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Exposing the gender effects of design and technology project work by comparing strategies for presenting and managing pupils' work

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Abstract

Managing project work within design and technology is one of the skills that the teacher brings to the activity. The way that practical project work is presented and managed, so that control is maintained and pupil achievement is enhanced is something each teacher develops. The process adopted may have been devised by the teacher in response to a combination of the twin pressures of covering programmes of study and personal survival but rarely in response to a difference in designing style between boys and girls.

This paper has evolved from research into ways of describing the process of designing. Two possible descriptors are what have been called 'Big pictures and Small steps'. Big pictures designing is future focussed, inspirational, and results in statements of complete ideas. Small steps designing is reflective, sequential, analytical, and descriptive. 'Good' designing is evidenced as a combination of these two styles.

Some pupils may have a preference for one approach which, if it conflicts with the way their teacher manages the project work, may restrict their progress. Raising the awareness of the teacher to the effects that the strategy that they impose on the project work has on the pupils, could be an important factor in increased student success. The study compared two different approaches to the presentation and management of project work. It shows the effects that each approach had on the performance of a group of seventy five 11 year olds, and highlights the different responses of boys and girls to the same design situations. The results indicate that the strategy adopted by the teacher for the sequencing of practical project work had a greater effect on 'good designer' boys, than it did on 'good designer' girls and had a greater negative effect on less able girls than it did on less able boys.

Keywords: design methods, design pedagogy, designing, gender studies

Introduction

This study had two stages:

- 1 Justifying that 'big pictures' designing and 'small steps' designing were identifiable descriptors of students' design work, and capable of indicating the quality of the designing outcomes.
- 2 Using these descriptors to examine pupils' designing it was possible to show the effects that introducing project work with a bias towards 'big pictures' or 'small steps' designing had on pupils' designing outcomes.

Stage 1 - Justifying that big pictures designing and small steps designing were identifiable descriptors of students' design work, and capable of indicating the quality of the designing outcomes.

Descriptors of the activity of designing

Attempts to find ways of understanding the activity of designing have been divided into two threads of investigation.

First the search for the universal 'procedure' which it is thought is derived from a combination of the psychology of creative thinking (Poincaré, 1924) and project management strategies for architects and

engineers (Jones, 1980).

From the similarities between these two approaches as shown in Figure 1 (the first 2 columns show the management procedure the third show the psychology of problem solving process) emerged the theory that there was a universal 'procedure', often confused with method, that could be adopted by both the novice and experienced designer to help them to achieve the successful outcome. The second thread of designing theory was not focussed on 'procedure' as an imposed management structure, but on the way that the individual worked in order to reach the final outcome. It was therefore concerned with mental processes rather than procedures or the metacognitive, self directed process of designing. The examination of procedural ideas in the light of this personal process lead to the procedures becoming more and more flexible until all that could be said was that there were kinds of activity which took place within the designing but they could

take place at any time. What was important was the iterative 'to-ing and fro-ing' of the individuals designing and the decisions which take place in the course of this designing. Study of designing at this level focusses around the analysis of the protocol of the individual designer, and then attempts are made to find structures and strategies which can be used to move the understandings of the work of individuals and their designing forward. (Cross, Christiaans, Dorst, 1996)

The concept of the 'designing toolkit'

Fundamentally this study sits part way between the two approaches of project procedure and the individual's designing process. It recognises that the novice designer may need 'procedural' interventions from the expert (teacher), but that also in order to develop the activity of designing has to progress to operate at a metacognitive level for the 'artistry' (Schön, 1990) of the activity to be developed. It forms a part of a larger work which seeks to develop descriptors of

	Asimow 1962 (Engineering)	RIBA Architects 1965	Psychology of problem solving	Linear Model of Design and Technology (education)
Stage 1	Feasibility finding a set of feasible concepts	1. Inception	Preparation	Identify problem
Stage 2	Preliminary Design Selection and development of the best concept	2. Feasibility 3. Outline proposals 4. Scheme design		Incubation
Stage 3	Detailed design An engineering description of the concept	5. Detail design	Illumination	select and detail
Stage 4	Planning Evaluating and altering the concept to suit the requirements of production distribution, consumption and product retirement	6. Production information 7. Bills of quantities 8. Tender action 9. Project planning 10. Operation on site 11. Completion 12. Feedback	Verification	make solution evaluate
	Columns * reproduced from J.C.Jones (1980)		Column + reproduced from Lawson (1990)	Column - reproduced from Kimbell et al (1991)

Figure 1 Showing versions of the process of designing alongside creative problem solving

'designing style' which can be used as a diagnostic toolkit for novice designers at all levels to help them to manage and understand their own designing in a way that helps them develop more effectively.

