Towards maximising pupil endeavour:

An enquiry into a learning approach centred on teamwork and simulation in the context of Technology education

by

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Abstract

The enquiry originated from observations of a series of learning events which appeared to generate high levels of pupil endeavour. These events were typified by being residential, employing commercial simulation, teamwork and a suspended timetable which allowed long periods of concentrated work on a design task.

Observations provided the impetus for an enquiry intended to illuminate the learning approach and the origins of this increased endeavour. This enquiry employed a series of case studies with a parallel literature survey.

The pre-enquiry learning events are described and an impression of the factors involved established. The evolving nature of the enquiry is explained. A literature survey is made of the key factors. The methods employed, including their limits and limitations, are described. The case studies are summarised and discussed in relation to the literature survey. Conclusions are drawn and suggestions for further research are made.

The key findings are that the enquiry indicates high levels of endeavour are replicable, given understanding of the factors involved. Pupils' perceptions of the relevance of the events is high. Pupils tend not to adopt a competitive approach on an inter- team basis but do respond to deadlines. Pupils tend to develop cooperative management structures rather than establish leaders which are not seen as relevant. Endeavour is maximised in teams which are selected to be heterogeneous in terms of gender, friendship groupings, subject expertise and ability. Positive synergy is identified in terms of endeavour but not the range and quality of design ideas. Teachers, whilst recognising the value of granting autonomy to teams, find it difficult to release control and intervene only when necessary.

The contributions to knowledge lie in the areas of designing in teams under competitive pressure; pupil team reaction to competition and the response of staff to working in these learning contexts.

Key words: Group, team, simulation, endeavour, concentrated study, cross-curricular working, cooperation, competition.

This is to certify that I am responsible for the work submitted in this thesis, that the original work is my own, except as specified in acknowledgements or footnotes, and that neither the thesis nor the original work contained therein has been submitted to this or any other institution for a higher degree.

H G Denton.

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1.0 Introduction

This section opens with a description of the genesis of the enquiry followed by sub-sections on the structure of the thesis and reflexivity within the work. A pre-enquiry phase is explained including the philosophical position which underpinned it. The way in which the enquiry emerged from this pre-enquiry phase is discussed followed by indications of the developing context of the enquiry in relation to National Curriculum developments.

1.1 Genesis

In 1985 the Department of Design and Technology at Loughborough University was approached by staff of two schools. They were dissatisfied with the way they had used the residential week required by their pilot response to the Technical and Vocational Educational Initiative (TVEI) and asked the Department to design and run a residential course. This was to have relevance to the central TVEI aims which they saw as helping children to operate effectively in the world of work. The commission was open; at that first phase of TVEI development the TVEI unit and the Local Education Authority (LEA) wished to see what emerged.

An event was designed and run. It was evaluated by means of staff observation and a student questionnaire. There was a positive response to the event and high levels of endeavour demonstrated by pupils. Plans were made by the TVEI Unit to repeat and expand from the two school TVEI groups (40 students). Three such events were run over a period of 12 months. All were received positively by pupils, teachers and TVEI observers. The learning approach represented by these events is explained in 1.4.1.

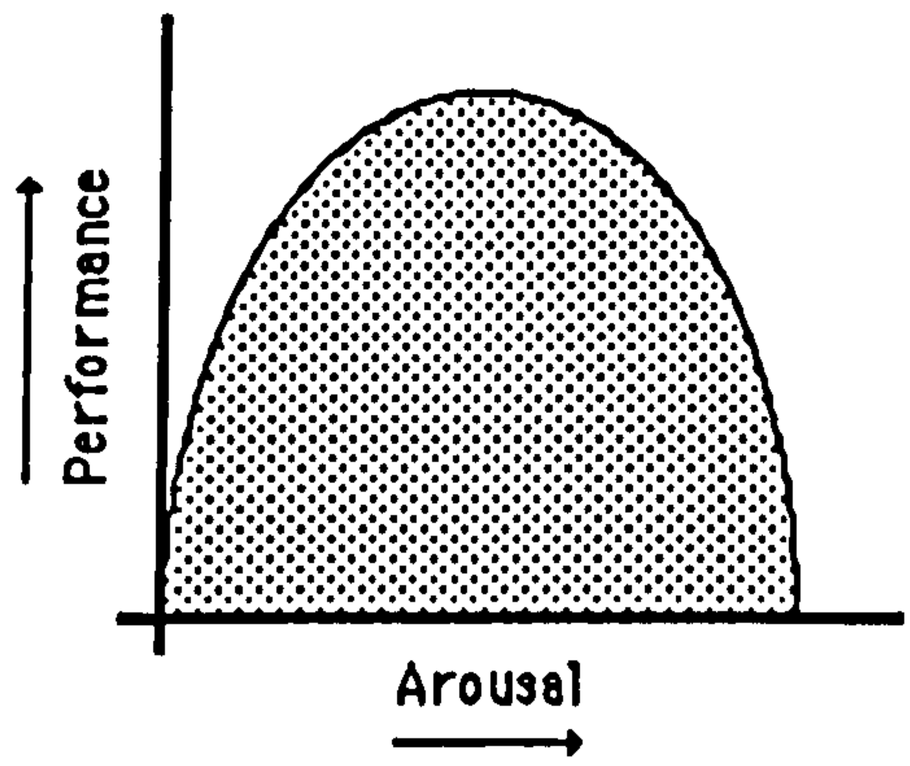
During these events my interest grew beyond a normal professional involvement and an enquiry emerged with the aim of illuminating and understanding the approach represented by the events.

Pupil endeavour became a focus because it was an interesting, under-researched and easily visible performance phenomenon in the events. Teachers accompanying pupils were able to relate their observations of pupil endeavour to levels they would normally expect in their school environments.

Endeavour is a term relating to effort, the exertion put into attainment. It is under-represented in most pupil assessment other than by possible inclusion in records of achievement. Yet endeavour is a useful factor to consider; it represents the ability to sustain a depth of focus over time, to make an effort.

Endeavour is difficult to quantify. In the case studies of this enquiry every study was observed by teachers who normally worked with the pupils and students involved. Their observations did allow a comparative measure. Other workers have recognised the difficulty and have chosen to concentrate on conditions which most support endeavour (Hackman 1983 and Farran 1968 looked at `effort`, a synonymous term).

There is probably a relationship between endeavour and achievement. Rosenshine (1986) proposed a positive relationship between Academic Engaged Time (AET), a similar concept to endeavour, and achievement, though the form of achievement was not revealed. The relationship between arousal and performance also has parallels. This is usually represented by the Yerkes-Dodson hypothesis in which a graph of performance against arousal is typically an inverted `U` as shown below. Initially increased arousal results in increased performance up to an optimal point. After this further arousal causes performance to decrease.



The relationship between arousal and performance

The Yerkes-Dodson Hypothesis was based on work in 1908 on rats in mazes. Subsequent work has been done on humans in laboratory conditions but Yerkes-Dodson remains difficult to apply in field conditions due to

interpretations of arousal and performance. Nevertheless the hypothesis is widely accepted on a practitioner level with texts such as Childs (1973) and Wright and Taylor (1974) using anecdotal evidence to support it in a learning situation.

1.2 The structure of this thesis

Section 1.0 is an overview. The nature of the pre-enquiry phase is explained. This provided data allowing tentative categories for study to be identified and a programme of fieldwork and a literature survey to be developed.

Sections 2.0 and 3.0 are literature surveys of the two main categories: group/teamwork and simulation.

Methodology is considered in 4.0. Data collection and analysis are explained.

The case study accounts have been gathered into appendices 1 to 5. Section 5.0 is a summary of these case studies.

The fieldwork is juxtaposed with the literature and discussed in section 6.0. Categories generated are interpreted in relationship to the data and literature.

Conclusions are offered in section 7.0 and future areas of enquiry highlighted in section 8.0

1.3 Reflexivity and the written style adopted

This study lies within an illuminative paradigm with the author as researcher/teacher and methodology which generated primarily qualitative data. Several workers (Gilbourne 1987; Parlett and Hamilton 1983; Stoate 1988; Sangar 1985; Humberstone 1986) have advocated the use of the first person when writing up such research. This is intended to underline the subjective nature of much of the data.

The use of the first person also underlines the reflexivity of the exercise. In this case I was directly involved in developing many of the learning contexts described. This need not invalidate the enquiry as care was taken to ensure

triangulation of data collection by different observers together with triangulation by method, time, and space. However, a scholarly detachment was necessary in interpretation. Having said this workers using a hypothetico/deductive paradigm, generating 'hard' data are vulnerable to bias in interpretation (Freeman 1986). Humberstone (1986) pointed out that even the knowledge of and acceptance of theory prior to a research process might constitute preconceived ideas.

1.4 The pre-enquiry phase - the early work

These events and their development constitute a pre-enquiry phase. They were not seen as research at that time but as teaching and an opportunity to develop some of my ideas. They were evaluated appropriately but no detailed records were kept. Because of this the section lacks rigour but establishes the context.

1.4.1 Pen picture of the pre-enquiry events

In these events teachers acted in an observational and pastoral role, not contributing to the running of the event itself. The general objectives were based upon what were seen as features of the evolving TVEI philosophy of that time (1985). The events were intended to give pupils experience of:

working in teams

project and time management

commercial environments, using simulation; particularly:

- costings in relation to a product
- working to deadlines
- competing in the marketplace

The events also fulfilled TVEI requirements for a residential experience.

The rationale behind these events, the timescale and staffing, did not allow for a closely focussed assessment of individual pupil achievement. The intention was for pupils to learn by direct experience discussed in debriefings at the end of each day. Staff observations were used to support self-analysis by pupils.

These events were each of five days duration and residential. Activity was based in the Department of Design and Technology. Teams of four were selected

by staff on the basis that members were not peer groups and there was a mix of gender, ability and subject expertise.

Each event offered teams a task: a response to a design opportunity such as the production of prototype meals and packaging for inter-city motorway coaches. Teams operated within a simulated commercial environment; each was a `company`, developing the product and launching it on the market at a trade exhibition. The product had to be designed and developed, including costings. A simplified business plan had to be established, point of sale advertising developed and a sales display set up. A deadline was given, usually the last morning.

Demonstrations (`inputs`), were given at specific times, but could be attended by only one member from each team. This member was responsible for gathering information which had to be communicated to the team. Teams could work at any time. Sports passes were issued and teams or individuals could have recreation when they wished and for as long as they wished.

Each morning a central briefing was held at 09.00. This was used to remind teams of the key events of the day, raise observations on performance and make general teaching points. Time was taken to reinforce the simulation by reminding teams of the conditions and competition. At 17.00 a debriefing was held which encouraged pupils to evaluate the experience up to that time. Work could continue after this.

On the final morning the `trade displays` were finalised and a simulated `market place` held. Teams took the role of buyers, having a purchasing power of £1000. This had to be spent using criteria that the buyers felt were important. After orders were placed pupils completed a course evaluation questionnaire.

The financial position for each company was worked out on the basis of orders placed and a hierarchy of performance was established. Staff from the University evaluated the work and prepared feedback in the form of a written criticism and grades on the design work. Assessment focussed on the performance of the team rather than the individual. This was done both to emphasise the team focussed nature of the task and because of the limited time available for individual assessment.

A final debrief was held where the `results` were given and points drawn between the financial and academic sets. These debriefs opened a great many points for discussion.

The events were evaluated by triangulating observations from the University staff and the teachers with feedback from pupil questionnaires. These events were stand-alone, schools did not prepare for them or follow up in any formal way.

1.4.2 The philosophical position underpining this pre-enquiry phase

This was a response to an opportunity. I had ideas I wished to put into practice based on my own experience as a teacher, but these ideas took me beyond what I had been able to do in schools. I was learning as I went forward.

1.4.3 Limitations of traditional curricular approaches

Having recently joined the University from schools I was acutely aware of certain limitations I felt I had identified in most conventional school systems:

a. Most timetables were made up of short `periods`. Experience of working only within such timetables may actually limit pupil ability to manage work over longer time spans.

b. The subject-based curriculum in most secondary practice appeared to have limitations. Experience teaching Design and Technology showed that pupils had difficulty transferring knowledge and competence from areas of the curriculum such as mathematics or science, into Design and Technology.

c. Fieldwork carried out for my M.Phil (Denton 1984) indicated that teamwork in a Design and Technology context appeared to generate a higher level of endeavour and enthusiasm. However, group or teamwork appeared to be used less in schools as external examinations approached. This was unfortunate as the majority of people are called upon to work in some form of group or team in adult life. There appeared to be little recognition of the need

for group/teamskills by most teachers and there was no coherent planning given to developing them.

Similarly, at that time, there was little evidence of commercial contexts being incorporated into the majority of Design and Technology work. TVEI was in its first phase and in a limited number of schools; commercial awareness was still largely limited to pupil placements such as `work experience`. Personal experience indicated that simulated commercial contexts and teamwork in Design and Technology were able to raise levels of endeavour.

1.4.4 Design and Technology in a cross-curricular context

As a teacher of Design and Technology I felt comfortable establishing the pre-enquiry events around a design opportunity. However I wished the experience to be broader; to bring together knowledge and competencies from other areas of the curriculum. My thinking was that by experiencing an event which called for knowledge and competencies from a range of subjects pupils would be better able to do so in other situations (see transfer 3.6).

