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Approaches to designing at key stage 4

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Approaches to designing at key stage 4

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Abstract

It is intended that this paper will report on the preliminary findings of an investigation concerned with the approaches to designing adopted by boys and girls in year 11 (age 16). The study involved fifty pupils and their teachers whilst they were engaged in major project work, undertaken as part of a GCSE Technology examination. The research is focused on eight case study schools and forms part of an on-going programme initially involving fifty schools selected from seven Local Education Authorities in the North East of England. (IDATER93 and IDATER94)

The sample was chosen utilising two data-gathering instruments. Firstly, a questionnaire that asked pupils to give their perception of: their enjoyment of designing and making; their personal ability to design and make. Secondly, a computer-presented, self-administered Cognitive Styles Analysis (CSA) test designed to assess two fundamental cognitive style dimensions: verbal-imagery and wholist-analytic. A case study approach based on observation was then used to chart the sample's (n = 50; 36 boys and 14 girls) progress in designing and making during the course of their major projects.

The paper will consider the similarities and differences between the genders in the initial sample (n=112) using the data collected from the questionnaire and the CSA test. Gender tolerance of the delivery programmes utilised by each school and the two main strategies that were adopted by teachers to enable pupils to meet deadlines and address the Examination Board's assessment criteria will be discussed. The different influences that these strategies may have had upon the boys' and girls' motivation, their approach to designing and the outcomes that were produced for assessment will also be examined.

Introduction

This paper reports the preliminary findings of an investigation concerned with the approaches to designing adopted by year 11 pupils. The study involved fifty pupils and their teachers who were engaged in major project work that was part of a General Certificate of Secondary Education (GCSE) Technology examination. This research is part of a wider on-going programme concerned with identifying some of the causes for a lack of motivation noted amongst pupils in years 10 and 11 whilst they follow courses in design and technology ^{1,2}.

Design and technology in schools involves a complex integration of processes, concepts, knowledge and skills ³. As the subject area has developed so has the use of the design process as a method of delivering and examining subject content (for example: ^{4,5,6}).

The latest revision of National Curriculum (NC) Design and Technology has retained support for the activity of designing and making even though there have been changes in emphasis regarding content throughout the revision procedure ⁷.

Design processes used in schools have developed out of the linear design models used in the early 1960's ⁶. As teachers have become more experienced in working with them and as the subtlety of the process has become more apparent, so the models have become increasingly complex. By the end of the 1980's many models of the process had been developed ⁸. It was acknowledged that some models became so complex that they were confusing to those who used them ⁶. In 1986 the Department for Education and Science (DES) suggested that what was needed was a loose framework to guide designing rather than a well defined process

model which they saw as a “straitjacket”. This approach supported by Lawson⁹ stressed that designing required flexible procedures. He pointed out that when designing for different situations similarities did exist although it was most important to be aware of the essential differences too.

In addition to the approach taken to designing, research has shown that many other factors affect a pupil's performance and learning during design and technology project work^{10,11,12}. APU⁶ suggested that the factors could be divided into two types: those attributes that a pupil brought with them: their gender; general ability; curriculum experience - and the attributes of the task itself: its context; its structure. Whilst Curry,¹³ referring to learning styles in general, organised the factors into three main types which he likened to layers of an onion. He suggested that learning behaviour was controlled by the central personality dimension, translated through the middle information processing dimensions and then, “...given a final twist by interaction with environmental factors encountered in the other strata”¹³.

In the context of design and technology the complex relationship between key factors such as a pupil's knowledge base, level of communication skills, conceptual skills, creative ability, cognitive style, goal orientation and such external forces as culture, context, parental and teacher expectations cannot be underestimated. Nor can the effect of attitude upon motivation be ignored. However, to identify which attitude has caused demotivation and then determine whether it is internal or external, stable or fluctuating and whether it can be controlled or is uncontrollable is a difficult task¹⁴. To add further to this complex picture there are also the intricate gender differences which recent research has highlighted (for example:^{6,15}). For this research study ‘gender’ has been taken to indicate biological gender. This is in contrast to behavioural or learning gender style where gender is seen as a continuum rather than as a binary divide¹⁶.

In an achievement context such as school, pupils show either helpless or mastery

patterns of behaviour when confronted by difficult tasks^{15,17}. These patterns of behaviour are not necessarily related to levels of intelligence¹⁴. Learned helplessness¹⁸ does not only effect the less intelligent. Research would have us believe¹⁷ that in a school situation there is a tendency for girls to acquire helpless orientation when they are faced with the possibility of failure. Boys tend to attribute their failures to external causes whilst girls blame their own inadequacies. Dweck and Leggett¹⁹ suggest that in a challenging achievement situation mastery orientated pupils pursue the “learning goal” of improving their ability whereas helpless pupils pursue the “performance goal” of proving their ability.

