The place of the process skill making in design and technology

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The place of the process skill *making* in design and technology, lessons from research into the way primary children design and make

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Abstract  
*Making is a fundamental skill in design and technology. There seem to be few problems with identifying when it occurs and in teaching the sub-skills involved. Less is known, however, about the frequency of its occurrence in a design and make task and about its relationship to the other process skill such as modelling, researching and evaluating.*

*By studying primary school pupils closely as they design and make it has been possible to make some observations about the place of making in the whole process of design for the young children observed. The findings are based on a research project which used video recordings of primary pupils to observe their procedures. A graphic method for gaining a new perspective on the process of design is described in order to support the conclusions drawn.*

**Introduction**

Design and technology capability requires pupils to master a knowledge and understanding of key concepts and combine these with an ability to proceed with a design task by employing a range of process skills. Knowledge and understanding will not only include such conceptual areas as mechanisms and product quality from the design and technology curriculum, but also some of the ‘big’ ideas from other curriculum areas such as electricity (science) or use of ‘visual elements’ (art). Procedural ability will include an understanding of how to go about designing and making and will include process skills such as specifying outcomes, modelling ideas and evaluating products. A summary of these design process skills which are drawn from a wide range of publications can be found in Johnsey ¹. A modified version of these is listed later in this paper.

One of the apparently simplest process skills to identify is that of *making*. In contrast to some of the other process skills, we know with some certainty that this consists of easily observable events such as cutting, joining, shaping and marking. The National Curriculum for Design and Technology ² uses the term Making Skills to describe a broad area of activity in contrast to Designing Skills. For the purposes of this paper, however, making will be taken to mean the construction of a product in which pupils might ‘measure, mark out, cut and shape, join and combine materials and apply additional finishing techniques ...’ ².

This paper will consider the place of *making* in the whole process of design and go on to examine the relationship it has with the other process skills. The ideas discussed are based on recent research in which the way primary school pupils carry out design and make tasks in the classroom situation was examined ³.

**Outline of research**

The research, carried out over two years at the University of Warwick, involved close observation of primary school pupils during eight case studies. The pupils, who ranged in age from nursery to year 5, carried out short design and make tasks with little or no teacher intervention. Their actions, and in some cases their conversations, were recorded on video tape. These recordings were subsequently transcribed by describing, briefly, each type of behaviour as it changed and noting the time this occurred. By using a category system based on published models for the design process and a pilot study it was possible to classify each of these behaviours. The results were then displayed in a graphical form to gain
Fig 1. Behavioural Chart for Ben

Fig 2. Behavioural Chart for Louise
an overview of the whole activity. The ‘behavioural charts’ associated with each case study made it possible to search for patterns in the results which would have otherwise been obscured. It was possible to compare all eight studies at a glance and look for similarities in the way the tasks were carried out. Two of these charts are shown in Figures 1 and 2.

The vertical axis on each chart represents the process skills which make up the category system used to classify the data transcribed from the video recordings. These are:
- IDE - Identifying the potential for a design activity.
- INV - Investigating the context from which the design task will emerge.
- CLA - Clarifying the meaning and implications of the design task.
- SPE - Specifying the requirements of the outcome of the task.
- GEN - Generating ideas and solutions related to the task.
- RES - Researching the problem and its possible solutions.
- MOD - Modelling ideas for possible outcomes.
- PLA - Planning to produce the outcome.
- ORG - Organising resources (materials, tools, space and time).
- MAK - Making or producing the outcome, including making improvements.
- EVA - Evaluating the developing product, the procedures involved and the completed outcome. (The evaluation of other’s designed products was considered to be included in Identifying, Investigating and Researching.)
- O/T - Off task

Figure 1 represents the behaviours displayed by Ben who is a year 5 pupil making a device to recover keys from an inaccessible place. The teacher’s introduction, represented by the diagonal line on the chart, lasts only three minutes. Ben and his partner use a worksheet to firstly make their own set of card keys on a wire ring. The instructions on the worksheet ask them to use any material which is available to make as many devices as possible for recovering the keys from between a crack in two stage blocks. The pair work well together, making two different devices in the time available. Much time is spent testing the devices and making modifications to these. The first device, a hook on a string, worked well but the second was more problematic.