1.4.5 Commercial simulation

Experience told me that pupils would be better motivated if they had an integrating context which seemed `real`. This was built by using a brief couched in commercial terms and by `painting the picture` in briefings. This process of building the simulation was continual during the events.

A part of the simulation was the possibility of pupils experiencing `success` or `failure`. This was an important and potentially difficult area. Some popular educational thinking at the time stressed the need to avoid competition in order to minimise the possibility of negative feedback due to failure. The reasons for this are recognised but such thinking has limitations. If we were able to isolate pupils from failure in schools and then release them into the adult world would we not be responsible for the consequences when they faced the effects of competition? If competition was introduced in a planned manner, considering development and individual capability, then staff could observe and support pupils as necessary.

The fact that the events were residential was not intentional but it did add to the ability to build a simulation. Pupils nominally worked industrial hours (with flexibility) without the disruption of a conventional timetable. By being away from school and normal classroom environments there were fewer stimuli suggesting `school`. By being away from home it was possible to build their focus into the evenings. These factors enabled the simulation to be built and experienced by pupils to a far greater depth than would be possible in a normal school environment.

1.4.6 Time management

Teams were given responsibility to manage their own time. This was a significant challenge as none of the pupils had experienced working in this manner (post course questionnaires).

Timeplanning was given a hidden supporting structure by arranging `inputs` in such a way as to encourage regular team meetings to share information. Teams felt they had freedom to manage their time, but in effect were supported by the structure of the event.

Support also came in briefings and debriefings held at the start and finish of each day. These were primarily a forum to discuss work done. They were also used to stress the need for timeplanning and point out problems as they arose rather than waiting to the end of the week, which would lose immediacy and risk `failure`.

Staff could support as `adaptive interventionists` (Roebuck 1978), mainly observing team activity and helping only when necessary. This was possible because the event was structured so that necessary resources and skills were made available to the teams through the inputs. The activity became self supporting, giving staff time to stand back and observe.

1.4.7 Teamwork

Teamwork was a central feature of the events. Individuals within teams cooperated on a common task, delegating when appropriate, whilst competing against other teams within the simulated commercial context. The experience

each member gained was not identical due both to delegation and the fact that `inputs` were only open to one member of each team. This was acceptable as experience of the team task management process was more important than learning specific knowledge and skills.

The delegation of work placed responsibility on members. It was hoped that as members recognised their responsibilities they would contribute fully and recognise the importance of their contribution to the whole. If staff saw an individual or team failing to such a degree that it jeopardised the team result it would be possible to intervene to assist the individual and/or team on course.

By using teams it was possible to tackle more substantial tasks. This offered potential for a task which challenged and was seen as relevant in adult life.

1.5 The foci developed from the pre-enquiry phase

The methodology used to gather data in the early events did allow a progressive focussing on what were perceived to be the structural elements instrumental to success, including:

Teamwork as a specific form of groupwork.
Simulation of a commercial environment.
Time management of the task by teams.
The suspension of the timetable to allow concentrated work.
The task being seen as of relevance by pupils.
Residential, rather than school based activity.
Staff effects.

The literature was helpful but could not illuminate the interaction of these factors (and any I had not identified).

1.6 A study emerges

The enquiry emerged progressively as I recognised the opportunity for research and sorted my own motives and priorities. I wished to maintain a broad perspective because I could not be sure whether the elements listed above were complete and I could not be sure of any interactive effects. I was a solitary worker investigating what appeared to be complex phenomena. The

resources available meant that I could not commission fieldwork, I was limited to opportunities that arose or that I could generate.

These limitations were not insuperable and whilst they restricted what was achievable, there were positive opportunities for an enquiry. A broad perspective was maintained through a series of case studies, though there was an element of action research in that each case study updated the approach used in the next. As the enquiry emerged reading at depth began in parallel with case study work.

A problem was knowing when to stop and present findings in the form of a thesis. Glaser and Strauss (1967) suggested a point of `theoretical saturation` is reached when no further information is generated from further samples. This may be the case when phenomena are tightly defined but in this enquiry the unique nature of each case study was constantly developing new directions. Nevertheless, the central elements became well triangulated from the case studies. This thesis, therefore, represents a point when experience and understanding were pulled together. It has some contribution to make to understanding. Developments in education, particularly in the field of Technology make the work both timely and relevant.

1.7 Developments - fieldwork in the enquiry

Articles published (Denton 1986, a, b) on the basis of the pre-enquiry phase generated some interest. Over a period of three years five case studies were conducted on learning events commissioned by schools and LEAs. Accounts are to be found in appendices 1 - 5. These are summarised in 5.0.

The case studies began with a short event (account 1), using a year 12 `A` level Design group in a school. This employed a simulation lasting 90 minutes which had originated in an Open University course (T263, unit 2) and had been developed into a design task within a commercial simulation by Flood (not published). This is described in appendix 1.

Case study 2 generated data on work with year 7 pupils and within the normal timetable. The study ran over 9 weeks, at 90 minutes per week within a Design and Technology lesson.

Case study 3 followed another publication (Denton 1987). I was contacted by the Head of Corporate Identity for Nestlé (UK). He had taken an interest in the work and asked if such an approach could be developed in schools local to the Nestlé headquarters in cooperation with the LEA and Nestlé. This work took a different form and was valuable in that it allowed exploration of new areas. The Nestlé link allowed direct work with groups of teachers from six schools via an in-service course (INSET). These teachers returned to schools where they generated and ran their own interpretations. A central feedback session was held four months later where presentations were given on the work done. There was discussion of each case by teachers, LEA advisers who had observed the work in schools, Nestlé managers and myself as designer of the INSET. The account is effectively one of six case studies based on teachers reports of their work and notes from the discussion.

The Nestlé link allowed a considerable expansion of data. It was possible to observe:
how teachers took the approach described above and interpreted it in their own schools.
which of the elements they held to be important;
the problems of implementation in a school setting;
how pupils reacted and the levels of endeavour observed.

Teacher interpretation and implementation in a school environment was further illuminated by an opportunity to assist a school within a TVEI Joint Support Activity (JSA) (account 4). Here INSET was given to a group of teachers. This covered the philosophy of the general approach and examples of the work done. This developed into the process of planning an event in the school. Planning was completed by the teachers and an event run over five days and evaluated by the teachers and JSA staff. Two teachers were interviewed, the notes taken constitute an account.

The final case study (account 5) is a closer focus on a residential event, a development from the series of events of pre-enquiry work.

At this point a diagrammatical summary is useful in understanding the range of the fieldwork:

A summary of case studies

Case Study	Age	Number in sample	Timetable or dedicated	Residential or in school	Time	Evaluation method
1	17 yrs	9	timetable	school	2 hours	teacher and researcher observation plus Nominal Group Technique
2	12 yrs	19	timetable	school	10 weeks at 90 mins per week	teacher and researcher observation, Nominal Group Technique and open questionnaire
3 a	12 yrs	25	dedicated	school	1 day	teacher observation and report
3b	15 yrs	50	timetable	school	8 weeks at 35 mins	teacher observation and report
3c	14 yrs	100	timetable and 1 day dedicated	school timetable plus 1 day	4 weeks in	teacher observations and report
3d	13 yrs	100	pilot in TT + 1 day dedicated	school	4 weeks in timetable plus 1 day	teacher observations and report
3e	17 yrs	50+	dedicated	school	2 days	teacher observations and report
3f	12 yrs	100	dedicated	school	2 days	teacher observations and report
4	15 yrs	60	primed in timetable + 5 days dedicated	school	5 days	teacher observations researcher interview
5	17 yrs	80	dedicated	residential	5 days	teacher and researcher observation, observations from visiting researchers, teamwork profiles, Nominal Group Technique

1.8 The context of the enquiry

The start point of this enquiry preceded the National Curriculum and particularly the work leading to the publication of the Statutory Order *Technology in the National Curriculum* (March 1990). The way in which the

debate evolved and this Statutory Order emerged is interesting but not central to this enquiry. The terminology and philosophy behind the first statutory instrument in Design and Technology education are relevant because it is against this that the conclusions of this enquiry must be projected.

The approach under enquiry was a response to an aspect of TVEI. The teachers concerned in that first contact were Craft, Design and Technology (CDT) specialists. The approach centred on the act of designing and making in a simulated commercial context. The events were seen as complementing the curriculum but not contributing directly to examination courses.

Technology, within the National Curriculum contains two profile components: Design and Technological capability and Information Technology capability. 'Capability' is used to emphasise performance; the active approach intended. The use of the single word Technology in the title is expedient but could also confuse. Technology is an active term in that it refers to the application of scientific principles. It can be seen as a process, but it refers to a body of scientific knowledge.

Design is a term which describes a process of planning and establishing the form of an object, system or environment. It can be argued that it is possible to design without applying scientific bodies of knowledge. Yet it is impossible to employ a technological process without designing. In this argument it is Design which is the more logical term for the activities which are called for by *Technology in the National Curriculum.* Scientific knowledge is not always demanded, though an argument could be made that all knowledge is a science.

There is virtual agreement that this country needs effective design in manufacturing industry if goods are to be sold and wealth created (Wray 1990, Rothwell et al 1983). The technological nature of much of our industrial output has meant that it is the term technology rather than design which has gained the political high ground.

The inclusion of Information Technology within Technology was again expedient. This could have been located in other areas of the curriculum or more properly been separated to prevent assumptions as to 'ownership'. Nevertheless the juxtaposition of Design and Technological capability and

Information Technology capability probably made it expedient to use the cover term Technology.

It became appropriate to adopt the new terminology in the discussion of this enquiry. Many of the activities conducted within case studies would not have been defined as technology prior to the Statutory Order but are now subsumed. Analysis of the Orders identifies many of the aspects central to the approach under enquiry. Group and teamwork are identified as is simulation, a process led approach and a move away from simplistic `problem solving` towards the recognition that much design work is the response to identified opportunities. The need for a commercial context for much Design and Technology work is also established.

Within this thesis when referring to National Curriculum Technology a capital will be used to differentiate from everyday use of the term.
The learning approach described in 1.4.1 and the subsequent case studies covers a broad range of factors. Each case study was unique and yet there is a common thread of the use of group/teamwork and the simulation of industrial/commercial contexts. Because of this the term `the approach` acts as a loose descriptor of that covered in 1.4.1. `Event`, when used on its own, is a term used to cover a specific learning event as described in each account. Events varied from ninety minutes to five days.

National Curriculum terminology is used to define age ranges. Year 7 is chronologically age 12, with year 11 the final year of compulsory education. When referring to children in the compulsory years the term pupil is used, when post compulsory (years 12 and 13) they are referred to as students.

2.0 Group/teamwork: a survey of the literature.

The aim of this section is to explore the nature of group and teamwork. Terminology is discussed and working definitions produced. Potential benefits and limitations are considered. Some developments in teamwork in industrial contexts are identified together with models of group and teamwork from the literature. Group and teamwork are then examined in relation to teaching and learning.

2.1 Terminology

Cowie and Rudduck (1989) observed no shared understanding amongst teachers of the nature or use of group work in the curriculum. There appeared also to be no agreed terminology. Advocates use terms such as groupwork, teamwork, collaborative groups, cooperative groups and autonomous groups. From industrial contexts there are problem solving teams, special purpose teams, self-managing teams, autonomous work groups. Many use these terms without defining them and some interchange terms without clarification. It is necessary to establish a terminology to act as a reference point from which to discuss the literature and fieldwork.

2.1.1 **Group** is a generic term for any situation where two or more work together. This could be could be passively, sharing resources, or actively, with cooperation or collaboration.

Cooperative and collaborative groupwork are differentiated in this enquiry by reference to The Oxford English Dictionary (OED)(2nd ed):

To collaborate - to work in conjunction with another or others to cooperate especially in literary, or artistic production or the like.

To cooperate- the action of working together towards the same end, purpose or effect, joint operation.

The distinction is clouded by the use of `to cooperate` within the OED definition of `collaborate`. In many respects the terms are interchangeable, however in this work they will be applied as follows.

2.1.2 **Collaborative** is a general term and could apply to many situations where ideas are discussed. Individuals working collaboratively may be working together, as a group. The work they produce will be separate but of an identical nature.

2.1.3 **Cooperative** is taken to be more specific, meaning that ideas and expertise will be shared, there is a joint task. The distinction is that of the common goal - `the same end` (OED). Individuals working cooperatively would have a common goal to which each contributes, possibly after a period of separate, delegated work.

Within the fieldwork of this enquiry all groupwork tended to be of the cooperative type and so the term `group` or `groupwork` is used for brevity.

2.1.4 **Team work** means members may, at various times, be delegated individual tasks and work independently, meeting to feedback and coordinate a common task. Teamwork involves little replication. In collaborative groupwork communication will be largely explanation and discussion. In team and cooperative groupwork communication will also involve reporting back. Teamwork involves competition at an inter-team level. Groups, whilst they may have informal, internal competition do not compete externally without becoming teams. It is possible to switch from group to teamwork and back during a project, under teacher direction or informally.

2.1.5 If work is structured in such a way that success depends on each member contributing, then it is termed interdependent. If the work encourages cooperation but does not require interdependence for completion it is non-interdependent. In the fieldwork whilst there was delegation, making work interdependent, if an individual avoided work it was possible for other members to pick up that work and complete it, making it non-interdependent. If a significant proportion of the team were to avoid work a point would be reached when the remainder could not carry the extra load or would not wish to and the task would fail.