Big pictures and Small steps as descriptors

The Assessment of Performance in Design and Technology Report (Kimbell, et al, 1991:154) described capability in Design and Technology in terms of 'action', 'reflection', and 'appraisal'.

These two aspects (action and reflection) are linked through the crucial quality of appraisal...in an iterative process, 'to-ing and fro-ing' between thought and action.

These were not procedural activities but descriptors of the process. The capability of the subjects were assessed by the focus, depth and degree of interplay between these three descriptors, action, reflection and appraisal. In a different attempt to relate pupils' thinking styles to performance in Design and Technology, Atkinson (1995) used a test of Cognitive Style to examine the performance of pupils in their GCSE coursework, utilising a test devised by Riding (1992) The descriptors used in that test were seen along two axes, each subject being placed along the two continua of wholist to analyst and imager to verbaliser. In psychological terms analysts were defined as being field dependent, being affected by the world around them (in their perceptions) and wholists as being the opposite and field independent.

By combining these two concepts, using wholist and analyst to examine pupils' style of designing, new descriptors for 'designing styles' were proposed. The description of a 'wholist', being someone who saw and designed things as whole and complete objects, and an 'analyst' as someone who saw and designed as a series of stages was used by Lawler (1996) to examine students' designing. The terms did provide useful ways of describing students designing. An investigation by Lawler, Kimbell, Davidoff, Roberson (1999) to examine the terms used in describing designing and perception has shown that there were similarities in the use

of the terms, but that they were not about the same things; (a person who tested as a wholist in their perception did not design exclusively as a wholist but could be both wholist and analyst in both their perceptions and designings). From the confusions caused by calling what are different things by the same names I have chosen to call wholistic designing 'big pictures' designing, and analytical designing 'small steps' designing.

Developing the terms used in Lawler (1996) 'Big pictures designing' projects into the future, shows complete ideas, focusses on what might be, takes risks, synthesises ideas, is playful, spontaneous, imaginative and intuitive. It does not work through ideas systematically nor 'tell the story' of the designing deliberately. The end results will often be new and creative answers to the problem, but may not be practical. Big pictures designing was typified by the student seeing the whole and finished solution in one go. They found it difficult to 'unpack' or develop the single presented idea.

Small steps students designing disassembles tasks and ideas by being diagnostic, calculating and weighing conflicting constraints and being systematic but does not take risks and is not predictive. The small steps designer enjoyed recording the progress of the designing. Previous studies showed the results were often redesigns of existing solutions, the work was more likely to be completed and the result was likely to be practical and successful. Small steps designing was typified by the student seeing the task as a series of stages, where the dissection and evaluation of the components of the task or solution were most evident.

Diagrammatically big pictures designing could be described as a leap of imagination and small steps designing as small contained analytical activities. (Figure 2)

The progress of an individual's designing can be described diagrammatically as a series of hoops and bubbles showing a combination of 'big pictures' and 'small steps' designing. (Figure 3)

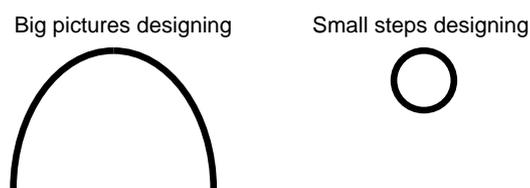


Figure 2 Designing styles expressed diagrammatically

As with the level of capability interpreted by the report of the Assessment of Performance in design and technology (Kimbell, Stables, Wheeler, Wosniac, Kelly, 1991) the interplay between big pictures and small steps designing was an indicator of the level of design capability. To test this notion, a small team of the original assessors was given the big pictures and small steps criteria, which was then used to reassess some of the original student scripts. A high level of reliability was achieved between the big pictures and small steps scores and the original capability levels. Students who displayed a fluency in moving between big pictures and small steps designing were producing high quality designing. Whilst not the same things as action and reflection they showed up as similar indicators of quality.