The assessment of pupil performance forms the backbone of GCSE project work. Educational philosophers would have us believe that the assessment used to judge pupils' work should not dictate the curriculum content²⁰, rather it should be designed to develop capability and test competence^{21,22,23}. However, the importance of the examination results to pupils and teachers alike dictate that the nature of assessment and its criteria influence what is learnt and how it is taught^{24,25}. Additionally, the need for accountability has led assessment to become overly objective²⁶. As far as examination syllabuses have been concerned, this has led to the use of a prescriptive design process with a very specific list of criteria to be met. Layton⁸ aptly suggested that if teachers were not careful the process could impose “a procrustean regime” on the way pupils designed. Pupils have become ‘outcome driven’, with the process becoming a series of products. To obtain good examination grades pupils have had to provide evidence that each stage of the specified process has been addressed, irrespective of whether it was appropriate to the design of their particular product or not.

Against this background this phase of the research has sought to investigate further the factors affecting pupil motivation towards project engagement and completion that had been identified in earlier sections of this on-going research project.

Methodology - The Sample

For this study a new sample of pupils was selected from eight case study schools used in previous stages of the project ^{1,2}. The sample was chosen according to: pupil perception regarding their enjoyment of designing and making; pupil perception of their personal ability in designing and making; each pupil's predominant cognitive style.

Cognitive (or learning) style has been shown to be intimately related to people's ideas and attitudes ^{27,28,29}. It has been defined as "... an individual's characteristic and consistent manner of processing and organising what he sees and thinks about" ³⁰. The perception and evaluation of information are integral to the act of designing. It was considered appropriate, therefore, to utilise the relationship between enjoyment of designing, capability to design and predominant cognitive style in order to choose the sample.

The selection of the sample was made using two data-gathering instruments. These were administered at the end of year 10. Pupils in a mixed ability technology class at each school were asked to fill in a questionnaire (n = 124) during one session and complete a Cognitive Styles Analysis (CSA) Test (n = 115) on a second occasion. Pupil absenteeism gave a final sample size of 112, all of whom had participated in both tests.

The questionnaire assessed the pupil's enjoyment of designing and making and the pupil's perception of their overall ability when using design processes. Specific questions regarding the pupil's conceptual and modelling skill levels whilst designing were also included. The computer-presented, self-administered CSA test designed by Riding in 1991, was used to assess two fundamental cognitive style dimensions: wholist-analytic and verbal-imagery ²⁸. The wholist-analytic style he explained was concerned with whether an individual tended to process information in wholes or parts, and the verbal-imagery style with whether an individual was inclined to represent information during thinking verbally or in images.

The result from the CSA test showed that there was little difference in the proportion of

verbalisers to imagers in the total sample. However, it was interesting to note a gender difference in that there was a ten percent swing towards imagers in the sample of girls and a five percent swing towards verbalisers in the sample of boys. (see Table 1)

PERCENTAGE OF VERBALISERS & IMAGERS IN TOTAL SAMPLE			
Cognitive Style	Boys Percentage	Girls Percentages	Totals
Imagers	47% (40)	56% (15)	49% (55)
Verbalisers	53% (45)	44% (12)	51% (57)
Totals	100% (85)	100% (27)	100% (112)
<i>Table 1</i>			<i>n = 112</i>

When the wholist-analytic dimension was added to the equation the results were not as clear cut. There continued to be no significant difference in gender between wholist and analytic verbalisers, although, a gender difference between wholist and analytic imagers was noted. Sixty-seven percent of girls and only forty-five percent of boys were found to be analytic. (see Table 2)

COGNITIVE STYLE DIMENSIONS SAMPLE SPLIT BY GENDER				
	Verbaliser		Imager	
	Boy	Girl	Boy	Girl
Analytic	56% (25)	58% (07)	45% (18)	67% (10)
Wholist	44% (20)	42% (05)	55% (22)	33% (05)
Totals	53% (45)	44% (12)	47% (40)	56% (15)
<i>Table 2</i>				<i>n = 112</i>

The results from the pupil questionnaire at the end of year 10 showed that at that time there was no statistically significant gender difference regarding pupils perceived ability or their enjoyment of designing. Although, a significant large number of the total sample believed that they were poor at designing and did not enjoy the activity. Fifty-one percent of the boys and thirty-seven percent of girls were found to be in this category. (see Table 3)

When the data from the CSA test and the data from the question concerning pupils enjoyment of the process were combined, little gender difference was identified between