2.2 The potential benefits of group/teamwork

Teachers committed to groupwork saw benefits in five areas (Cowie and Rudduck 1988 p 55):

a. Skill and confidence in communicating.
b. Depth of learning and understanding.
c. Skill and confidence in social interaction and collaboration.
d. Personal development.
e. Life chances.

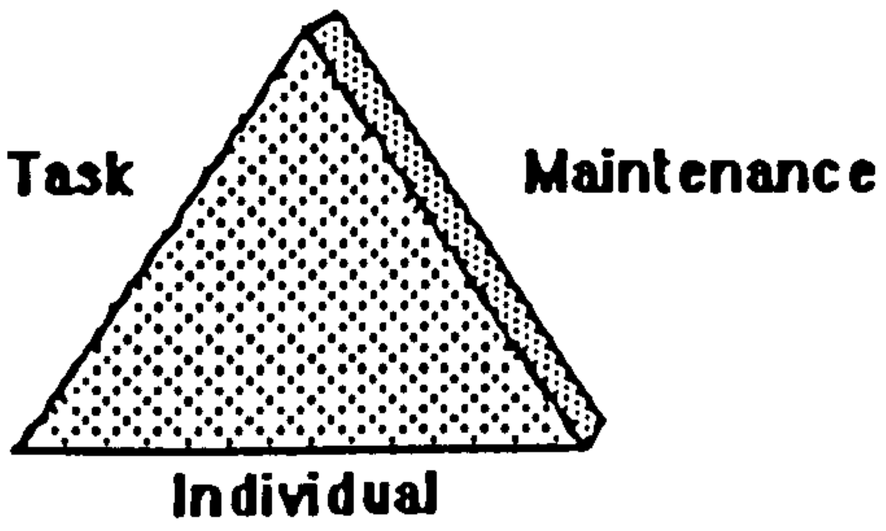
Whilst these are perceptions rather than established truths they are based on professional experience. Three categories are identifiable: social benefits, vocational benefits and learning benefits.

2.2.1 Social Benefits

Groupwork is a recognised method of identifying and resolving problems of varying nature in most areas of living. .....Properly devised and organized it presents a forum for mutual support, learning, problem solving and behaviour modification. (Barker 1990 p23).

Barker`s observations go beyond social benefits but aspects of support and behaviour modification are clear.

Campbell and Ryder (1989) referred to the TIM triangle model (Task, the Individual, Maintenance) of how groups behave.



This model sees the task, the individual and maintenance as interlocking. The task will be perceived differently by group members, but a form of consensus will emerge. This will lead to clarification of the task and sub-tasks. Similarly individuals differ as to what they hope to gain from the exercise and how they respond to the group. Maintenance is about the process of making the group work. This area includes relationships between members and the task.

The three areas are in a constant state of dynamic equilibrium. Any movement in one area must cause adjustment elsewhere. Inadequate maintenance may cause the task to be ineffectively managed and could effect personal relationships. The group needs to work at being a group. If an individual is not exposed to the problems and possibilities of working in a group then they are unlikely to grasp the subtle interplays of task, individual and maintenance roles.

Groupwork has been used to assist ethnic integration. Miller and Davidson-Podgorney (1987) looked at enforced integration in American schools, finding that mixed groupwork could help develop empathy. In a school context there may be improved identification between learner and school and mutual concern between group members. Cowie and Rudduck (1988) also noted these effects in the case of gender and class.

Hampden-Turner (1971) recognised benefits in group work for reducing `race prejudice` and stereotyping. A possible mechanism for this effect may be through the enhanced self concept and self esteem which Yeoman (1983) considered the successful handling of groupwork can bring. Hampden-Turner considered individual development was only effective through interaction with others, this would require a reasonable level of self esteem due to the risks involved in interaction, particularly where there may be strong stereotypes associated with culture, race and gender. However, gains are not straightforward, groupwork has to be understood to be applied successfully. The limitations are discussed in 2.7.

Certain social skills and attitudes appear to assist the individual when working in groups. Experience of groupwork may develop these skills and attitudes. HMI (1987), looking at `attitudes` required for working in a group considered that these included: cooperation; responsibility to other members; readiness to

listen to others' points of view; readiness to support the view which seems to carry best hope of a solution; to lead or follow as appropriate; perseverance.

Barlex (1987) listed; cooperation, leadership, empathy/sympathy and reliability. Cowie and Rudduck (1988) considered groupwork requires shared social and procedural rules: reasonableness; orderliness; openness; freedom to take risks with ideas; equality and respect for person. They also observed that often normal experiences in school do not develop or support these 'rules'. It may be a simplistic assumption that exercises which involve group/teamwork will develop them. Nevertheless, at this point it is necessary to go forward with this as a point of faith.

2.2.2 Vocational.

Cowie and Rudduck (1988) felt that there was little consensus as to what industry expects from recruits. However, there is an emerging opinion amongst some industrialists (Peacock 1989) that ability to work effectively in a group/team is important.

One dimension of group/teamwork in industry is competition. Whilst a working group within a company may be largely insulated from the overall competitive nature of the market place there is evidence that groups tend to be more competitive than individuals (McCallum 1985). Intra-team cooperation may coexist with inter-team competition.

Competition makes many teachers fear for the self esteem of lower ability children. There are those who challenge the competitive nature of society and claim many ills develop from it. By introducing the element of competition, in the context of pre-vocational and vocational education, we may help children come to terms with the problems and possibilities it raises. At the same time there is the danger of problems centred on self esteem. This will be discussed further in 7.0.

2.2.3 Learning benefits.

2.2.4 Yeoman (1983), concluded that when children learned in groups the effects were significantly better than individual learning and at the very least no

worse. She observed that for low level cognitive tasks there was a positive effect on learning and that for high level work there again appeared to be a positive gain though this needed further work.

2.2.5 Bennett and Cass (1988) found that when children of different abilities worked in groups the `lower ability` worked better and achieved more if grouped with `higher ability ` children providing they were supported by having another lower ability individual in the group. A single low ability child tended to withdraw. High ability children appeared to achieve just as well when grouped with high or low ability, they were not `held back`. This was also the case if they were the only high ability child in the group.

Bennett and Cass did not define the terms higher or lower ability or make reference to particular skills or abilities. The inference was one of a general academic ability. This work refers to individuals within mixed ability groups. It does not compare individual performance in groups with individuals working alone but juxtaposed with Yeoman`s work the indications are strengthened.

2.2.6 Miller and Davidson-Podgorny (1987) reported research on Team Games Tournaments (TGTs) when teams of four or five pupils of mixed gender, race and ability were given a lead lesson on a given knowledge base. They then spent a week in intra-team cooperation preparing for an inter-team competition. Teams used worksheets, quizzes and discussion to prepare. This work indicated positive gains in knowledge based learning in comparison with individual learning

2.2.7 Farran (1968) observed American 8th grade children in a residential `Advancement` school for under-performing children. These children had a high regard for competitive sport. Individual prestige was related to prowess in sport rather than academic performance.

Farran hypothesized that by making academic work an inter-group competition (teamwork?) regard for such work would rise. Farran saw effort and achievement as contingent on pupil regard for an activity, so by raising regard for intellectual work it was hoped that children would learn more. The link between regard and achievement appeared to be assumed.

In fact Farran found that pupils who competed individually learned more than those in an inter-group competition. This contrasts, to some extent, with the work of Miller and Davidson-Podgorny. Competition was having the expected effect, but why not groupwork? There could be many answers and is probably an interplay of factors. Details of the experiment were limited which makes it difficult to draw conclusions. Possibilities include:

a. Farran only looked at subject content - there were other possible gains.
b. The children were new to the school and may not have established effective groups by the end of the experiment. Establishing groups takes time.
c. The groups may have been peer chosen. Such groups may possess a negative attitude towards academic work. The group dynamics in such a situation may have emphasised this attitude and acted to limit academic efforts.
d. The effort required to coordinate the group may have detracted from the learning itself.

2.2.8 A consistent element in much work on groups and teams is the indication that: *What social scientists are ever loath to concede is that 2 + 2 can make 5 or even more. One of the most obvious experiences of social life is that human beings can mingle their competencies to create a surplus of knowledge, love, confidence and self esteem.* (Hampden - Turner 1971 p 13).

Similarly Peacock (1989) stated that there was evidence that team performance is `infinitely` higher than individual. Salomon and Globerson (1989) considered that groupwork can induce a greater mindfulness as well as helping groups to perform more elaboration, rehearsal, planning, summary and the ---*internalisation of peer provided meta cognitions.* (p89).

Cambell and Ryder (1989 p22) considered one feature of groupwork is: ---self-conscious *reflection on one`s own and the group`s behaviour.* This links with Salomon and Globerson in terms of `mindfulness`.

Harkins (1987) pointed out that when evaluation potential was held constant, pairs outperformed singles. These statements refer to `performance` rather than academic learning. However, we do have the work of Yeoman to establish a positive link with academic learning. The term synergy has been used in reference to performance from team and groupwork.

2.2.9 Synergy

A dictionary definition of synergy refers to the working together of drugs to produce an effect greater than the sum of their parts.

2.2.10 Hackman (1983) stated that synergy refers to group phenomena which emerge from interaction and affect how well a group is able to deal with a situation. This is a neutral statement, allowing synergy to be judged as negative, positive or neutral in terms of performance. Shaw (1971) referred to `group syntality` as the personality of the group, that is any effect the group has as a totality. He saw `effective synergy` as being the total synergy available to the group minus energy required for interpersonal relations. Similarly Hackman listed `group process loss` as being a drop in performance due to time spent communicating and to personality effects within a group. Techniques such as Delphi (Weaver 1971) and Nominal Group Technique (Lomax and McLeman 1984, O`Neil and Jackson 1983) reduce the interaction of members in order to minimise `group process loss` and maximise effective synergy (see also 2.5.5).

2.2.11 Driskell et al (1987), using data from Hill (1982), noted that group performance can be greater than one would expect from the sum of parts. They attributed this to an `assembly bonus effect` in that the pooling of resources tends to minimise errors. This could account for results in exercises such as Hall`s (1971) `Lost on the moon` (as described in Ginifer 1978) where firstly individuals and then groups assess the suitability of equipment for survival. Group scores appear always to improve on the average individual score. Assembly bonus could account for this effect when the task is simply assessing factors. Those who have used `brainstorming` techniques would probably feel that assembly bonus cannot fully explain the improved flow and breadth of ideas in more `creative` tasks. The ideas of others can apparently be used to `leapfrog` to further ideas much as DeBono proposed (1982).

2.2.12 Hampden-Turner (1971) felt that two people can interact synergistically :

It consists of an affective and intellectual synthesis which is more than the sum of the parts, so that each party to the interaction can win a return on investment that is greater than the competence risked. (p55).

Hampden-Turner made an interesting re-interpretation of the classic Hawthorn experiment which was based on a small group of workers. During the experimental period the researchers removed the supervisor who normally oversaw this group. The group became independent. Responsibility grew as did social exchange in the group. This may have caused a synergetic effect on output rather, or in addition to, the normal explanation of workers increasing output because they were being observed.

2.2.13 Industrial experience also indicates that when individuals interact in the work place the result can be improved performance. Many companies are moving away from `scientific management` (Buchanan 1989). This broke processes into parts and produced `line management` and the classic assembly line where tasks were simple, repetitive and frequent. Interaction with others was limited and absenteeism and frequent stoppages were common. Many stoppages were caused deliberately, possibly so that workers could break from work and interact. Production techniques where teams complete a whole assembly, such as a car, are now showing marked improvements in performance and worker attitudes, though there have been difficulties which are discussed in 2.4.6.

2.2.14 It is interesting to note that the National Curriculum Statutory Instrument for Technology (1989) does not mention groupwork within AT2 (generating a design). This may have been a relevant place to enable pupils to compare effectiveness in generating ideas when working in a group or individually.

2.3 The limits and limitations of group/teamwork

2.3.1 Cowie and Rudduck (1988) noted the following characteristics as limitations of groupwork in schools:

a. Reluctance to value contributions from some members.
b. Persistent dominance of groups by individual pupils.
c. Break up of groups, for example 4 to 2+2.
d. Tendency to go in certain directions without looking at alternatives.
e. Some pupils will not join the group, having a personal disposition to groupwork, so making groupwork in the class more difficult.
f. Inequality in accepting responsibility for the group`s work.
g. Acceptance of over-easy agreement in the face of complex issues.
h. Inactivity or lack of interaction when the task fails to engage pupils.

These points illustrate that groupwork does not lead to automatic gains. It is important to analyse why.

2.3.2 Bennett and Cass (1988) pointed out that often children work `in groups` rather than `as groups` (p19): *As such groups are no more than the physical juxtaposition of children engaged in individual tasks.*

Biott (1987) made a similar point; that cooperative groupwork is rare and that `joint groupwork` is the norm within groupwork. The responses above may be to ineffective and ill-understood groupwork.

Buchanan (1989) noted that many teamwork experiments in industry have foundered due to management misunderstanding and fear of loss of control. If teachers react similarly then groupwork is unlikely to be designed and executed in an appropriate manner (Cowie and Rudduck 1988).

2.3.3 Expectation effects are possible. To some teachers rising noise levels mean that children are not learning. Pupils allow social and other expectations to influence their performance in a task. We cannot eliminate these powerful and often subconscious effects but careful explanation of why groupwork is being used, and monitoring by an aware teacher, can minimise negative outcomes and boost the positive.