Stage 2 - Using these descriptors to examine pupils' designing it was possible to show the effects that introducing project work with a bias towards 'big pictures' or 'small steps' designing had on pupils' designing outcomes, and to examine this with reference to gender.

Methodology

Choosing the population

Groups of pupils were chosen to be sufficiently far into the schooling system as to

be able to express themselves on paper but before any procedural methodology had been imposed on them by their teachers. Pupils in the final year of their primary schooling were therefore chosen. All of the pupils in one school (year 6) were tested, 75 pupils in all.

The format of the tests

The tests themselves were very similar in concept to those reported in the Assessment of Performance in Design and Technology project (Kimbell, et al, 1991) . They consisted of two contextualised designing activities, conducted one at a time with small groups of pupils. The tests took the form of prompted activities with a certain amount of time given for each activity to be recorded on the test sheet. Each of the tests had a contextualising activity, followed by the designing activity. Each test took 75 minutes. The two tests were structured so that the procedures had a bias either towards 'big pictures' or 'small steps' designing, particularly in the introductory phases.

The procedural structure of the two tests is summarised by Figure 4.

The pupils took both tests in the same week on two consecutive days, in small, mixed sex groups of up to 20 pupils at a time.

Assessing the results

Using the criteria outlined above, the amount of 'big pictures and small steps' designing was recorded for the two tests for each pupil. The amount of 'big pictures' and 'small steps' designing was quantified on a 4-part scale for each test. Each pupil ending up with four scores, two for the first test which was introduced via 'big pictures designing' and two

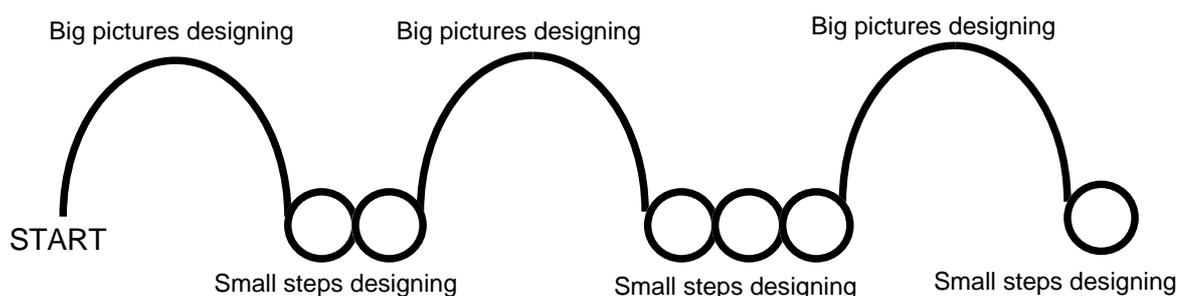


Figure 3 A typical design project expressed diagrammatically

for the second test introduced via 'small steps designing'

The results were then recorded diagrammatically as shown in Figure 5.

The results were then classified using the following criteria, each pupil being put into one of these categories:

Type A - Bias towards test 1 (big pictures

designing) a pupil showing higher scores on test 1 than test 2 in both big pictures and small steps designing

Type B - Bias towards test 2 (small steps designing bias) a pupil showing higher scores in test 2 in both big pictures and small steps designing

Type C - Highly influenced by the test bias showing high big pictures designing in test 1

Test 1 introduced via 'big pictures' activity	Test 2 introduced via 'small steps' activity
Subject- Design of a water toy	Subject- Design of a Packed Lunch container
Contextualisation -video on children and play.	Contextualisation- Examination and written comments on the contents of 2 packed lunches
Response boxes in order	Response boxes in order
1 Jot down first thoughts	1 Investigation activity of 2 different lunch boxes
2 Put down design ideas	2 Put down important points for the design of lunch boxes
3 Describe what you are setting out to achieve	3 Put down design ideas
4 List the things the design must do to be successful	4 Develop design ideas
5 Continue with designing	5 Comment on work to date (red pen)
6 Comment on work to date (red pen)	6 Put down what would you do next and why
6 Put down what you would do next and why	7 Comments on the test
7 Plan the stages to produce a finished item	
8 Comments on the test	