PUPILS PERCEIVED ENJOYMENT AND CAPABILITY TO ACHIEVE GOOD RESULTS		
	Boys Percentages	Girls Percentages
Enjoyed and achieved	22% (19)	26% (7)
Enjoyed but couldn't achieve	14% (12)	15% (4)
Didn't enjoy but achieved	13% (11)	22% (6)
Didn't enjoy and couldn't achieve	51% (43)	37% (10)
Totals	100% (85)	100% (27)
Individual Column Chi Square	668.750	18.750
<i>P</i> - Value	< .0001	< .0006
Total Chi Square, <i>P</i> - value	2.078, <i>p</i> = .5564	
<i>Table 3</i>		<i>n</i> = 112

verbalisers and imagers. However, when the 'perceived capability' factor was added to the analysis some differences were detected. A significantly large number of boy imagers believed that they were incapable of achieving good results whilst designing ($\chi^2 = 50.00$, *df*

PERCEIVED DESIGN ABILITY					
	Verbalisers		Imagers		Totals
	Boys	Girls	Boys	Girls	
Can	23	5	15	6	49 44%
Cannot	22	7	25	9	63 56%
Totals	45	12	40	15	112 100%
Chi Square	.500	2.000	50.000	4.500	98.000
<i>p</i> - Value	.9590	.3146	<.0001	.0678	<.0001
Table 4 <i>n</i> = 112					

= 1, $p < .0001$). Girl imagers and both girl and boy verbalisers were evenly split with approximately half of each sample suggesting that they could design successfully and half believing that they could not. (see Table 4) The combination of questionnaire results and cognitive style dimensions allowed a matrix of eight possible pupil types to be plotted. However, whilst not all pupil types were evident in each school the proportion of boys to girls in the selected sample remained similar to that of the overall sample.(see Table 5 for details.)

Methodology - The study

A case study approach was used to monitor the chosen sample ($n = 50$). Pupil progress throughout the designing and making of a GCSE examination project during year 11 was tracked on a fortnightly basis. Notes, sketches and diagrams were made on observation sheets during each visit. These sheets recorded the following aspects of the project work: the progress made by each pupil between the visits; the research, design and manufacturing methods utilised; the style of communication and modelling used throughout the project; all difficulties encountered, both those referred to by the pupil and those observed during the visit. Copies of all teacher handouts concerned with major projects were also collected. During the visits informal interviews were conducted with both the teachers and the pupils.

TABLE SHOWING COGNITIVE STYLE OF FINAL SAMPLE									
	Imagers				Verbalisers				Categories
School Code	A	B	C	D	E	F	G	H	
007- <i>I</i>	-	<i>Abo</i>	<i>Agx</i>	<i>Abo</i>	<i>Abx</i>	<i>Wgx</i>	<i>Abx</i>	<i>Wgo</i>	A = Imagers who enjoy designing and believe can design B = Imagers who enjoy designing but believe cannot design C = Imagers who prefer making but believe can design D = Imagers who prefer making and believe cannot design E = Verbalisers who enjoy designing and believe can design F = Verbalisers who enjoy designing but believe cannot design G = Verbalisers who prefer making but believe can design H = Verbalisers who prefer making and believe cannot design W = Wholist A = Analyst <i>I</i> = Interventionist <i>C</i> = Collaborative <i>x</i> = Complete project <i>o</i> = Unfinished project <i>b</i> = Boy <i>g</i> = Girl
021- <i>I</i>	<i>Wbx</i>	-	<i>Abo</i>	<i>Wbo</i>	<i>Agx</i>	<i>Wgo</i>	<i>Wgo</i>	-	
031- <i>C</i>	-	-	<i>Wbx</i>	<i>Wbo</i>	<i>Abx</i>	<i>Wbo</i>	<i>Abx</i>	<i>Wbo</i>	
032- <i>C</i>	<i>Wgx</i>	-	<i>Abx</i>	<i>Wbo</i>	-	<i>Abx</i>	<i>Abx</i>	<i>Abo</i>	
035- <i>I</i>	-	<i>Wbo</i>	<i>Abo</i>	<i>Ago</i>	-	<i>Abo</i>	<i>Wgx</i>	<i>Ago</i>	
036- <i>C</i>	<i>Wgx</i>	<i>Abx</i>	-	<i>Abo</i>	-	<i>Wbx</i>	<i>Abx</i>	<i>Ago</i>	
047- <i>I</i>	<i>Wbo</i>	<i>Abx</i>	<i>Wbo</i>	<i>Wbo</i>	<i>Abx</i>	-	<i>Abx</i>	<i>Abo</i>	
049- <i>I</i>	<i>Agx</i>	-	<i>Abx</i>	<i>Abo</i>	<i>Abo</i>	-	<i>Agx</i>	<i>Wbo</i>	
Table 5 <i>n</i> = 50									

Delivery programmes

Delivery programmes were devised by each technology team to enable pupils to cover all the GCSE syllabus requirements. These took into account resources, staff specialisms, time tabling restrictions, and whether Information Technology was to be examined as part of a GCSE examination, or assessed only to meet NC requirements. The programmes were also designed to give parity of time to units of work carried out by different teaching groups.