2.3.4 It may be necessary to use techniques to reduce the effects of dominant personalities on groups. Delphi and Nominal Group Technique can be effective in this respect but social interaction and increased responsibility are important to progress beyond a simple assembly bonus effect towards positive synergy.

2.3.5 Group size needs to be adequate to gain social interaction but not so big that all do not have meaningful tasks. Cowie and Rudduck observed that up to 12 are effective when the task is exchanging ideas but 6 to 8 is the optimum. In a `problem solving task` the most effective size appears to be 3 or 4. Leary and Forsyth (1967) noted that as group size rises responsibility appears to drop. In extreme cases this could be related to examples of riotous crowd behaviour.

2.3.6 The task needs to take cognisance of gender and cultural bias and to encourage delegation which is interdependent. The individual who prefers to work alone should be treated sensitively. Teachers will need to help individuals to recognise the value of experiencing groupwork, it must not be presumed to be self-evident. The National Curriculum subject documents available at the time of writing include experience of groupwork within Science, English and Design and Technology.

2.3.7 There is evidence for negative synergy. Harkins (1987) described `social loafing`. This has been identified in a wide range of group activities from the physical to intellectual. When individuals feel that assessment centres on group performance there is a tendency for some to make less effort. Members must feel their output can be compared with others in the group before their effort increases (this will be discussed further in 2.5.7c).

2.3.8 Salomon and Globerson (1989) used the term `freerider` when a member lets others do the work. This is often evident in lower ability members who may feel they have little to contribute. The attitudes of the other group members would be critical here. The freerider effect is most likely to occur when a task is non-interdependent and the group performance depends on the most able member, though it can happen in interdependent tasks where group progress is at the rate of the slowest member. In an interdependent task it is often the more able who feel held back, less motivated and freeride. Larger groups increase the tendency to freeride (see also Leary and Forsyth (1967) above).

2.3.9 Salomon and Globerson also referred to the `sucker effect` when a hard working member slows down when they feel they are being left to do the work. This, combined with the freerider effect could cause an iterative slow down in the group as a whole. These authors also refer to several other potential group effects:

2.3.10 Sexist roles; when tasks (or sub tasks?) are perceived by members in terms of gender. Children can feel less capable or `out of role` in a situation and leave it to the opposite sex. Typically boys are allowed to dominate aspects such as computer and constructional work.

2.3.11 Thinkist; when one member is seen as superior for a task and others simply act in support. Bennett and Cass (1988) referred to indications that low

ability pupils often accept the decisions of `high` ability students even when they are `obviously` wrong (though would they be `obvious` to lower ability students?). Allison and Messick (1985) have observed that pressures towards conformity in a group can prevent consideration of alternatives and so produce poorer results. There is a tendency for people to accede to group decisions, thinking themselves in the minority.

2.3.12 Ganging up on the task; when the group do not like or value the task and consciously or unconsciously put less effort into it as a whole.

2.3.13 Status differential effects; where the perceived status of some members creates sensitivity. High status pupils gain in social influence and visa versa.

2.3.14 Group ethnocentrism; when a group builds identity to a point that competition rises to the level of dysfunction and conflict (Hackman 1983). Hampden-Turner (1971) reported laboratory experiments where groups were put into competition to limit inter-group synergy. A frequent response was the building of group esprit de corps to the effect that inter and intra-group relations suffered together with creative thinking. Pressures to conform rose. During this process groups developed an over-confidence and also an incapacity to suspend these favourable assumptions. Within groups more formal relationships began to develop into hierarchies with only one goal - to win. The overall effects were dysfunctional.

2.4 Industrial perspectives

2.4.1 It is instructive to examine some examples of group/teamwork in industrial contexts. Hoerr (1989) in a survey of companies where teamwork had been introduced gave examples of productivity rises of 250%. The detail of how these figures are arrived at was not made explicit but similar claims are common.

2.4.2 The production line on which much manufacturing industry is based has been developed from `scientific management` principles. Work is broken down into sections. Hierarchical management structures are the norm. Rewards tend to be defined only by output, usually of the whole unit. This has led to slow production, rigidity of response and poor employee motivation. Absenteeism is common and quality and safety can suffer. Teamwork has been adopted in some

companies to remove these problems and capitalise on group/teamwork potential.

2.4.3 Teamwork takes many forms in industry: problem solving teams consist of 5 - 12 people meeting infrequently to respond to specific situations; special purpose teams often tackle design problems and involve high level decisions; self managing teams could number 5 - 15 and consist of a group responsible for the production of a complete product (Hoerr 1989).

2.4.4 In self managing teams the degree of social contact during the working period may be minimal as workers are, for example, operating individual machines. There are periods when all meet to decide on production strategy. The keys to performance appear to lie in personal responsibility and appropriate use of people and machines.

2.4.5 One of the main reasons for adopting group/teamwork in companies has been the need to be able to respond more quickly and flexibly to change (Peacock 1989). Teamwork appears to offer practices which will meet this need and some examples have produced promising responses in terms of output and employee attitude. The methods employed usually entail `flatter` management structures with a maximum of 4 tiers from the shop floor. Self-managing production teams are used where there is greater flexibility in role and greater responsibility for production. Buchanan (1989) made the following observations on worker responses to teamwork:

1. Extra personal self-confidence.
2. New personal skills brought out.
3. They learned to work closer to people.
4. They became more tolerant.
5. Greater awareness of personal attitudes to others.
6. Confidence in own ability to learn new skills grew.

2.4.6 Not all is positive. Hoerr (1989) and Buchanan (1989) have reported that many failed industrial teamwork experiments were due to management inflexibility and unwillingness to release responsibility. Staff turnover at factories introducing teamwork has tended to go up as those workers unhappy with the system leave.

2.4.7 There are potential lessons for schools. At a pre-vocational level it is relevant to give children experience of teamwork in order to help them with such practices in adult life. The sensitivity needed to make such techniques work is apparent as is the need for thorough understanding, at management level, of both the principles associated with group/teamwork and the difficulties of innovation.

2.4.8 Peacock (1989) as Director of Research and Development for Phillips called for more experience of teamwork in schools and stated that he looked for experience of teamwork in employees at interview. Similarly Bradshaw (1989) reported that employers are increasingly expecting students from higher education to have a grounding in personal skills, communication, problem solving, teamwork and leadership. We can contrast this with the work of Cowie and Rudduck (1988) who observed that employers were selecting school leavers primarily on the basis of academic qualifications even when they were demanding schools give teamwork experience. They further observed that teachers saw society as demanding qualifications. Schools were trying to meet such perceived needs by focussing on academic qualifications and dismissing aspects such as groupwork.

2.5 Models of group and teamwork from the literature

2.5.1 Hackman (1983), described a simple model of groupwork based on:

Input - process - output

A group has inputs at several levels. Hackman listed:

individual level - members` skills, attitudes and personalities
group level - structure, cohesiveness, size
environmental level - the task, rewards, environment and stress levels.

The input conditions are then acted upon by the group process, that is the interaction of members and task. Finally there is a goal or output, individual or shared.

Often organizations focus on the more easily assessed aspects of output. In schools this could be the production of league tables based on examination results. In industry it may be the number of products leaving a factory. But there are other output dimensions if a group/team is to be seen as a longer

term unit. Hackman proposed three: whether the product meets specification; that the social processes should be maintained and enhanced; and that group processes should satisfy members.

2.5.2 Hackman pointed out that much research has focussed on process aspects such as personality or leadership and their influence on output. Much of the research has been done in laboratories or extrapolated from work on therapy groups (T groups). Such work can be valuable, but is not a strong basis for generalizations.

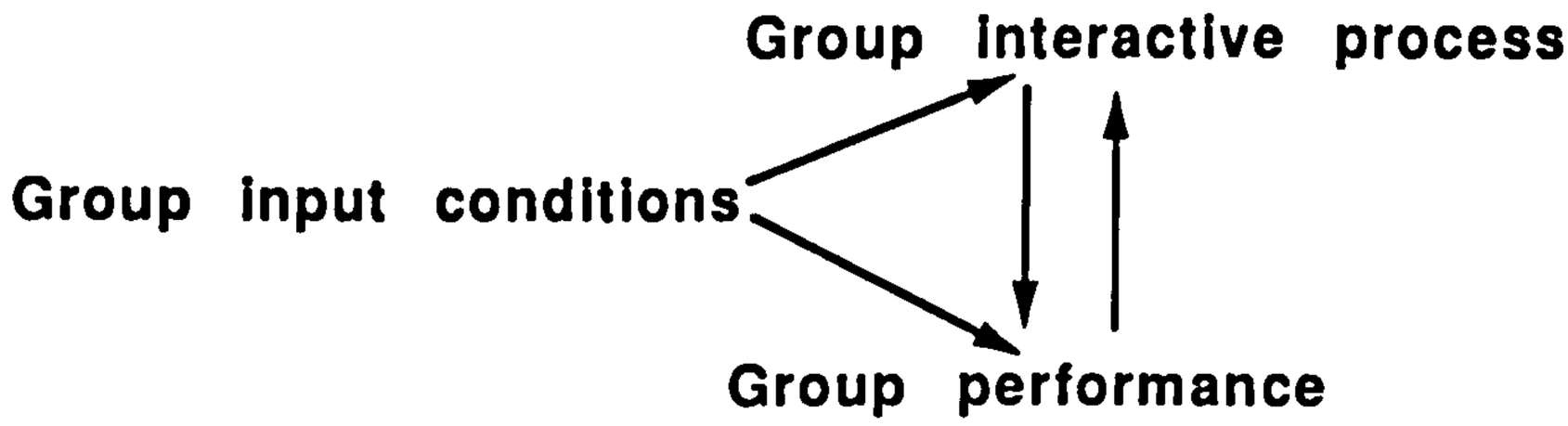
2.5.3 Hackman made the point that by concentrating on process and using laboratory work the most effective variables influencing outcome may be those held constant whilst others are manipulated. For example, in an extensive review of the literature, he pointed out that much research focused on relationships within groups. These appear to change attitudes but not outcomes directly.

Within education teachers could manipulate a wide number of variables. If a model is to be of value it must be simple and focus on elements that:
a. Teachers can control.
b. Have the greatest effect.

2.5.4 There has been much work on personality in groups (Driskell, Hogan and Salas 1987, Dallos 1976) but the teacher has little control over this and it is difficult to use in the formation of groups. Personality has a dynamic element and will alter depending on environment, physical and social. Better for teachers to accept that personality has an effect on group process and outcomes but also recognise that it is a very difficult variable to manipulate. Be aware, but concentrate on the manipulation of factors which have a more manageable effect.

2.5.5 Some group techniques `work` by restricting interaction. Examples include Nominal Group Technique (Lomax and McLeman 1984, O`Neil and Jackson 1983) where discussion is rigidly controlled and the Delphi technique (Weaver 1971) where members may not be in direct contact. In contrast Hackman (1983) claimed that some groups appear to work better when plagued with conflict than others which are not. The simple input - process - output model cannot explain these apparently contradictory effects, limited interaction and conflict should lower output by most group process theory.

2.5.6 Hackman suggested a link between input and output by-passing process, whilst accepting there are process effects.



Input conditions affect both process and outcomes whilst there is a reciprocal relationship between process and performance. Hackman moved on to list those factors which he considered most support effort within this model.

1. Conditions:

a. The task should be whole and meaningful, outcomes obvious to members.

b. Tasks should require high levels of skill, offering challenge.

c. Outcomes should have significant consequences.

d. The work should offer regular feedback.

e. Group size not too large - otherwise loafing promoted.

f. The group/team not too homogeneous - they may lack resources.

2. The organizing context should:

a. Be challenging, including deadlines and quality control.

b. Bring positive consequences for raised performance.

c. Focus rewards on the group not the individual.

3. Group synergy should:

a. Minimise process loss - for example time losses on meetings.

b. Create a shared commitment to the group/team.

c. Minimise weighting contributions on the basis of gender, enthnicity or other factors.

Note that Hackman used the term `effort` (without defining it) rather than achievement or performance. Like Farran (2.5.4) he assumed that increased effort will bring increased performance.

2.5.7 Most points above are self explanatory. However, it is worth amplifying three.

a. 1b, calls for high levels of skill, 1f calls for groups to be heterogeneous. Hackman was working in an industrial/military context. In a school context these may conflict. It would be possible to select for high levels of skill and yet ensure a heterogeneous group by including specialists from different areas. However, in schools teachers must include lower ability pupils.

b. 1d is ambiguous in that it calls for regular feedback from the work but does not mention whether this should be from staff or from the task structure.

c. In 2c Hackman called for rewards to focus on the group rather than the individual. Yet Harkins (1987) pointed out that `social loafing` increased when assessment centres on group rather than individual performance. Harkins claimed that individuals must feel their output can be compared before their effort increases. These statements appear contradictory, but a great deal depends on what the authors meant by the terminology used and the objectives they were measuring. Miller and Davidson-Podgorney were looking at `cooperative interaction` but did not define the term. They were certainly looking at specific `academic achievement` whereas Hackman was looking more broadly.

2.5.8 Driskell et al (1987) identified conditions similar to Hackman`s three levels, including:

a. Individual level factors - skills, knowledge and personality states.
b. Team level factors - size, structure, norms, cohesiveness.
c. Environment level factors - the task, stress levels, reward structure.