Figure 2 shows how Louise and her partner, Tina, both year 4 pupils, set about making a Jack-in-a-box as a present for someone. Louise is the dominant one of the pair and the model is her idea. Tina, takes the role of compliant helper for most of the time. Once Louise has thought of her idea she works at it with confidence but is willing to accept help when required. Sometimes she is distracted by others but she easily returns to her task and shows a degree of perseverance. Her idea is to mount a polystyrene cup on the end of a wire pipe cleaner and make it pop out of the top of a card box which she has prepared with a pink card lid. Both girls find difficulties with construction and making the mechanism for the model to work. In some instances a compromise is made and in others they persevere until the model works. This period can be clearly seen towards the middle of the behavioural chart where making and evaluating dominate.

Conclusions regarding the place of making in design and technology

These two case studies are representative of all eight studies and can be used to illustrate some conclusions regarding the process skill of making which are drawn from the whole research findings. It should be made clear at this point that the procedures described and the conclusions drawn are for pupils as lay-designers. One might expect the procedures followed by expert designers (those with specialist training) and student designers (those who follow procedures which are influenced by an educational process) to provide different results.

1. The making ‘spine’

A predominant feature of each behavioural chart is the making behaviour running through from beginning to end. Far more time is spent making than anything else in almost every case study. The making behaviour on each chart appears as a ‘spine’ from which other behaviours branch out at irregular intervals. In each study, making begins within
a few minutes of the children being free to follow their own procedures. This continues as a regular occurrence until the end of the activity. Where making is interrupted it is usually only for a short time. This observation suggests that during activities of this type, making is fully integrated with other process skills rather than occurring at a single, separate stage in the whole design process. This is in contrast to the way making is represented in many design process models where it is depicted as occurring in the ‘second half’ of the activity after much preparatory work.

There are a number of probable reasons for this dominant making strand. The making behaviour could clearly be broken down into a number of sub-skills such as cutting, joining, marking etc. and therefore represents a collection of behavioural categories. This is in contrast to a simpler category such as planning which involves fewer sub-skills.

A more important reason for its dominance may be connected with the way primary aged children naturally choose to design and make. Many of the other design process skills occur while making is going on. While it is not apparent on video, children will almost certainly be planning what to do next as they make and they may be generating ideas as a result of the making process. The product being made is often the ‘model’ for what is to come next. Children will be modelling their ideas by manipulating the product they are making. The making process, then, may well be a vehicle for achieving success in the other design process skills.

Making may be attractive to many primary aged children for reasons other than the achievement of a design solution. It may provide opportunities to learn skills that other classroom activities do not provide. For instance children will often choose to make products with materials and tools which are unfamiliar to them - not because this will provide a superior design product but because they want to learn how to use these and to enjoy the physical sensations involved. Making, in this instance, becomes a concrete way to learn rather than a way to fulfil a design task.

2. The effect of making in the early stages of design

There is evidence to show that, in the early stages of the design activity, the making activity stimulates such process skills as clarifying, specifying and researching. Some of these features are illustrated in Figures 1 and 2 where a making activity often gives rise to these ‘early’ process skills. Anecdotal evidence suggests that primary aged pupils are very keen to begin making when given the opportunity and yet, early on in the design process, they may not have clarified their ideas about what to make and how this might be achieved. Therefore, while making may be a vehicle for carrying out other process skills, it may also provide an essential stimulus for doing so.