Figure 4 The structure of the tests

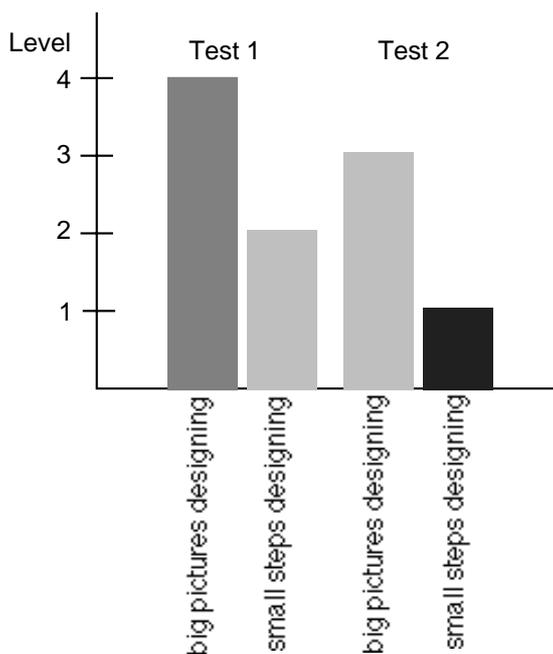


Figure 5 The results of both tests for an individual pupil

and high small steps score in test 2.

Type D - Not affected by test bias, showing the same scores for big pictures and small steps designing in both tests. (as shown in Figure 6)

Results

(See Figure 7)

Interpretation of results

- 1 A large proportion of the boys (47%) achieved better scores when the project work procedure was introduced through 'big pictures designing' whereas a large proportion of girls (45.5%) achieved better results when project work was introduced through small steps designing. The converse of this is true in both cases (17.5 & 18%).
- 2 The proportion of girls and boys who were able to follow the bias of the tests or who