Working with adults in an industrial context, they considered personality as a selection factor. Whilst it has already been stated that personality is not a easily manageable factor for teachers to consider this work is of interest. Driskell et al recognised difficulties in measuring personality but failed to acknowledge that there are also dynamic effects. They conducted a factor analysis on personality traits from a number of studies and identified six which they claimed related to teamwork. These included intelligence, adjustment, prudence, ambition, sociability and like-ability. However these mainly related to leadership within teams. In contrast Bradshaw (1989)

noted that teams composed homogeneously of high intellect members did not perform as well as heterogeneous teams, often failing to produce results on time. The highly intelligent do not necessarily make good leaders and intelligence alone will not ensure teamwork ability.

2.5.9 The immediate point of contrast between Hackman and Driskell is the emphasis on leadership by Driskell. Driskell worked in a context where leadership appeared to be of assumed importance. Not all writers agree with this. Biott (1987) emphasised responsible membership rather than leadership. Hampden-Turner (1971) whilst not referring directly to leadership pointed out that formal systems are a fall back for `anomic man` (from the Greek root - lawless, a person with a lack of social or moral standards). He illustrated this with his findings that the most successful companies were those with a loose, egalitarian structure and flatter hierarchy. In the higher performing companies disagreements were resolved by discussion, whereas poorer performing companies tended to use enforced structure and `rank pulling` to resolve disagreement.

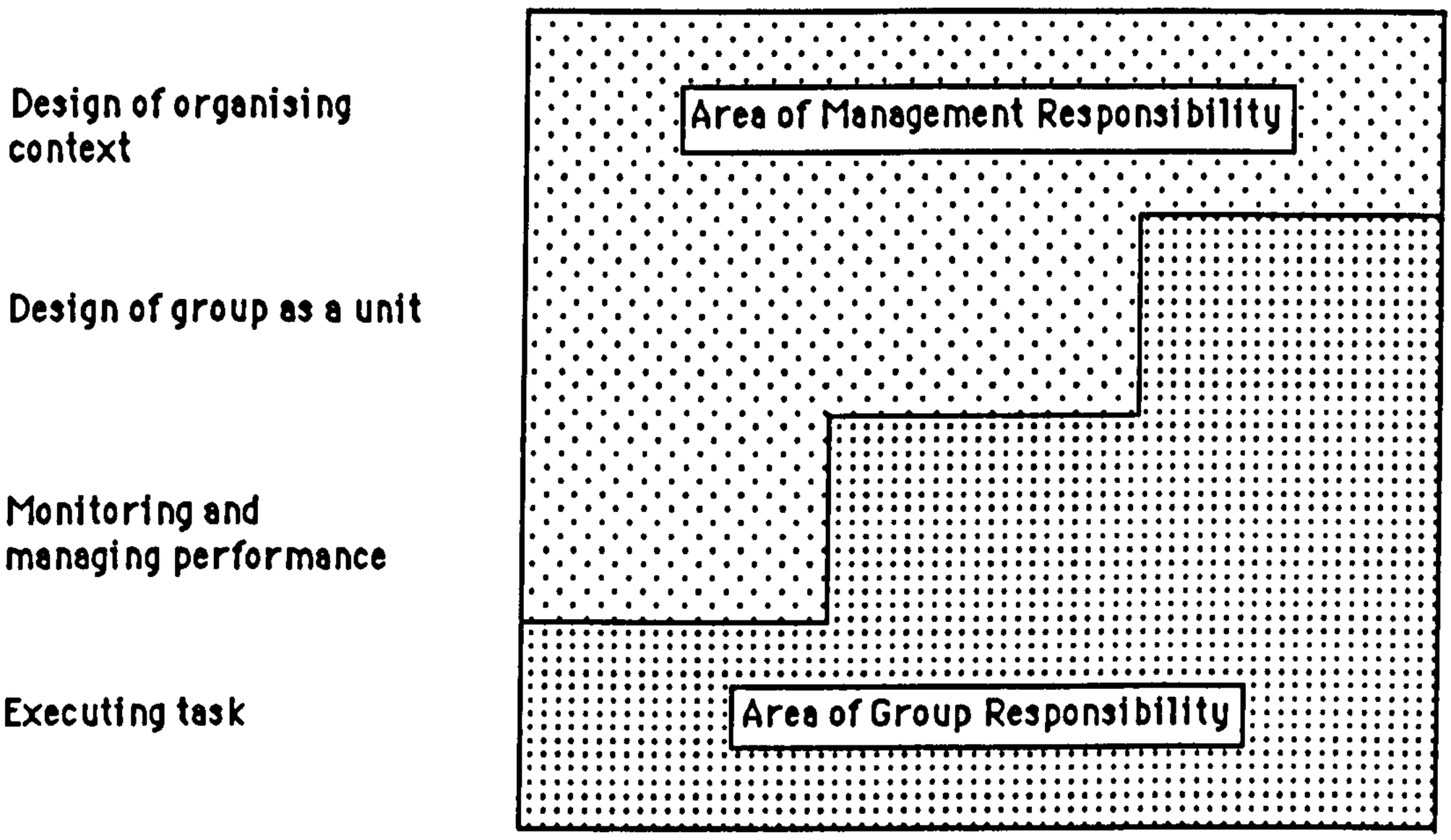
Hampden-Turner`s points were in the context of companies with complex goals. This relates with Hackman`s point that the task should require high skills and be meaningful, whole, and have obvious outcomes for members. This is less likely to happen in companies where the structure is guided by `scientific management` and workers see only their specific sub-task. Scientific management tends to use production line systems and management by a relatively rigid hierarchy. As Hampden-Turner considered that people require balance to develop, this must place limits on psycho-social development. Rigid systems cause over specialisation and little balance. Buchanan (1989) also criticised scientific management for a preoccupation with financial and extrinsic rewards. Management often fails to recognise intrinsic rewards; the development of self esteem and self actualization.

2.5.10 These points combine to establish the beginnings of a case for teams to be set up without formal roles or leadership, the position taken in the pre-enquiry phase of this enquiry. Hackman did not include systems or leadership in his points for supporting effort. Biott considered membership more important than leadership. Hampden-Turner stated that by avoiding a formal structure discussion is promoted leading to positive synergy. However, Hampden-Turner tended to be optimistic in his writing, we cannot presume that positive

synergy would follow, but it could, provided other factors (see 2.5.17) are acted on.

2.5.11 Hackman stated that groups need structure but his emphasis was similar to Hampden-Turner; any structure should help the team to discuss alternatives and evolve appropriate strategies of their own. Cowie and Rudduck (1988) made a similar point; pupils are often expected to learn within groupwork without adequate briefing on procedures, roles and responsibilities. None of these workers defined what they meant by structure but a common point is that some form of structure/guidance is needed to sustain groups while they devise their own.

Within an industrial context Hackman proposed the following descriptive structures and divisions of responsibility for organizational authority. Note that this gives groups responsibility for much of their own structure and operation.



Three typical examples of organization are:

a. Manager led - for example military units or airliner flight crew where there is a leader carrying absolute responsibility.
b. Self managing work group - where management designs the organizing context and group but the group is responsible for managing and monitoring performance.
c. Self designing work group - where management are responsible for organizing context . The group designs the team, strength, task, and performance monitoring. Some teams select their own membership in order to improve the chance of cooperative working (Mohrman, Ledford, Lawler and Mohrman 1986).

These three typifications should be seen as a continuum. There is much opportunity for members of a military team to make decisions at various levels, but Hackman`s point is accepted in principle.

2.5.12 Hackman`s structure has parallels with group/team selection in education. Perry and Euler (1988) advised that teams should not be allowed to self select. This tends to produce homogeneous groups which minimise opportunities for learning from members. Having said this a homogeneous group is more likely to establish cooperative working procedures quickly. Contrast this with Mohrman et al (above) in an industrial context proposing self selection. Maturity and the responsibility may help these workers recognise the need for selection criteria other than friendship.

Perry and Euler stated that high cohesion teams out performed low cohesion teams, but self selected teams did not out perform teacher selected teams. Initially self selected teams may be more cohesive, but do not necessarily remain so. Perry and Euler did not indicate whether self selected teams tended to lose cohesiveness or whether teacher selected groups improve cohesiveness over time. Similarly they did not define cohesive. Dictionary definitions emphasise an ability to stick together, this would not necessarily ensure a high level of performance. The self selected team may be cohesive as members share common mores, viewpoints and friendship but at the same time may lack a range of perspectives. As was discussed above often groups plagued with conflict perform better than those which appear cohesive (Hackman 1983). A self selected team may:

a. Lack an assembly bonus in that it cannot pool a broad range of resources (Driskell et al 1987). They may perform better initially because there is less process loss (Hackman 1983).
b. Lack enough discussion from different viewpoints to generate a positive synergetic effect.

2.5.13 Bennett and Cass (1988) looked at the frequency of explaining in groups which were either of high, low or heterogeneous `ability`. The frequency rose in heterogeneous and average ability groups while it dropped in homogeneous high or low ability groups. Contrasted with Perry and Eulers` work on self or teacher selection it may be that self selected groups may be of a more homogeneous range for ability. They may share mores and viewpoints so reducing the need to explain and the options for debate.

Bennett and Cass indicated that when groups of three were composed of two `high ability` and one low, `performance` (at explaining?) fell. When the group was composed of two lower ability and one higher the performance rose. Solitary low ability children appeared to opt out of discussion or misunderstood the discussion of the higher ability members. Lower ability children in pairs, were more likely to contribute in a group with higher ability. There was evidence that high ability pupils did well in whichever type of group they were placed.

This work is of interest despite the fact that it was based on a small sample of 11/12 year olds. Bennett and Cass argued that lower ability children may have `insufficient skills` to explain when in groups with higher achievers. This does not explain their improved performance when paired. This may be a case of confidence in a given context rather than `ability` or `skills`.

2.5.14 Levine and Russo (1987) looked at conformity, regarding it as behaviour intended to fulfil group expectations as perceived by the individual. They reported a high level of conformity in small groups until a majority of 3:1 was reached. In larger groups individuals were more likely to break away from conformity. Groups such as those observed by Bennett and Cass probably had strong pressures to conform.

Levine and Russo felt that there was evidence that minority views can be of value in causing the majority to consider other perspectives. They quoted

Nemeth and Kwan (1985) as showing that majorities tend to create convergent, uncreative solutions whereas minority contributions can help produce divergent, creative solutions. Comparing this with the work of Bennett and Cass there is more evidence for the use of teacher selected teams on the basis of a spread of abilities and perspectives. Further, it may be that team sizes aught to be larger than four to encourage minority views, though this would have to be balanced against other factors in group/team selection.

2.5.15 Levine and Russo (1987) listed six types of social influence which promote conformity within groups:

a. Reward - the desire to obtain majority rewards.

b. Coercive - the desire to avoid majority punishment (public conformity and private non-conformity is possible).

c. Expert - the majority seen as having superior knowledge.

d. Referent - a desire to identify with an attractive majority.

e. Legitimate - based on the belief that the majority has a moral right to prescribe one`s behaviour.

f. Informational - a desire to be correct and the perception that the majority position is congruent with one`s existing belief and value system.

Point a. raises majority rewards, discussed above. Point c. relates with the Miller and Davidson-Podgorney (1987) expectation status model of cooperative interaction. Here status reinforces prior differences. Pupils `size up` who is `smart` and there is an expectation that they are correct in any situation.

2.5.16 Miller and Davidson-Podgorney proposed two other models of structure in cooperative interaction:

The ignorance model. Knowledge about groups determines inter-group attitudes and behaviour. Ignorance may cause prejudice. Interaction may raise anxiety but high levels of structure lower anxiety. Similarly a strong task focus tends to lower anxiety.