3. The Make - Evaluate - Make (MEM) sequence

One dominant pattern of behaviours is clearly apparent in all the studies and could be said to characterise the pupil’s behaviours during such activities. The sequence is Make - Evaluate - Make (MEM). The large degree of making in each case study has already been discussed but it appears that alongside this, the supportive behaviour of evaluating occurs regularly. The sequence can be clearly seen in Figure 2 from 33 minutes 50 seconds to 55 minutes. With the exception of two examples of organising the MEM sequence continues for 11 minutes 10 seconds. During this time Louise has most of the tools and materials she requires on her desk. She becomes intent on arranging a card box with pink flaps and then making the polystyrene cup head pop out on the end of a pipe cleaner. This requires much trial and error and perseverance. What stops this sequence is the failure of the head to pop out satisfactorily on the end of the pipe cleaner because this is too flexible. She and her partner return to generating ideas for a solution and carrying out research by consulting the teacher for advice.

An appreciation of the MEM sequence throughout a design activity will enable teachers to take a broader view of the nature of evaluating in design and technology.
4. The Evaluate - Analyse - Improve cycle

In the early stages of the research two behavioural categories were identified, improving and analysing, which were subsequently incorporated into making and evaluating respectively. It was agreed that improving always involved some more making and that analysing was a part of the wider category evaluating. This refinement has meant that a behavioural sequence, noted in a number of publications, has become hidden. This is the evaluate - analyse - improve cycle (Figure 3). A brief study of the data transcribed from the video recordings, however, confirms that the prolonged MEM sequences are, in many instances, repeated examples of this cycle.

Figure 3 The Evaluate - Analyse - Improve cycle

For instance Fig 1 represents an activity in which Ben is making a new ‘grabber’ for the keys by forming tongs with card ‘hands’ on the end. At 8 minutes 25 seconds he and his partner are fixing the card ‘hands’ on the wire (making). At 9 minutes 45 seconds he tries this device out (evaluating) but decides the card needs folding a little (analysing then improving). He tries this out (evaluating) but concludes that it won’t work by saying, ‘It won’t grab. Well it will. It’s just that it won’t keep open.’ (analysing). This leads on to an understanding that the device needs straightening to make it longer.

The implications for teaching design and technology

The research data are based on a study of pupils carrying out simple design tasks given a relatively free hand. However, one would expect the procedures carried out by the student designer to be affected by appropriate teacher intervention. The following suggestions will enable teachers to consider the process skill of making in a broader sense and to plan appropriate learning programmes to enhance this skill.

1. Do not expect making to take place only after a complete design idea has been worked out. Making and the other design process skills work best hand in hand.

2. Make pupils more aware of the procedures they are carrying out as designers, thus focusing attention onto areas which they do well and those which require improvement. For instance, making clear to children the importance of on-going evaluation and how this is interspersed with making is likely to increase the quality of this skill in the learner.

3. Give pupils practical making tasks early in the design and make activity. Primary children appear to rely a great deal on a practical and physical interaction with the context within which they will design and make. The ability to handle materials and tools and investigate artefacts is a stimulus to other design and make skills such as specifying design outcomes and generating design ideas. The practical tasks need not involve making the final design product but could be closely associated with it.

4. At times, expect pupils to make choices which enhance their learning as well as those which will lead to a well designed and made product. Sometimes pupils will be motivated by outcomes other than design outcomes. Arrange for children to become familiar with tools and materials and making techniques so that the novelty of employing these does not detract from the design task in hand.

5. Expect pupils to spend more time making but also identify when the making is, in fact, aiding their other design process skills. A pupil who begins making, by handling the materials which might be employed, is also simultaneously modelling ideas, researching the problem and generating solutions. Fixing components together in semi-permanent ways, for instance, enables the developing product to become a ‘model’ for the final product.
Conclusions

Making is a process skill that most educators feel they are reasonably familiar with. Most attention is paid to the need to gain the manipulative skills and construction techniques associated with this skill. There are, however, other facets of making which should be explored. As well as being the means by which a designed product is achieved, making appears to provide support to a range of other process skills related to design and technology.

References


3 Johnsey, R. The design process in primary school design and technology - An examination of the way in which primary school and pre-school pupils design and make. University of Warwick (1995) (MSc thesis to be published).