The delivery programmes adopted fell into three categories. Type one ($n = 2$), devoted all of the technology lessons every week to completing one aspect of the syllabus before moving on to the next unit of work. Type two ($n = 3$), split the technology time each week equally between Core and Extension work. Type three ($n = 3$), integrated the Core and Extension work, devoting the majority of time in year 11 to a single project.

The total number of hours of timetabled time allocated to the major project varied only slightly from school to school, all schools having followed closely the examination boards recommendations. However, the actual amount of time used for major project work varied greatly from pupil to pupil. The differences could be accounted for by the amount of 'extra' time pupils were willing to spend on their projects both at home and in school.

Project deadlines were managed differently in each school. Some schools displayed all the necessary completion dates at the beginning of the academic year, whilst in others project deadlines were not referred to until hand-in dates were imminent. Evidence from the study would suggest that these differences, when combined with the teaching strategies adopted by the schools, did have an effect upon the pupil's ability to manage their project work.

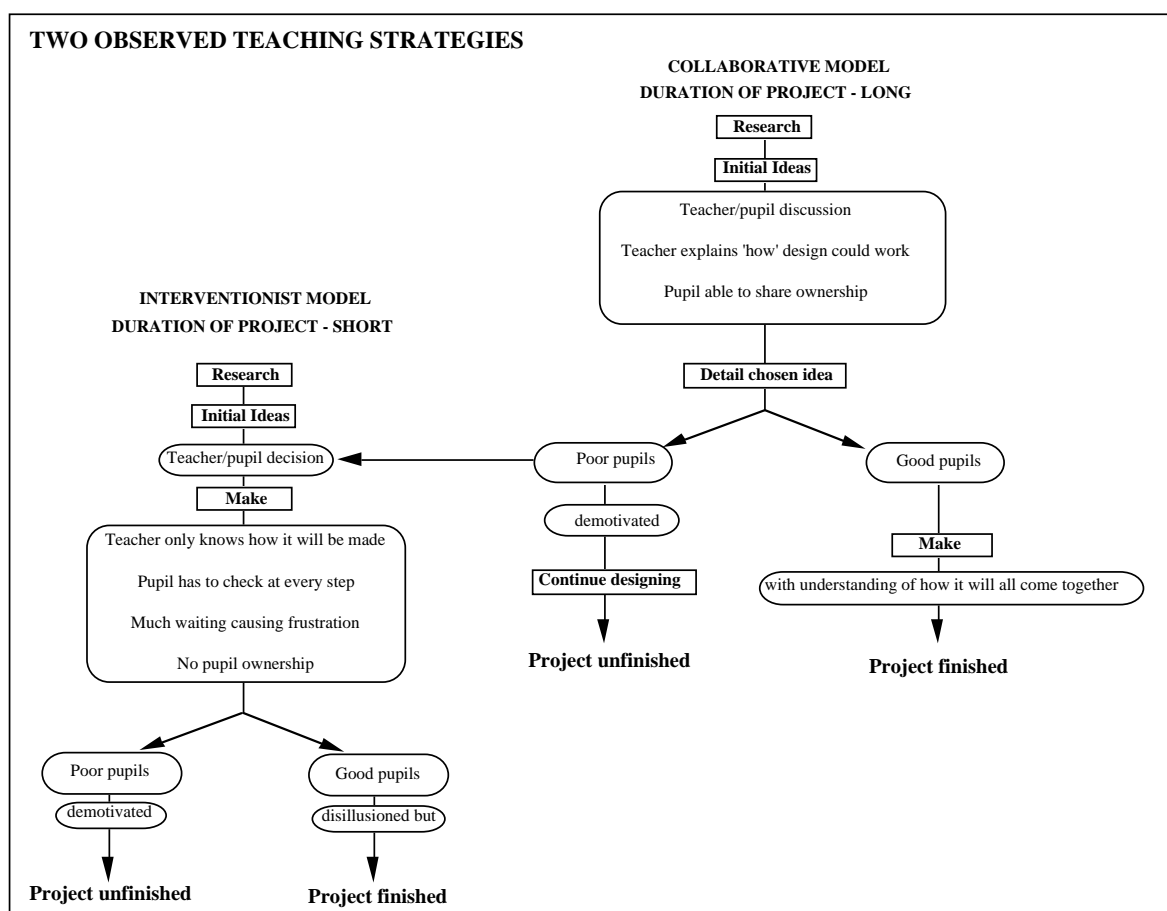
Approaches to designing adopted in relation to the observed teaching strategies

Through observation of approaches to designing adopted by the pupils it was apparent that teachers utilised one of two

strategies to enable their pupils to meet deadlines and address the Examination Board's assessment criteria. Analysis of the two approaches suggested that in one the teacher tended to act as a collaborator, whilst in the other a more interventionist mode of teaching was adopted. (see Diagram 1.) The 'collaborative' model was found only in schools where the delivery programme supported an extended time allocation for the major project, whilst the 'interventionist' model was generally observed in schools where the major project was completed over a relatively short period of time.

