwork design test.

The woodwork test involved the designing of a toy animal for a child's Noah's Ark set. The animal had to be suitable for a child to play with and be capable of being carved from a block of wood by a schoolboy in the workshop. The metalwork test involved the designing of a wall plant-pot holder. The holder had to support the plant-pot firmly against the wall and be capable of being made by a schoolboy. Half the pupils participating in each test developed their solutions by drawing and half by modelling. The drawers had to make a number of preliminary sketches and then a full-scale detailed drawing whilst the woodwork modellers made a full-size clay animal and the metalwork modellers a card plant-pot holder.

Four specialist judges evaluated the solutions in accordance with the following criteria: fitness for purpose, suitability to material, and feasibility of construction in the school workshop. A five-point scale was used for each depending upon the amount of alteration necessary by a teacher before a design could be reasonably executed.

The mean scores of the modellers in all groups were found to be superior to those of the drawers. The difference was significant at the one per cent level. A follow-up questionnaire to the design tests showed that over two-thirds of the pupils preferred modelling as a design technique, considering it to be more enjoyable and more effective than drawing.

The results of the tests indicate that a wider use should be made of modelling as a design technique in the school workshop. Modelling does not usurp the function of drawing; both can be employed side-by-side as an aid to one another. At present models

and mock-ups, if used at all, tend to be made after drawings. In many cases models can be used first to stimulate and develop ideas before making drawings. Indeed, one might well go on to hypothesize that the consideration of three dimensional ideas could best be tackled this way round in order to achieve the greatest degree of success and feeling of achievement on the part of students.

Fig. 1 A functionally effective and simple design for a wall plant-pot holder made in card by a first year grammar school pupil. The design is suitable for construction in mild steel strip and could be made by a schoolboy of reasonable ability.

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2. LOWENFELD, V. The nature of creative activity, *American Journal of Psychology,* 58, 1945, pp.100-110.
3. TORRANCE, E.P. *Education and the Creative Potential,* Minneapolis: The University of Minnesota Press, 1963.
4. ZANKER, F.O. An approach to teaching design, *Craft Education,* 5, Stanley Works, 1967, pp.2-6.
5. SCHOOLS COUNCIL, *Education Through the Use of Materials,* Working Paper 26, London: Evans Bros., 1969, p.14.
6. STEWART, R. Modelling versus drawing as a design technique, *The British Journal of Educational Psychology,* February, 1973.

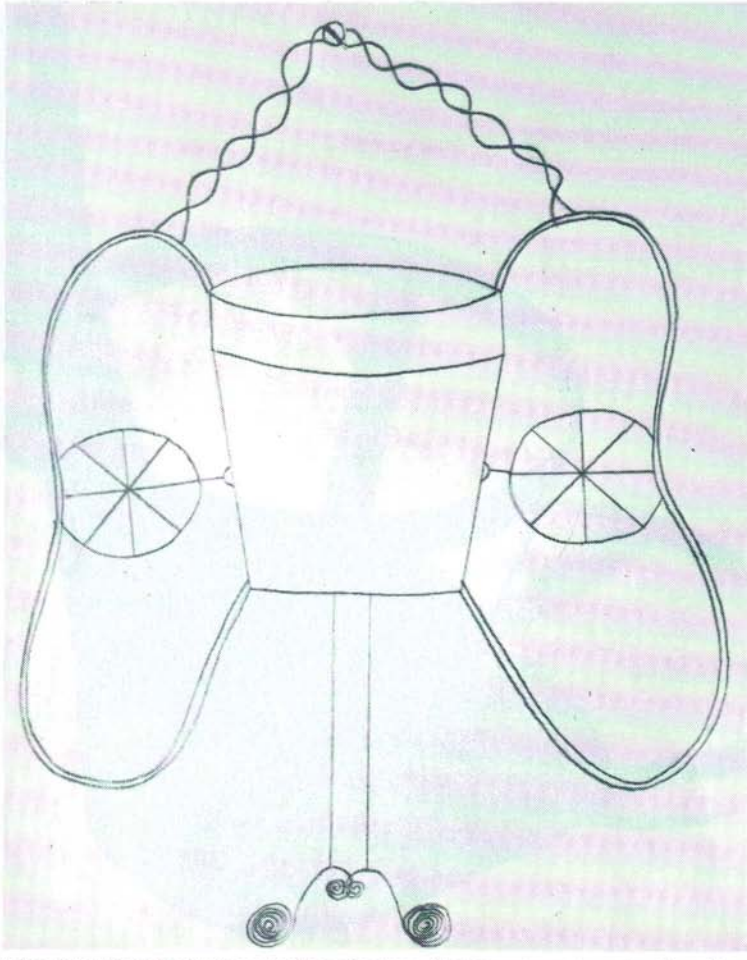

Fig 2. A drawing of a wall plant-pot holder, also by a first year grammar school pupil, which makes an interesting contrast to the model shown in fig. 1. The design is fragile yet difficult to make, many constructional details being vague or missing. Note the attempt to show the roundness of the container and the flat base on one drawing.