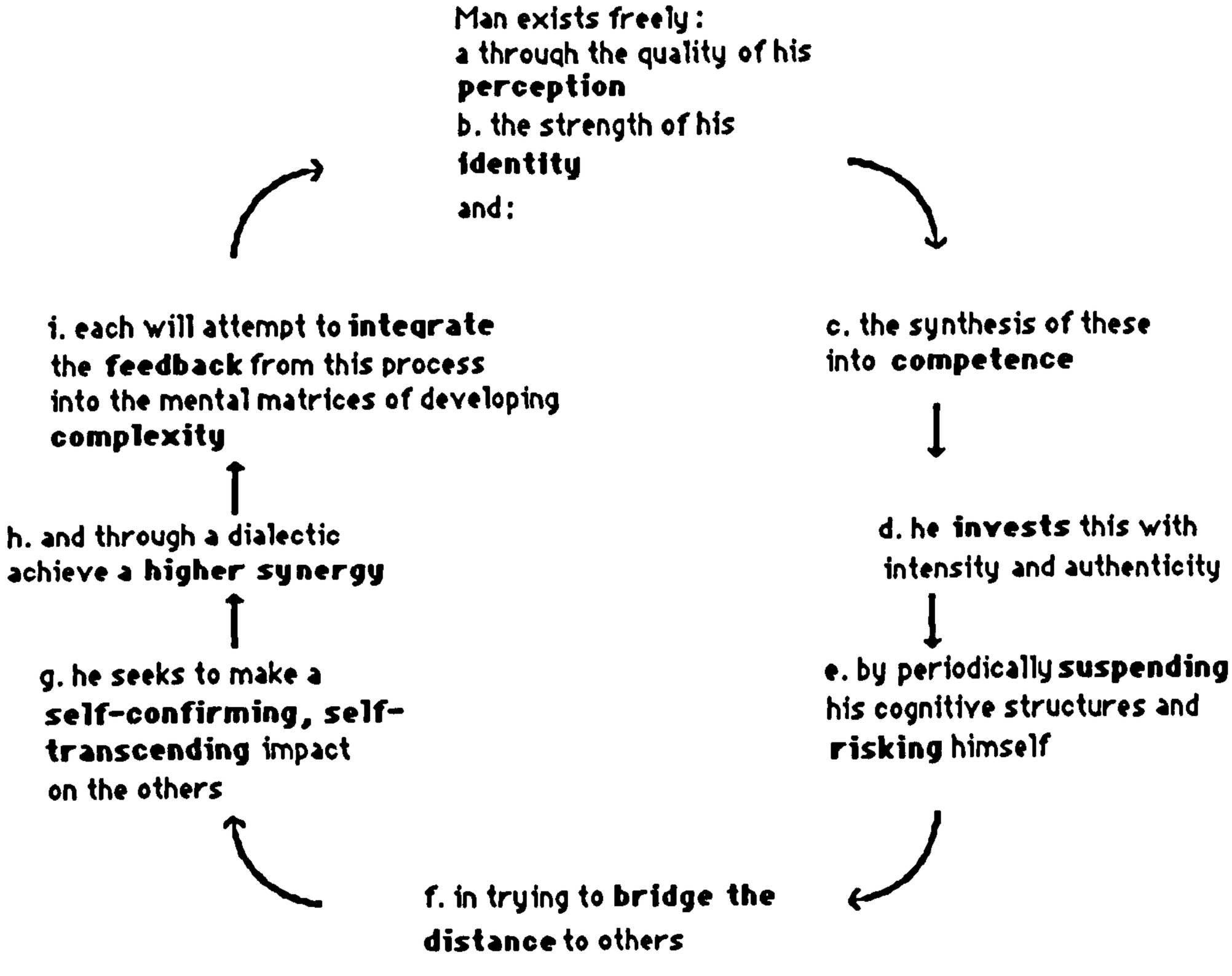
The social categorisation model - where members attempt to identify social boundaries. This links to the ignorance model as those boundaries will be often based on ignorance, whether they are social, gender, intellectual or racial.

The authors noted that competition increased task focus. This in turn appeared to lower members focus on social categorisation but could leave category distinctions and prejudice intact. Whilst they are not explicit about it these authors appear to warn that competition can lower the the integrative effect they report for cooperative groupwork.

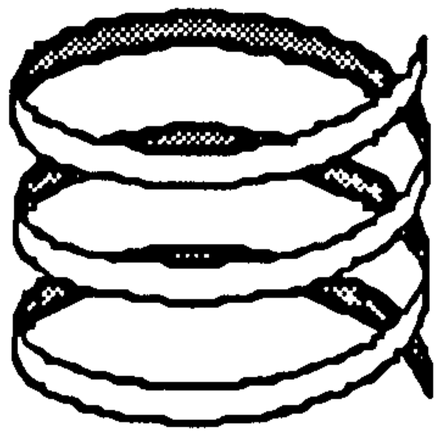
2.5.17 Hampden-Turner (1971) offered a model of the interdependent development of individuals. This model was based on T-Group training which originated in America in 1947. Unlike the task orientated groups of this enquiry T-Groups meet in deliberately open contexts to discover how members related to the others in the group, how they could create purpose and how they could use this knowledge to further their own development and learning. There is relevance in examining this model in terms of gaining further perspectives in this enquiry.

Hampden-Turner based his model on a cycle of psycho-social development:

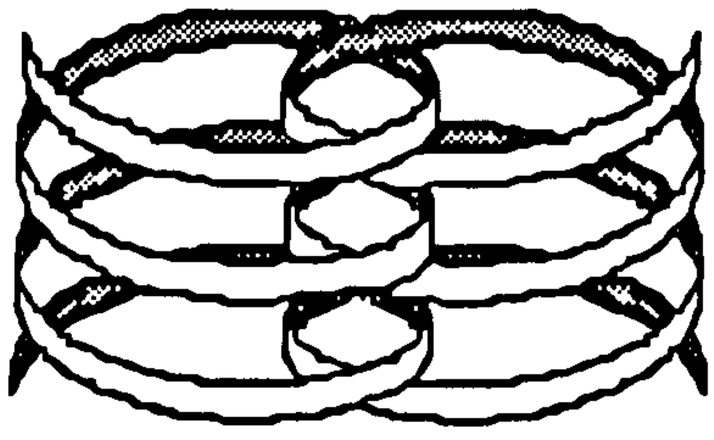
(pp 180)



The basis for this model was the development of the person`s existential capacities interdependently with others. This would occur in any relationship including T-Group or the task orientated groups in this enquiry. The model is cyclical and as the sections within it are strengthened there is development at 90 degrees to that plane, so that one would see a helix.



Each person`s helix will interlock with others in their immediate environment, in this case the group membership. This interlocking occurs primarily in segments g. and h. - `seeks to make a self confirming, self transcending impact upon the others` and `through a dialectic achieve a higher synergy`.



Psycho-social development of individuals in the group is possible via continual cycles, but is dependent on others and the relationship must be of `significant other`. The lower reaches of the helix represent low levels of development. As we ascend relationships mature, but weakness in any of the segments of the individual or the others will hold back development.

Quality of perception (a.) is illustrated by reference to being able to recognise the `absurdities` in life. Hampden-Turner listed many examples including

aspects of the Vietnam conflict. It is important to recognise that the individual has to invest competence (c.) in the group environment in order to grow. This means taking risks and suspending one`s current syntheses (e.). An example could be sharing one`s religious views, which may be deeply held. If the significant other responds negatively there is a danger of psycho-social injury to both parties. The individual must be able to suspend their own syntheses and try to recognise the perspectives of the other(s). Such a process is threatening because risk is taken with the significant other(s). Failure brings the danger of stagnation or even regression. The group psycho-social environment is very important in supporting members` development.

The individual must try to bridge the distance between his or herself and the other(s) (f.). The further that distance the less likely the individual will want to attempt, yet the greater the potential for development. Hampden-Turner considered tolerance as the most useful indicator of ability to bridge and saw it as the reverse of ethnocentricity.

In seeking to make a `self confirming, self transcending impact on others` (g.) the individual is interacting in such a way that communication of thoughts and feeling enables both the individual and the other(s) to move upwards in the helix. The impact is not simply the acceptance of the individual`s views by other(s) but their use in an interactive manner. Here is the basis of Hampden-Turner`s mechanism of synergy.

The act of other(s) accepting the energy of those views feeds on itself, generating more. This would be a form of feedback loop. As the individual feels a positive effect from the bridging and risk that it entailed, then communication will build rather like feedback in an audio amplifier system if the microphone is placed in front of the speaker. It is important that the communication goes on, synergy is unlikely to be developed if that first bridging leads to breaking communications.

As members integrate feedback their mental `matrices` grow, and a loop of the helix has been completed.

2.5.18 Hampden-Turner saw any group as being made up of the interaction of the members` helices. All intersect but together produce a cycle for the group as an entity. That cycle has the same phases as the individual. Group cycles can

then interact with those of other groups producing growth and synergy between them. People are members of many groups and groups may have sub-groups.

2.5.19 Hampden-Turner considered formal structures within organizations may block the development of the organization (or group) and individuals within. A formal structure limits opportunities to develop new perspectives and grow by suspending current cognitive structures, taking risks and so moving around the cycle. Hampden-Turner wrote that formal systems are a fall back position for `anomic man` and that such people tend to be fundamentalist in their approaches as in this way they protect themselves from the risks and stress of the cycle.

Hampden-Turner observed that companies with rigid hierarchies and structures tend to perform less well than those with flexible structures, egalitarian relationships and flatter hierarchies. He pointed out that in the former, disputes are settled by hierarchical imposition, `rank pulling`, whereas the latter use discussion to solve problems.

Accepting the above argument, a discreet and supportive structure may be of value in supporting the member(s) who require it. Such a structure could also offer the freedom to develop as proposed above. Simply removing structure is not what Hampden-Turner implied, it may lead to chaos and collapse.

2.5.20 Hampden-Turner considered that a group of 9-12 people could achieve an effective balance of depth and breath. This was in relation to T-groups and their typical two week period. T-Groups, however, are not constrained by externally set tasks and deadlines such as the groups in this enquiry. These figures can be contrasted with those of other workers (2.3.5).

2.5.21 The early period of a group is rarely effective due to lack of familiarity. Identities are weak within the group due to insufficient investment and confirmation. Hampden-Turner claimed that `most` groups make the transition to progressive strengthening. He observed that enforced confrontation within the group can leave `anomic man` with no escape, forcing him to start the cycle. This point appears to contradict his previous statements to some extent. They indicate that in such a situation the result would be negative unless a considerable time and care was taken by other

members as the 'anomic' individual may not see members as significant others as so their views would not carry significance.

2.5.22 Hampden-Turner considered that people with a scientific/technical training perform 'sluggishly' in T-Groups as their training makes them resist making decisions until all the 'hard' data is available.

2.5.23 Membership of a group can allow an individual to experiment with identity. Any loss would be limited by knowledge that the group will end at a given point in time. In periods of serve anomie the group may turn to authoritarian control.

2.5.24 Hampden-Turner followed up some T-Group members into their workplaces and found that generally they did 'gain' as people: 35% reported gains which held and 30% reporting gains which then increased. Only 22% reported that gains faded on return. He observed that this may be due to the environment in which they were operating failing to support continued development.

2.5.25 Hampden-Turner reported an experiment where two laboratory based groups were placed in competition so that inter-group synergy was impossible. He observed that groups readily accepted such competition as a part of normal culture. The relationships between the groups crumbled as the joint cycle broke up. Esprit-de-corps rose but he noted that interpersonal relations within the groups also started to degrade along with creative thinking and increased pressure for conformity. There was a sense of over-confidence, purges of deviants and an incapacity to suspend favourable assumptions about the group. The groups became more structured and hierarchical. There was no effort made to understand the perspectives of others. There became only one goal, to win. Transposed into a commercial environment we may have similar responses - to maximise profits at all costs. Hampden-Turner made the point (p214) that: *---profitability may be a good description of a creative system but a poor prescription.*

2.6 Group/teamwork in relation to teaching and learning

There are four sections: developments in education relevant to this enquiry; teaching aspects; learning aspects; the assessment of groupwork.

2.6.1 Developments in education relevant to this enquiry

2.6.2 Peacock (1989) saw group skills as advancing knowledge and enabling flexibility in a world of change. Curriculum Matters 9 called for groupwork within Craft, Design and Technology and there are many statements relating to groupwork in National Curriculum documentation such as Science, English and Technology. Johnson (1991), reviewing five recent American reports on changing workforce requirements, noted that three included teamwork explicitly and one implicitly.

2.6.3 National Curriculum Technology (1990) used the terms group, groupwork and team within the Programmes of Study. Science (1989) included as AT 1 `Exploration of Science` which focused on scientific process and included groupwork. A specific Attainment Target on group work was included within the interim Science document (August 1988, AT18) but but did not appear in the final version. No reasons were given, but speculation could centre on the difficulties of assessment as much as the need to rationalise the number of AT's within the document.

2.6.4 Parental influence on the curriculum is likely to grow. Biott (1987) observed that both parents and pupils tend to have firm views on what constitutes `work`. Similarly he noted that teachers prefer concrete results and have a tendency to concentrate on the products of groupwork rather than groupwork itself.

2.6.5 Learning aspects

2.6.6 Cowie and Rudduck (1988) identified the following pupil perspectives on groupwork (pp62-68):

a. A large proportion felt that groupwork was very helpful in certain areas of the curriculum.

b. Many liked the warmth and friendliness in groupwork when going well.

c. Some saw no value and `messed about` in such work.

d. Some saw groupwork as `easy lessons`.

e. Some resented what they saw as a `waste of time`.

f. Some resented teachers not asserting authority in the `expected` way.

g. `A small proportion` of pupils had a strong need to work alone.

These are not quantified but emerge from a large survey .

Statements a. and b. are positive but not precise. They indicate that some pupils enjoyed groupwork and felt it of some benefit. If pupils can be helped to see group/teamwork positively there appear to be gains in general motivation (Makins 1989).

The remaining statements are negative. This contrasts with a. and b. though the authors use the words `large proportion` for a. and b. and `some` for c, d, e, and f. Nevertheless this indicates that some children see little or no benefit from groupwork or the lessons in which it is used. No data is available to illuminate why this should be so. It may be that these pupils had not experienced cooperative groupwork but had been confined to collaborative work.

2.6.7 Hampden-Turner considered that in order to develop, a group must suspend existing cognitive structures. This is threatening and may lead to conflict. Tuckman (1965) made observations which parallel those of Hampden-Turner to some degree. Tuckman saw four stages of development in social-interpersonal and group/task aspects of groupwork:

Social-Interpersonal	**Group/task**
1. testing - dependence	1. orientation
2. conflict	2. emotionality
3. cohesion	3. relevant opinions exchanged
4. functional	4. emergence of solutions

Firstly members attempt to discover what interpersonal behaviour is acceptable. The group attempts to identify the task parameters. Secondly individuals attempt to express individuality and there is an emotional response to the demands of the task. Miller and Davidson-Podgorney predicted an increased level of conflict at this stage from their social categorisation model. Thirdly members accept individual and group idiosyncrasies and open an exchange of relevant interpretations of the task. Finally members act functionally and solutions to the task emerge.

