Observing the way primary children design and make in the classroom: an analysis of the behaviours exhibited

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An investigation into different models for representing the design problem solving process

Baynes offers one view of the process of design:

“Designing is not confined to the planning stage of a project. It continues throughout the process of creating a product, a model, an exhibition or a machine. Designing means looking ahead by using discussion, analysis, creative thinking, making testing and modification.”

Any attempt to describe something as complex as how children or adults design is fraught with difficulties. Not enough is known about an activity which is dependent on both the characteristics of the designer and the context within which designing takes place.

For the purposes of this pilot study I have taken designing and making to be an holistic activity in which an open-ended task or problem is identified. After due consideration something is then produced in order to complete the task or solve the problem. The way in which this is done can be described as the design or problem-solving process and consists of a series of related behaviours, some of which will be observable actions. I have chosen to focus on the kind of behaviour which might be exhibited and recorded on video as children carry out short design tasks. In doing so I have inevitably made assumptions about what the subject is thinking and the motives behind each action.

Classifying children’s behaviours when carrying out design tasks

In these first attempts to classify children’s behaviours I have used:

(i) A study of a wide variety of models for the design/problem solving process. A summary of this study is shown in Table 1.

(ii) The behaviours the children themselves exhibited when carrying out the tasks.

Table 1 shows the vocabulary used in a variety of models which describe the design/problem solving process. In some cases the design process is described diagrammatically as a linear or cyclical set of behaviours (CDT from 5 to 15 or Design and Technology 5 - 12) but in others the description is less structured and simply lists some behaviours attributable to designing or solving particular types of problem (Design and Primary Education and Science for ages 5 to 16, August 1988). Some publications clearly refute the notion that designing follows a set, linear path with a beginning and an end (Technology in the National Curriculum - Non-statutory Guidance) though all of them, interestingly enough, list the characteristics of designing in approximately the same order.

From the descriptions of design behaviours in Table 1 we find there is a reasonable consensus of opinion about the nature of designing or practical problem solving and the order in which, supposedly, things happen. A further analysis is aided by the identification of three major stages in the design process which I have outlined in Table 2. I have used the words in brackets as a shorthand when...
The children would work in pairs in a room familiar to them.

The video recording would focus on one pair of children only, and the record of observations would be for one of these children.

It was decided that a group of eight children from year 4, working in a room separate from their classroom would provide a relatively relaxed atmosphere in which to carry out a short design task. The video camera was set up in a fixed position and focused on one pair of children so as to follow the whole of their design task. Microphones were set up on the working table to record the children's conversation.

The simple design task was introduced by a teacher and the children set to work without further teacher intervention apart from words of encouragement. (The teacher could also be used as a resource if the

Describing the process in graphic form

The stages in the problem solving / design process described in this Table could be represented in a graphic form by introducing another dimension - that of Time. A conventional, ideal view of the design process might look like the graph in Fig 1 which I have developed for the purpose of this pilot study. Each stage in the process is listed in order on a vertical axis while the time spent on each stage is denoted by the length of the bold lines in the direction of the time axis. We might expect more time to be spent on such tasks as making and modelling and most process models predict some looping between testing and improving. These features are displayed on the graph. The times chosen are entirely arbitrary but the general pattern would remain the same in the eyes of many theorists.

The pilot study

In order to make the pilot study manageable I chose to impose the following constraints:
- The context for design in each case would be one with which the children were already familiar, eg design a simple game.
- The task would be relatively easily achieved with simple classroom resources such as paper, card and glue.
- The design task, as far as possible, would be an holistic one which could be completed within an hour.
if the children chose to ask questions.) The children therefore, were not involved completely in identifying the design need or defining it for themselves. They did, however, need to clarify the problem and in some cases this meant they were defining part of the task for themselves. Card, paper, some recycled materials, glue and simple tools were provided as well as a few catalogues which could be used as reference materials if so desired.

The children were shown the materials and tools they could use and then given a very open brief. They were to “ ...make something which moves which might be a present for someone.” It was felt that this was sufficiently open to allow the children to partly define their own task and yet be well within their interests and abilities. The children enjoyed their “special” lesson and all managed to complete something in the hour they were given. I focused on two girls, Lisa and Tracy who, after some deliberation, decided to make a pop-up toy from a box and plastic cup. The idea came from Lisa and she seemed to be the driving force behind the partnership. She became intently involved in making the model work, only straying off-task one or twice during the hour to talk to friends and see what they were doing.

Analysis of the video material

Analysis of the video material is in its early stages. It consists of writing a description of the child’s behaviour each time it changes significantly and noting the time. The list is then checked by a second viewing and alterations made. Each behaviour description is then classified according to the list in Table 2. Part of the analysis for this particular case study is reproduced in Table 3.