No matter which teaching strategy was adopted the start of the projects followed a similar pattern. Examination Boards suggested contexts and pupils identified their own opportunity or need to address. This gave the pupils ownership of their projects at this stage of the process. This freedom to choose their own project was identified as an important factor in pupils enjoyment of key stage 4 in earlier phases of the research ^{1,2}. Teachers then discussed examination criteria, and work was begun on briefs, specifications, analysis of the chosen brief and research. Observation of the sample indicated that girls enjoyed this aspect of the project more than the boys which would support the APU findings of 1991 ⁶. The girls tended to feel safe working within the reflective, evaluative research and analysis phase whilst the majority of the boys were looking forward, past the design activity, to the manufacturing period ahead.

At the initial ideas stage of the project all schools encouraged pupils to formulate several ideas to meet the requirements of the brief. The amount of time allocated to this aspect of the work varied considerably depending upon which delivery programme had been adopted by the school. In some schools early ideas were a series of hurried sketches whilst in others a number of sheets were presented with re-worked drawings and carefully prepared written notes. Very few boys and even fewer girls were concerned at this stage with the intricacies of how their ideas could be made to work, or constructional details of how they could be made.



Once initial ideas had been drawn, the next observed stage was for the pupil to choose which idea to develop. This was normally carried out with the teacher's assistance. Through a combination of observation and discussion five separate factors were identified that influenced the advice teacher's gave to the pupils: the teacher's personal technological capabilities; their understanding of how each different idea could or could not be manufactured given the school resources; the amount of time available; the teacher's knowledge of the pupil's manufacturing capability; the teacher's personal vision of what they believed was represented on the pupils design sheet.

Interventionist Model

It was at this point in the process that the important differences between the two teacher strategies became evident. In the 'interventionist' approach, where speed was crucial, pupils tended to move very quickly from initial ideas to the manufacturing stage. Very few pupils produced carefully detailed drawings: development of the chosen idea was carried out as manufacturing took place. Ill

defined, but often in the context of the pupils existing technological or constructional understanding, adventurous ideas meant that pupils were working in areas which were beyond their technological capability. It was at this point that these pupils lost ownership of their idea. Decisions were made in a piecemeal, interventionist, manner by the teacher. This resulted in pupils having to rely heavily upon the teacher during the manufacturing stage of the process. Often, even capable pupils were unable to take the next step on their own due to the nature of the design process adopted. Teachers became overburdened and frustrated by pupils needing their help.

It was also during this stage that a difference was noted between the reaction of boys and girls to the 'interventionist' model. Girls tended to cope with the lack of ownership of their idea. They did not expect to understand how to tackle the constructional or technical facets of their project. They expected to be shown how to turn their ideas into reality. The more able girls saw the project as a learning experience or, were able to accept it as a necessary part of their GCSE examination in which they

wished to do well. In order to make the necessary progress they tended to make use of extra sessions through out the manufacturing stage of the project. This they saw as an opportunity to obtain more individual attention from their teacher.

The less motivated girls, on the other hand, became disillusioned by their lack of progress, rarely taking advantage of the extra sessions provided. During lesson times they tended to turn their attention to their design folder in order to try to meet the examination criteria as best they could.

pupils failed to finish their projects by the given deadline. This applied to sixty-seven percent of the boys and sixty-four percent of the girls.(see Table 6) In some schools no extra time was given to complete the deficient aspects of the project, whilst in others pupils were given the opportunity to continue working on them in their own time. Out of this group those who were motivated continued with their projects, although as a number of pupils said "...only because it is for the examination".

TABLE SHOWING PERCENTAGE OF COMPLETED PROJECTS BY GENDER				
	Interventionist Model		Collaborative Model	
	Boys	Girls	Boys	Girls
Complete	33% (7)	36% (4)	60% (9)	67% (2)
Unfinished	67% (14)	64% (7)	40% (6)	33% (1)
Total	100% (21)	100% (11)	100% (15)	100% (3)
<i>Table 6</i>			<i>n = 50</i>	

In contrast all boys tended to become frustrated with their inability to make progress. The less able boys seemed to become resigned to the situation, making less and less effort as time slipped by. The majority of the more able boys became very impatient. They found it difficult to cope with their lack of control when they were unable to solve manufacturing or technical problems for themselves. One boy expressed the feelings of many when he said "I am sick of waiting for my turn; I just don't know what to do next". Those who were highly motivated did make progress by attending extra sessions when, like the girls, the teacher could give them more individual attention. Others turned to their peers to see how they had completed tasks. Some simplified their ideas until they no longer became a challenge or a learning experience. Many made and re-made pieces of their project, altering their designs to fit their mistakes.