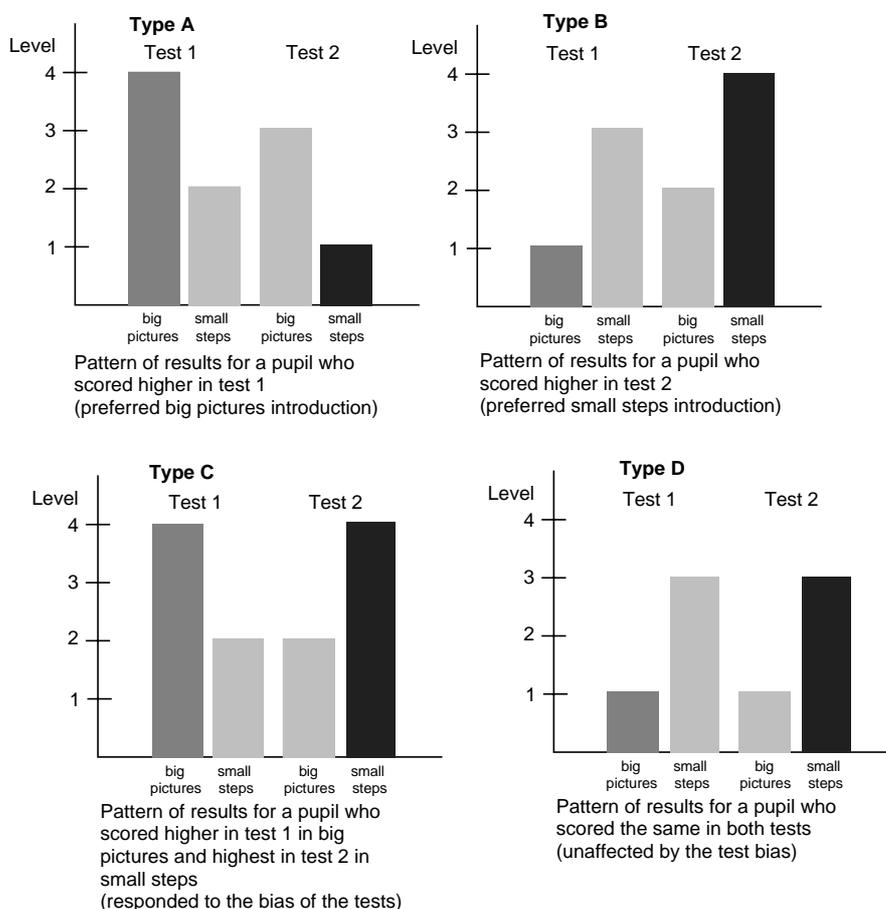


Figure 6 Showing results classification criteria

		Boys						Girls									
		Level	4	3	2	1	total	%age	Level	4	3	2	1	total	%age		
Type A	scored higher with big pictures approach		7	9	3		19	47.5	Type A	scored higher with big pictures approach		2	4		6	18	
Type B	scored higher with small steps approach		2	3	2		7	17.5	Type B	scored higher with small steps approach		4	8	3	15	45.5	
Type C	responded to the bias of the tests				4		4	10	Type C	responded to the bias of the tests			2	6	8	24.5	
Type D	unaffected by the test bias			3	6	1	10	25	Type D	unaffected by the test bias			3		1	4	12

Figure 7 Results sorted by classification criteria

were unaffected by the tests and produced the same in both is almost directly reversed, girls were more able to respond to the bias of the test (29%) and boys were unaffected by the tests (25%).

- 3 A greater proportion of high scoring boys did better with a big pictures designing approach (76%) than small steps designing approach. Whereas high scoring girls were spread more evenly between the two approaches, 66% of high scoring girls favoured a small steps approach and 33% favoured a small steps approach.
- 4 In terms of low scoring pupils, more boys were in the low scoring band (40%) and, of these, 37% were unaffected by the tests and 25% followed the test bias, for the girls 29% of girls were in the low scoring band, and of them most followed the bias of the tests (60%).

Conclusions

Boys achieved better results when the project work procedure was introduced via ‘big pictures’ designing, and ideas generation, whereas girls achieved better results when the project work procedures were focussed around ‘small steps’ designing.

Boys were less versatile in their designing, being less able to respond to the analytical bias

of test 2 whereas more girls seemed able to be big pictures designers in test 1 and small steps designers in test 2

Low scoring boys were more likely to produce the same results whatever the test bias whereas low scoring girls either followed the test bias or performed best on the small steps biased test.

Discussion

These findings are not a result of students having had imposed a design procedure by their teachers but represent the pupils preferred ways of working at age 11. At present it would seem that the ‘preferred’ designing procedure adopted by most teachers of design technology in UK schools, and favoured by examining boards matches most closely with what I have called ‘small steps designing’, which I suggest at age 11 favours girls. Girls are more flexible to the way that the project work is introduced whereas boys are more influenced by the imposed design procedure. At the low scoring level girls tended to be compliant to the way that the work was managed whereas boys were more likely to be unaffected by it, and low scoring boys made up a greater proportion of the whole male population of the sample.

This survey was concerned with one school and therefore the findings that come out of it

must be regarded with some caution. The following insights are of worth:

- 1 Big pictures and small steps designing are useful descriptors of students' designing in that they can provide feedback to the teacher as to the success of their project procedures plus feedback to pupils and students as to their metacognitive designing styles.
- 2 Present approaches to the management of coursework could be seen to be possibly disadvantaging pupils, and teachers and examiners should be encouraged to scrutinise their procedures in a different light. As stated in the introduction, the way the teacher manages pupil achievement and maintains control and the way that examiners assess the level of pupils' work, may have been devised without the consideration that the individuals in the group may have different designing styles. The pupils' performance may be inadvertently affected by the approach adopted to the project work and its assessment.
- 3 It is possible to show that, at age 11 years, pupils have already established preferred ways of designing, which is in fact their conceptual starting point on entry to their secondary schooling. A system which took account of and built from this point ought to be more effective educationally than one that assumes a blank slate and proceeds to impose a structure which may confuse a number of the pupils and thus affect their success in the subject area.

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