Tuckman (1985) wrote more simply that any recently formed group appears to go through stages of:
forming
storming
norming
performing

2.6.8 Cowie and Rudduck (1988) argued that individual learning reflects a masculine model of learning and discounts a more cooperative female model. Levine and Russo (1987) noted that females tend to conform more than males in a group situation in order to ensure smoother running of group processes. In contrast some males adopted confrontational attitudes possibly to support their own perceptions of `masculine` behaviour. However, these observations may be suspect as the sex of the researcher (and presumably the group membership) can be very important in influencing the reaction. Similarly there may have been gender bias in the tasks used in this research.

2.6.9 Cowie and Rudduck referred to Connell et al (1982) in seeing groupwork as supporting `working class` practices of cooperative coping in contrast to school demand for individual work. Pressures to succeed in an individual and examination orientated system could be taken to reflect middle class values growing from the old grammar and `public` school traditions. These points are interesting but attitudes in this country have changed much since Connell et al reported their work, their validity is in doubt.

2.6.10 Aspects of teacher understanding of groupwork

This sub-section identifies some aspects of teacher understanding of groupwork.

2.6.11 Biott (1987) identified `four commonly held ideas` by teachers (p5):

a. Teachers need to be involved to make groupwork worthwhile.
b. Leadership is assumed to be a key aspect.
c. That pupils are aware of the cooperative nature of groupwork.
d. That the teacher`s role is unproblematic.

These show that the teachers in Biott's sample have a poor understanding of groupwork. The fieldwork of this enquiry indicates that point a. is not the case. This will be discussed in relation to the accounts in section 6.0. Leadership was discussed in 2.5.9 and found to be not necessarily central. Similarly it has been shown that pupil perceptions of groupwork and its cooperative nature is not understood by all pupils. Point d. will be covered in section 6.0.

2.6.12 Cowie and Rudduck, and Biott, observed that much groupwork in schools is simply organizational; typically sharing resources. Groupwork was also used to avoid the strain of constant psychological and physical contact with pupils. Teachers tended to stop groupwork at the earliest signs of restlessness, a point which may cause pupils to lower their expectations from groupwork (Biott).

2.6.13 Many teachers recognised benefits from groupwork for social/psychological development but not intellectual. However, section 2.2.3 indicated some value in groupwork for developing academic attainment.

Bradshaw (1989) considered intelligence to be only one factor in group/team performance. He quoted Belbin's work where teams of various permutations of mental ability performed mental ability tasks. Teams of high ability members often finished last as they spent time trying to persuade others to adopt their ideas. Similarly they had a flair for identifying the flaws in each others arguments; progress on the task was slow. Neither Bradshaw or Belbin report whether these teams produced 'better' solutions.

2.6.14 Bradshaw also reported Belbin's observation that an emphasis on 'coming top of the class' in the past had been an unconscious training in anti-teamwork by emphasising individual endeavour. Those with the highest mental ability may be least equipped for groupwork. Similarly it was the perception of some teachers that the delivery of examination grades was the highest priority (Cowie and Rudduck). This may have caused a move away from groupwork as external examinations approach.

2.6.15 The assessment of groupwork

It is not intended to go into depth on the assessment of groupwork as:

a. This enquiry centred on the improvement of endeavour in the learning contexts under study.
b. The assessment of the skills and attitudes necessary to work effectively in groups is complex and a subject for research in its own right.

This section will simply uncover some of the problems and possibilities with particular reference to what is practicable in a normal school situation.

2.6.16 Why assess?

Assessment is necessary in order to be aware of the position of the learner in time, enabling planning for effective progress. Assessment must give both an overview of a class and specific perspectives on individuals.

The learner must have feedback on progress. Broadfoot (1988) indicated that enthusiasm for learning increased where teachers gave a partnership role and provided opportunities for individual discussion.

A principle assumption is that assessment should be integral to and aid teaching and learning. The questions are: what do we assess; by what mechanisms; and to what depth?

2.6.17 What to assess?

2.6.18 Agreement must be reached as to what the criteria for success are going to be. Some criteria relate to the product of learning and some to the process of learning.

In a Design and Technology context the product will usually take the form of an artefact, system or environment, together with models, drawings and records of the process of investigation. Criteria relating to the process of learning may include the individual and group attitudes and abilities to work as a group.

2.6.19 There are well acknowledged systems for assessing work of a Design and Technological nature. It is not the intention of this enquiry to go into this area other than to make one observation as a suggestion for further research.

Systems for assessment used in Design and Technology focus on the product and design process behind it. In most situations this is individual work. When there is cooperative groupwork and a joint product, assessment is more difficult. Some Examination Boards do allow joint project work, asking for the work of the individuals to be separately identified. Such a system cannot account for synergetic effects (positive or negative) within the group and encourages teachers see groupwork as a collection of individual work.

Groupwork is rarely like this. Assessing the contribution of the individual is possible but requires techniques such as close observation in addition to evidence such as design sheets. If groupwork is to be accepted, as National Curriculum documents indicate, then research is necessary to develop assessment instruments which address groupwork ability and are workable in the classroom

Assessing groupwork ability will be difficult . The elimination of the Attainment Target on groupwork from the National Curriculum Interim Science document (August 1988) has been mentioned. This used terms such as; Contribute ideas.

Share in a task.

Persevere with a task.

Show sensitivity to others in a group.

Offer ideas and initiatives.

Share a task as determined by the group.

Take on different roles.

Modify own views in light of views of others.

Accept help when offered and give help when needed.

Manage the resources of the team effectively.

Curriculum Matters 9 used:

Cooperation.

Responsibility to other members.

Readiness to listen to others points of view.

Support view which seems to carry best hope of a solution.

Lead or follow as appropriate.

Persevere.

If these terms are important group work assessment should focus on them. However, there are a number of problems which must be recognised first.

2.6.20 There are problems of reliability and validity. Some aims - appreciation, understanding, creativity, for example, are difficult to measure and what can be measured reliably such as factual recall has little educational validity.

2.6.21 There is a danger of looking at personality characteristics rather than groupskills when assessing members, so inhibiting learning about group behaviour. Personality is a dynamic quality which will be influenced by the social psychology of the group. Roles, status, gender, position, to name but a few factors, will influence the individual`s personality within any one group.

2.6.22 If teachers impose roles in groupwork and pupils are given freedom as to what role they play, they may continually adopt roles they feel confident with. This may limit development of a broad range of skills.

2.6.23 If assessment is to be used formatively it needs to be referenced. Criterion referencing of groupskills can be complex and open to ambiguity. The contribution of one member might not be great compared to the contribution of another, and yet for that person it could be substantial. Similarly there may be cases where an individual`s contribution varies depending on the social environment at a given time.

2.6.24 How to assess?

Cooperative learning breaks away from existing patterns of organization and traditional groupings of children. Teachers` roles develop towards being facilitators (see 2.7.7) and the approach makes conventional forms of assessment unwieldy. The nature of what is being assessed prohibits a comparison of one team member with another, it may be more appropriate to compare a team member`s performance with their own previous achievements. This provides a case for Profiles and Records of Achievement (RoA).

According to Lloyd (1986) profiles challenge traditional norm related marks. Multiple course objectives may be identified which are desirable and attainable but not necessarily assessable using exams and tests. Troman (1989) argued that profiling and RoA are forms of assessment underpined by

the principle assumption that educational assessment should be integral to and aid the business of teaching and learning.

2.7 Conclusions

2.7.1 There are benefits to be gained from group/teamwork. These range from social and vocational to academic. Endeavour may be an important factor but the link between this and academic performance is unclear.

2.7.2 Benefits only accrue when the learning context is designed with a broad awareness of group and teamwork, particularly potential drawbacks.

2.7.3 Teachers may design groupwork which is ineffective due to poor understanding. This could lead to poor pupil response and attitudes to group/teamwork.

2.7.4 There is a case for pupils to receive some form of pre-vocational education in a general education. Industry is developing teamwork as part of a response to rapid change requiring flexibly. Teamwork is also seen as one aspect in developing greater worker satisfaction and so greater industrial harmony. Experience of teamwork in schools may benefit young adults in more easily developing and enhancing qualities required to work as a member of a team.

2.7.5 Hart (1988) suggested five tasks for teachers setting up groupwork:

a. Consideration of group size.
b. Composition of group.
c. How the group is arranged.
d. Roles of individuals.
e. The task.

Lewin (1989) listed six factors for effective groupwork:

a. There should be a balance of educational and practical considerations.
b. The project should be chosen to motivate.
c. The task should be acceptable, realisable and give pupils with different learning styles a chance to excel at least part of the time.
d. The climate should allow contributions from all members.
e. Different forms of communication should be used.

f. Groupwork should start in the early years and be developed progressively.

2.7.6 Comparing these with Hackman`s points and emphasising those aspects which are easily manipulated and efficient in bringing about development, a general framework can be constructed. This would be a focussing device to help teachers design activities which involve group or teamwork. It would also be valuable as a starting point for a framework for progressive development of group and teamwork.

The group

- size
- composition
  - gender
  - ethnicity
  - ability

The task

- wholistic and with significant outcomes
- have relevance
- task and outcome be visible and concrete
- offer challenge to all members
- be matched to group size

The structure

- physical operating environment
- give group/teams appropriate degree of autonomy
- minimise process loss
- maximise positive synergy potential
- assessment
  - offer feedback
  - involve members
  - focus on group as well as individuals
- be designed within an overall structure of progression

2.7.7 An important aspect teachers must consider in designing group work contexts is the role they play themselves. Cowie and Rudduck (1988) described this as `facilitator` and listed the major responsibilities as:

a. To set clear and engaging tasks.

b. To avoid intervening too much or inappropriately. This is important as the facilitator may advise wrongly on the basis of insufficient understanding of a situation they had just started to observe.

c. To let pupils feel comfortable about asking for advice.

The role of facilitator is further considered in relation to simulation in section 4.0.

2.7.8 The evidence suggests that group and teamwork do have a role to play in education. The evidence also indicates that there is some misunderstanding amongst pupils and teachers as to the value and methodology of group and teamwork. Problems may arise from this misunderstanding. This suggests that teachers need guidance and support in order to help children develop effective group and teamwork abilities. This should be seen as a part of a systematic and long term development. None of the literature indicates that group and teamwork should be taught and experienced in a specific subject area, however, it is an aspect that teachers of National Curriculum Technology must take cognisance of.

3.0 Simulation.

The aim of this section is to discuss simulation as a teaching/learning technique. Firstly the terminology is clarified in relation to experiential learning techniques often associated with simulation. Some of the advantages and limitations of simulation are considered. The transferability of developed competencies from simulations to other contexts is discussed. Time management is considered in relation to learning in simulations. The design of simulations is explored, including design strategy, fidelity and complexity, competition, the use of computers, the value of roles and briefings/debriefings. This is followed by simulation in action; warming-up and the role of the teacher. The nature of evaluation in simulations is considered. Finally the key points are summarised.

3.1 Terminology.

Simulations, games and role play all represent situations in order to learn experientially. The emphasis here is on simulation, but it is necessary to examine the other techniques as there is often confusion.

3.1.1 Simulation.

Rediffusion (1986) quoted Goode and Machol (1957 p 1.3): *Simulation is the study of a system by the cut and try examination of its mathematical representations by means of a large scale computer.*

This emphasises experiential study (*cut and try*), but then centres on mathematical modelling and the use of computers. This need not be the case.

A model is a representation of the structure of a thing or system. It may be realised in a different `language`, scale or media in relation to the original. Changes in language could include the use of mathematics, drawings or computer representations. Examples may include a mathematical model of the finances of a company or the performance of an aircraft; an

engineering drawing of a component or a sketch of how a device works. Scale is often altered in conjunction with media: a scale model of a house in balsa wood or a mock-up of a car in clay.

The distinction between a model and a simulation is a fine one. A model is a representation; it may be used to experiment or communicate. In a simulation the model becomes the centre of an intentionally dynamic system, designed in order to learn experientially.

At this point it is relevant to differentiate between a simulation and a simulator, which is a device which simulates conditions in real life. Simulators may range from simple mechanical devices to complex electro-mechanical, computer controlled apparatus. An example of the latter would be an aircraft simulator enabling pilots to experience a wide variety of flying conditions and emergencies both quickly and safely. Their use can save time and money, assuming there is transfer of competence to the real aircraft. The Civil Aviation Authority allows some training to be carried out in simulators, indicating some confidence in transfer in this situation. A simulator is a piece of equipment; simulation is the process involved.

Some situations may be modelled and manipulated using mathematics. Developments in computer technology enable ever more sophisticated models to be manipulated. Engineers may design and test a bridge, using a computer, under a broad range of conditions within "expert systems" models; an artist may use fractal mathematics to produce images, and meteorologists attempt to model weather patterns. The computer is simply an aid, allowing increased levels of complexity by increasing the speed of computation when the model is manipulated.

Despite the continuing development of computer technology it is difficult to model human relationships and reactions mathematically. These can be modelled using simulation and role play.