In schools adopting the 'interventionist' model a disappointingly large number of

Collaborative Model

In schools where teachers exhibited what has been defined as the 'collaborative' model, a pupil's lack of time management skills were not seen as a problem in the early stages of the project. Time could be given to individual pupil-teacher discussions. Both boys and girls benefited from this situation. Sketches were often used by the teacher when un-clear communication of pupil ideas needed exploring. Detailing of the chosen idea became a collaborative effort between pupil and teacher, with pupils still feeling that they had ownership of their idea. With the help of their teacher they produced carefully detailed drawings which they used in order to make their products.

The majority of those who succeeded in reaching the manufacturing stage of their project were able to complete their work in time for assessment. In the case of the boys, this they achieved with minimum intervention from the teacher. Those pupils who lacked

the expertise to realise their products were able to make the necessary progress in collaboration with their teacher. However, when the initial deadline for completion of the projects arrived there were still thirty-nine percent of the sample who failed to finish. For these pupils the problems associated with this model came about through boredom. From a fairly early stage many pupils, particularly the boys and the less able girls, saw the design process stretching interminably ahead of them. The need for interim goals in long term projects³¹ was not addressed. The manufacturing stage which they looked forward to seemed an impossible target to reach. This caused a noticeable slowing down of work rates that only exacerbated the situation. Deadlines came and went.

For some of these pupils, usually those who were disruptive, the teacher moved from the 'collaborative' to 'interventionist' model believing that once involved in making the pupil's interest would be rekindled. However, as has already been pointed out, the 'interventionist' model was rarely successful at the manufacturing stage of the process, with the teacher's availability at each step being essential for the maintenance of the pupil's progress. With large class sizes, and the teachers understandable wish to help the motivated pupils, this was usually impossible, causing these pupils to become even more frustrated.

Outcomes

In the context of this research 'outcomes' have been classified as either, the product or the GCSE result. With regard to the product, a disappointingly small number of well designed, well made products were completed by the total sample. ($\chi^2 = 800.00$, $df = 1$, $p < .0001$). No pupil working with a teacher who had adopted an 'interventionist' approach to designing was found to be in this category. Analysis of the data showed that only thirty-eight percent of those pupils in schools where a 'collaborative' approach had been adopted managed to complete their projects by the initial deadline, and only thirty-four percent of pupils in 'interventionist' schools (see Table 5).