Comments

This method of analysis relies heavily on the observer’s interpretation of the meaning of each category of behaviour and each actual behaviour exhibited. There is a possibility that a different observer might make a different analysis. This will be the subject of further work within the project. Another improvement would involve an interview with the designer soon after the activity as he or she watches the video recording. This should help clarify some of the designer’s intentions and throw further light on the purposes behind the behaviour.

Analysis by graph.

A clearer picture of the data gathered can be made by employing the graphic representation described above. The data shown in this graph represents only a part of the whole design activity carried out by the child (Figure 2).

<table>
<thead>
<tr>
<th>Time (minutes)</th>
<th>Duration (seconds)</th>
<th>Observable behaviour (Lisa)</th>
<th>Classification</th>
</tr>
</thead>
</table>
| 20.51         | 4                  | Deciding on minor features of model almost by chance on seeing a particular component. (Lisa
|               |                    | sees marbles for eyes and tells Tracy.) | Generate / Model |
| 20.55         | 30                 | Finding the correct tool.    | Organise       |
| 21.25         | 25                 | Asking for technical help (from teacher).    | Research       |
| 21.50         | 50                 | Learning a construction technique. (How to make a hole with scissors in bottom of box.) | Organise       |
| 22.40         | 15                 | Marking surfaces for graphic effects i.e. face on head. | Make |
| 22.55         | 35                 | Fixing materials and components together. Making hole in box and in head. | Make |
| 23.30         | 30                 | Navigating the order in which construction takes place. (Tracy needed help to colour in so Lisa had to agree to fix wire on it later.) Tracy: “We will stick it later because I can’t colour it in then. I can’t colour it in.” | Plan |
| 24.00         | 5                  | Looking at how partner’s work has progressed. | Evaluate       |
| 24.05         | 10                 | Suggesting improvements to partner. | Improve       |
| 24.15         | 10                 | Identifying construction problems. i.e. with gluing marbles in polystyrene head. Lisa: “We’ll have to leave the marbles stuck for ages because marbles don’t stick.” | Evaluate / Plan |
| 24.25         | 110                | Being distracted from task by being interested in others. Helping others with their tasks. | Distraction |
| 26.15         | 28                 | Telling others what she is doing. | Specify       |
| 26.41         | 33                 | Collecting and selecting materials. | Organise       |
| 27.14         | 56                 | Measuring one material against another to get a good fit prior to shaping. Drawing rectangle on card. | Make |
| 28.10         | 17                 | Collecting scissors. | Organise       |
| 28.27         | 27                 | Beginning to cut rectangle out. | Make |
| 28.54         | 19                 | Checking rectangle for fit and re-drawing. | Evaluate       |
| 29.13         | 7                  | Cutting improved shape. | Improve       |
| 29.20         | 8                  | Refining rectangle of card. | Make |
| 29.28         | 17                 | Thinking through a problem. Discussing with teacher how to fit marble eyes on the face. | Plan |
| 29.45         | 47                 | Helping partner glue a marble to face. | Make |
| 30.32         | 13                 | Finding a particular construction method does not work or is inappropriate. (Marble won’t stick.) | Evaluate       |
| 30.45         | 12                 | Thinking of a new improved construction method. (Tracy takes over and uses Sellotape for marble eyes.) | Improve       |

Year 4 children designing and making “... something which moves which might be a present for someone”. Lisa is working with her partner, Tracy, to make a pop-up toy with a card box, plastic cup and a length of pipe cleaner.
Conclusions

If the initial analysis of the complete case study described is indicative of patterns which might emerge in future studies then some observations can be made.

• Quite soon in the design activity the Make behaviour becomes a dominant thread, taking up more time than any other behaviour.

• Some behaviours, according to Table 3 and Fig 2, appear to occur simultaneously but this merely illustrates the difficulties in drawing up these separate categories in the first place. For instance a strong link between modelling and generating ideas for solutions is demonstrated when Lisa picks up a marble and holds it against the model face to represent an eye (at 20.51). Also at 24.15 the evaluation of the method for gluing on the marble leads simultaneously to a new plan to use Sellotape.

• The constraints imposed by the way the task was set have a considerable influence on the behaviours exhibited. In this task there was little or no chance for the designer to define her own task or to investigate the context as fully as might be possible in a different setting. Furthermore there was no time at the end of the task for reflection or final evaluation by the designer. In future, opportunities for these behaviours to be exhibited could be built in to the task.

• This analysis takes no account of the effect of teacher-initiated intervention once designing has begun. The teacher in this example features only as an expert, able to provide help when this is requested. In these instances the technical instruction given was classified as Research on the part of the designer.

• The graph for the complete design task (not shown) is not like the idealised one in Fig 1 but instead shows a much more irregular pattern, jumping from Clarifying to Make to Research and so on, in quite short bursts of a few seconds at a time. There is, however, a trend which shows movement from the early stages described in Before a solution is decided upon (Table 2) towards the later stages, but punctuated by leaps backwards and forwards “across” the design process. This is partly illustrated in Fig 2 and would suggest the models described in Table 1 may be misleadingly simple and need further refinement.

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