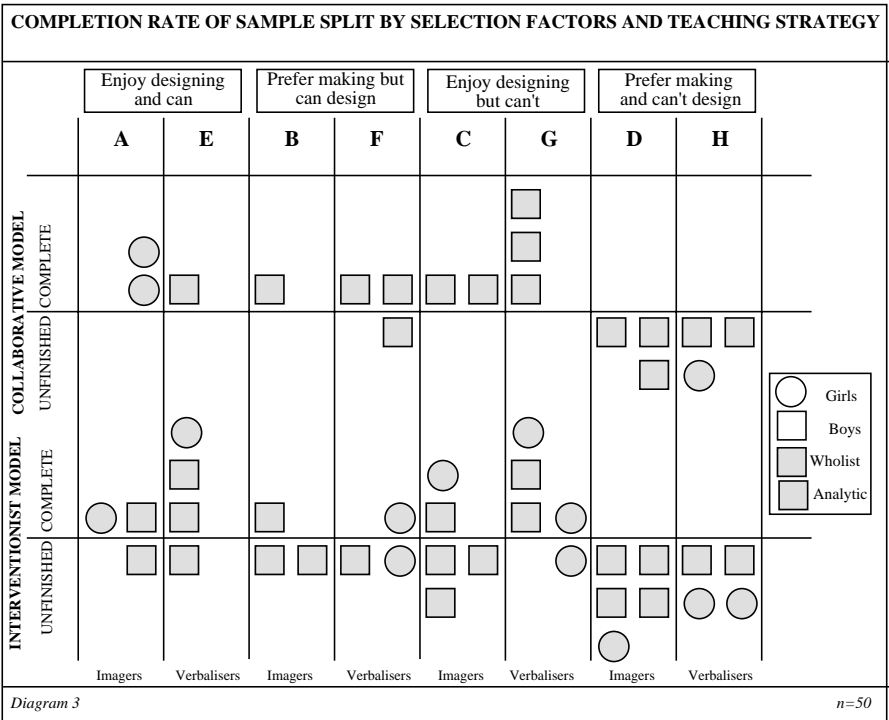
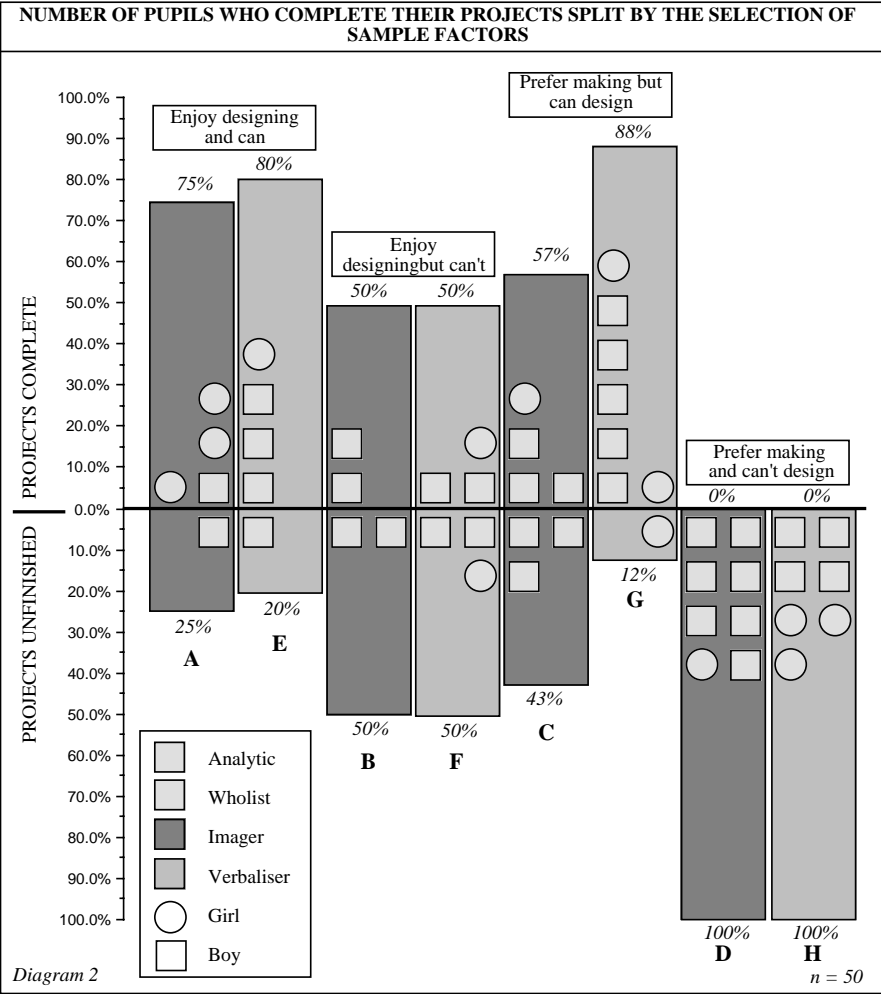
When the result of completion or non-

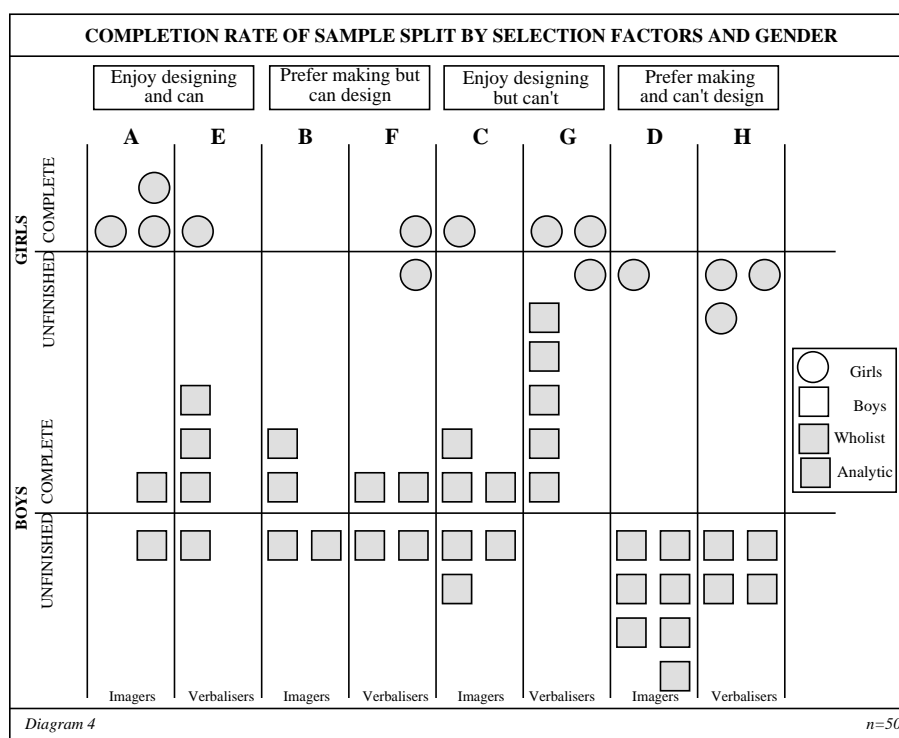
completion of projects was correlated with the data referred to in Table 5, interesting clusters were observed (see Diagram 2). Those pupils who believed that they could design had more chance of completing the whole project than those who believed they could not design. Many of those who enjoyed designing more than making but believed that they had poor design ability were also unable to meet the project deadline.

When the same data was analysed using cognitive style as a starting point, a high proportion of analytic-verbalisers were found within the group of pupils who believed that they could design, whether they enjoyed designing or preferred making. Verbalisers were found to have an equal, and in several instances, better completion rate than imagers. Whilst it was also noted that one hundred percent of those who preferred making and believed they could not design failed to complete their projects, whether they were, verbalisers or imagers. When the data in question was analysed using collaborative-interventionist groupings, some interesting clusters were observed (see Diagram 3). Once Groups D and H were removed from the equation (these scores skewed the results because of the 100% failure to complete rate of both these groups) analysis showed that ninety-two percent of the remaining pupils in schools that had adopted a 'collaborative' approach to designing and only fifty-six percent of pupils in schools that had adopted an 'interventionist' approach finished their projects by the initial deadline.

When the data was looked at from a gender perspective the numbers involved were too small for statistical analysis although some interesting differences can be seen in Diagram 4. Further statistical analysis of gender differences will need to wait until that data concerning completion of the projects has been collected from the original sample of 112 pupils.

As far as design folders from the total sample were concerned very few were completed without considerable pressure having been applied by the teachers. Motivated girls and boys in all schools were persuaded to re-work or 'pretty-up' existing work and fill gaps in





their design process. The limited time spent on the folder work in the 'interventionist' model meant that the folders, of even those who believed that they could design, presented little evidence of designerly thought at the various stages of the process. In an attempt to present the required evidence for assessment, pupils were encouraged to complete written sections describing their decision making procedures. This was often carried out retrospectively when pupils were pulling their design folders together.

The design work of those working in schools where a 'collaborative' approach had been adopted displayed two different levels of success within the folders. Those who enjoyed the act of designing produced visually excellent folders which contained creative thinking but also a considerable amount of re-worked and over-worked sheets. Those who did not enjoy designing produced numerous sheets of work attempting to satisfy the examination criteria but showing little evidence of designerly thought.

Sadly, when interviewed on completion of their projects, the great majority of the total sample were confused and dissatisfied with the design process they had used in their examination, seeing little point in the paper

work they had had to produce.

The majority of girls and boys who reached the manufacturing stage, produced products which displayed a lack of craftsmanship or fitness for purpose. Summative evaluations, although tackled by most of the pupils, were hastily carried out. For those who had only tackled the design work they were often meaningless and only completed in order to gain marks. Even the evaluations of those pupils who had reached the manufacturing stage were often superficial. This was largely due to the un-finished or unsatisfactory nature of the products themselves and the lack of time or thought that was given to this aspect of the work.

As far as evidence to support conclusions regarding the GCSE outcome is concerned, answers to a summative questionnaire elicited a positive response from the pupils. Eighty-six percent of pupils were pleased with the results of their project for the examination ($\chi^2 = 312.500$, $df = 1$, $p < .0001$). However, it should be noted that, neither internal marking nor final examination marks are yet available to support or refute the pupils belief in their own ability to meet the GCSE assessment criteria.

Conclusion

The preliminary findings from the study concerned with the approaches to designing adopted by Year 11 pupils would suggest that the delivery programmes and strategies adopted by a school can have an overriding influence upon a pupil's capability to design and make. Analysis of the three delivery programmes and two strategies adopted by the schools, indicate that neither the 'collaborative' or the 'interventionist' teacher model allow pupils to develop entirely valid approaches to designing. The nature and speed of the process in schools utilising 'interventionist' approaches does not allow for the development and detailing of creative, innovative ideas. On the other hand the slowness of the process, particularly at the design stage, in schools adopting a 'collaborative' model has caused pupils to become overly concerned with the process at the expense of well designed outcomes.

Analysis of the data collected would suggest that gender and pupil type do affect how successfully pupils are able to tackle project work in Year 11. The study has also indicated that the nature of project work at Key Stage 4 has caused many pupils, both boys and girls, to work beyond their technological capability. In an attempt to support all pupils throughout their projects teachers have developed a strategy that has encouraged them to design solutions to pupils problems in their minds, as the need has arisen. The necessity for pupils to have an understanding of the way forward in their projects has been given a low priority. However well intentioned this course of action may be, the evidence from this study would suggest that it has had a de-motivating effect upon many of the boys and some of the girls. The common belief that ownership develops a sense of responsibility, pride, and the motivation to succeed would support the use of strategies that allow pupils, both boys and girls to retain ownership of their idea throughout the project. This, in turn, may help to produce well designed products and examination results of which pupils, parents and teachers can be proud.

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