The Goode and Machol definition of simulation centred on mathematical representation, this is inadequate and inflexible. Rediffusion stated (p 1.3): *Simulation, as used in training, is a dynamic representation of a system, process or task.*

The term `dynamic` is important. Participants interact with the simulation. Similarly, if there are two or more participants they react both with each other and the simulation. Jones (1989) considered a simulation should be `non-taught` but participants allowed to make their own mistakes. However, people do not automatically learn from their mistakes and the role of the teacher in simulation must be considered. This is discussed in 3.10.2.

Simulations are imitations of reality. They have limits and limitations. They are intended to highlight selected aspects for specific purposes.

Jones made the important point that behaviour in a simulation is real. A role may be to manage a simulated company but the participant plays that role with professional intent and with autonomy. If the person is required to play the role of a 'tough manager' that person loses autonomy and the exercise is no longer a simulation but a role play.

Roebuck (1978 p 107) described simulations as: ---*organizational devices for arranging interactions.*

The `organizational devices` could vary in form. Adams (1977), writing from a library studies perspective, offered:

a. Case study, where participants are given information to analyse.
b. In-tray exercises, where decisions that are to be made are based on the information that arrives in an in-tray.
c. Incidents process, where participants are told an incident has taken place and action is required.
d. Action maze, where a series of multiple choice questions take participant(s) through a scenario. Each choice leads to a further section. The participant(s) learn the consequences of particular actions and must evolve a strategy to take them through the maze.

These examples are helpful but do not indicate the full range of simulation techniques. Mentioned above is the business simulation where individuals or teams react to information and make decisions which have consequences. Also mentioned has been simulator based learning such as the aircraft simulator or a dry land sailing simulator. Simulations may focus on

specific areas such as personal interaction; decision making; using equipment; managing procedures; or may encompass several of these areas.

Simulations are, therefore, ongoing dynamic representations of real or imaginary situations designed for learning purposes. They are characterised by:

a. Being based on a context, usually in real life.
b. Operating at various levels of simplicity/complexity.
c. Being experientially based.

This definition is loose. It is possible to clarify the meaning by considering other learning techniques often associated with it.

3.1.2 Games.

There are similarities between games and simulations. Many authors use hybrid labels such as 'simulation game'. Such labels can imply compatibility, when in fact there may be elements of incompatibility.

Games intended for learning can be distinguished from those intended for leisure and entertainment. The term "academic game" has been used.

Consider a series of definitions. Games are: ---*contests usually amongst player opponents operating under rules to gain an objective.* (Adams 1977 p 39)

Rediffusion (1986) considered games to be activities which contain elements of competition or cooperation for payoffs according to set rules.

Cryer (1990) stated that games are: *An interplay between individuals where there is a winner with a payoff which is satisfying psychologically and the others are losers because they feel manipulated and uncomfortable.* (p368).

Loveluck (1990) defined a game as: *A dynamic teaching device which uses the sequential nature of decisions within a scenario simulating selected features of a managerial environment.* (p25).

Jones (1990, b) considered games to be: *Closed systems in which the rules are self contained and self justifying.* (p355).

It is possible to recognise the following points within these definitions:

a. There may be more than one player and interaction between players is an important aspect of the game.
b. Games are closed systems within which participants play to laid down rules.
c. The game is competitive. Players aim to win within the rules.

Decisions, within games, are usually made on a strict rotation and often timescale. Chance is also a key point, typically progress is decided by throws of dice or choice of random cards.

In a game such as `Monopoly`, the participants are playing a game rather than simulating property development. Success depends on focussing on the specific objectives of the game. Any learning is focussed simply on being able to perform to those rules. No attempt is made to extrapolate this learning to other contexts or real life.

3.1.3 Role Play.

Van Ments (1983) defined role play simply as the experiencing of a problem under unfamiliar restraints in order to improve understanding. In practice the player acts a role in order to experience the interaction of that role with others. An aim is to develop player empathy (Adams 1977).

The environment of role play may be entirely in the mind of the players, based on the roles defined for them and how they are interpreted. The exercise may be enhanced by the use of props of various forms.

3.2 The relationships between experiential learning techniques.

3.2.1 The methodologies described above share many characteristics:

a. They emphasise gaining experience and knowledge by an active and often physical process.

b. They may be iterative. Cycles of briefing, experience, debrief offer feedback and the opportunity to "try again".

c. They may be simple or complex and are flexible enough to be adapted.

d. They lend themselves to group/teamwork.

e. They are intended to focus on the application of skills and knowledge within contexts representing real life situations. Alternatively fantasy situations may be explored.

f. They appear to generate increased learner involvement, possibly through a novelty effect. This can be employed positively, but there are unanswered questions as to whether novelty generated motivation can be maintained if used frequently.

g. They are learner centred.

h. They offer access to contexts from the interpersonal to those inaccessible due to distance, time, danger or costs.

i. They attempt to raise confidence by allowing practice in a safe environment.

j. The time scale may be manipulated, reducing lengthy processes and enabling more significant learning events to be incorporated in the exercise.

k. They may develop pupil attitudes and empathy.

3.2.2 Many of the points discussed in section 2.0 in relation to group and teamwork will also apply to these techniques, as group/teamwork is frequently employed.

3.2.3 The experiential methodologies focus on the application of skills and knowledge. There is evidence that simulations are not as effective for the learning of facts as conventional teaching (Jones 1990). Similarly, loading simulations, games or role play with facts may detract. The absence of sufficient facts may be planned intentionally to stimulate debate. Pupils need to be able to recognise when they need more information and develop techniques to find it.

3.2.4 An over emphasis on learning facts in a simulation or game may offer ambivalent messages to participants (Jones 1989). Some may act professionally, according to their role in the activity. Others may concentrate on assimilating facts and so miss behavioural objectives such as groupwork experience, decision making and communications.

Any learning situation generates a hidden curriculum which was not part of the aims or objectives but is inherent in the structure of the event (Glandon 1978). The simulation designer must be particularly sensitive to these hidden messages and be prepared to trial learning events to identify such effects.

3.2.5 The techniques offer access to otherwise inaccessible situations (h.). However, there are indications that response drops if contexts are too far removed from experience. Earl (1990) observed that a group of students in Scotland failed to respond as well as expected to a desert survival simulation. When re-written as a sea survival exercise the response was improved.

3.2.6 Experiential methods offer a safe environment for practice (i.). Such environments may also lower dangers and possibly stress in comparison with a real life situation. Yet it is also necessary to recognise that simulations may be stressful and that the level of stress may be a factor which is deliberately manipulated.

Stress is a personal reaction to a context rather than a quantifiable element and so individual learners will react differently. This makes stress control a difficult factor to manipulate. This is usually done through time limitations, general conditions and inter-personal relations.

3.2.7 Jones (1989) considered that ambivalence may occur due to mixing the methods under discussion. This ambivalence may be characterised by cross-purposes and ill-feeling when nobody is aware of the cause. An example of such ambivalence would be a clash between playing roles and the freedom the individual should have to react to a simulation with autonomy.

3.2.8 The causes for ambivalence may lie in the "deep structure" described by Bell-Gredler (1990). This can be defined as the psychological mechanism that explains the levels of interaction found in games and simulations. Three factors were identified:

a. Generalised reinforcers - any behavioural outcome that strengthens the behaviour that produced it (from Skinner 1953).

b. Defective contingencies. When generalised reinforcers strengthen inappropriate behaviours. The example given is of a computer based genetics simulation which tended to encourage pupils to try to produce as many different coloured cats rather than use the simulation to learn about genetics as intended. It is also possible to fail to reinforce appropriate behaviour. Some computer based simulations use randomly generated data to influence factors whatever the response of the participant. Similarly some games use dice to decide when a player moves. Such techniques may cause frustration and be ambivalent even though real life can be dictated by random external factors.

c. Negative utility occurs when a participant is reinforced for particular behaviour and yet experiences long term punishing consequences. Monopoly is a game which reinforces buying property and yet all but one player subsequently lose. This is ambivalent and can be the cause of frustration, anger, resignation and apathy.

Initiative may be encouraged in a simulation where the guidelines are loose. The closed structure of games may discourage initiative. Similarly, closure could be incompatible with many of the aims of educational reforms such as TVEI or GCSE which have moved towards emphasising real world contexts.

Loss of autonomy can also be reflected in fixed sequence decision making, such as turns at the throw of a dice, common in games. This reduces realism; in real life an appropriate decision may be when to make a decision.

3.3 Simulation and learning.

3.3.1 There would be little to gain by an exhaustive survey of learning theories. The position taken here is empirical and centres on experiential learning. As Thatcher (1986 p 145) put it: *Fundamental to all learning is some kind of active experience.*

Perry and Euler (1988) considered learning to be the sum of acquired knowledge and questioning insight. Thatcher used learning as a verb and Perry and Euler as a noun, but common to all is the idea that an active process must take place to transform an experience into knowledge.

A learning experience may be active, such as the interaction within a simulation, but this in itself, is not sufficient to ensure there is learning and the development of knowledge. Questioning insight is necessary to make that transformation.

3.3.2 With simulation, the active experience must be transformed by the questioning insight generated in a well conducted debrief. The debrief must be interactive, a 'teacher taught' debrief may not be. Thatcher wrote that articulating thinking is a vital part of converting experiences into knowledge. Thatcher echoed Bruner in pointing out the significance is not in teaching but in promoting learning.

3.3.3 Adair and Despres (1980) claimed that people have a "span of relevance" across which they can see the relationships of things (or experiences?). Some will only be able to make obvious connections, others to make

connections which are subtle and far from obvious. It must be a part of the role of the teacher in a simulation to help pupils make these connections and possibly develop their span of relevance. It would be necessary for pupils to articulate their thinking in order to convert their experience and the teacher's illumination of the experience into knowledge. The role of the teacher in a simulation is different in some aspects to most conventional teaching. This is discussed in 3.10.2.

Learning within simulation is iterative. A series of short experiences are evaluated and reflected on in cycles. The knowledge gained is fed into the next loop of the simulation. This iterative model of learning has been highlighted by several writers on simulation including Thatcher (1986) and Laveault and Corbil (1990). They quote Kolbe's (1984) cycle of concrete experience - reflective observation - abstract conceptuality - active experimentation. As each cycle is completed the person rises to a new level and the cycle continues, hence a similar model to that proposed by Hampden-Turner (2.0).

The emphasis on short working sessions with repetition and increased complexity (Perry and Euler 1988) also helps learners recognise relevance. It is only when the learner recognises the importance of the question that answers are remembered or understood (Megarry 1976).

At this point it would be relevant to briefly examine work from Thatcher and Robinson (1990) who made observations on learning difficulties in relation to simulation. They found 36% of difficulties related to traditional school subjects, with mathematics representing 24.5%, often typified by stress and fear. Their evidence suggested that cognitive 'blocks' in relation to mathematics were common. Emotional problems related to 23% of difficulties and 16% to physical defects. Interestingly they observe that 30% of their sample had little empathy for those with difficulties in spelling and writing.

The point on difficulties with traditional subjects and particularly mathematics in simulations is probably not unique to simulation but would apply in other learning techniques. The point on emotional problems is interesting as personal experience has indicated that simulation can develop strong responses in individuals which may cause emotional

difficulties. Supported effectively by staff such emotion can be used positively and defused at debrief. Managed incorrectly such emotion can become destructive.

3.4 Why use simulation?

Simulations may be versatile, covering a broad range of educational objectives. At the same time they may offer staff flexibility to emphasise or develop specific objectives at various times. For example, some knowledge, attitudes and skills are difficult to acquire by traditional forms of learning. In some contexts the use of simulators and simulations may be necessary as the environment for which the participants are learning may be distant, dangerous or simply too valuable for pupils, students or trainees to manipulate.

Simulation may be better than real life in some stages of learning as the actual environment may be so complex as to cause confusion. A simulation may be designed to offer appropriate levels of complexity and be designed for progression of learning. Simulation texts often use the term `fidelity` in discussing the degree to which a simulation or simulator represents real life.

Simulations do not appear to be superior to more conventional techniques for mastering fact based learning (Percival 1978, Adams 1977). Percival considers the most important cognitive function of simulation to be the reinforcement of previously learned `skills`.

There is evidence that simulation may boost motivation (Percival 1978, quoting Wentworth and Lewis 1973; Adams 1977). Simulation may have a marginally more positive effect on the motivation of `less able` pupils (Percival 1978). Adams (1977), writing on games, considered that motivation is increased and that there is evidence of increased confidence in later developments. Adams also considered games effective in modifying attitudes. Whilst this research related to games it may be reasonable to expect these effects to apply to many simulations.

These positive effects may be due to novelty. Novelty also applies to staff. As simulations are used comparatively infrequently in most classrooms

staff may take extra care in preparation and presentation, so biasing results. There do not appear to have been any significant studies of the long term use of simulation to determine whether such novelty effects maintain an improved performance.

The ability to manipulate time is of value. Time may be accelerated and/or frozen at appropriate points. The number of significant events within a given time may be increased in order to maximise learning potential. Simulation techniques also allow an exercise to be replayed so that points may be emphasised and participants may learn from each attempt and so refine their approach.

Stress may be deliberately stimulated in individuals by the design and manipulation of a simulation. This may be done to echo that in a working environment and be a specific objective in an industrial or military context. It may also be of advantage in schools, perhaps in pre-vocational work, providing it is well understood and managed.

Simulation, by giving freedom to interpret a context, offers opportunities to develop initiative as mentioned above. Similarly Adaire and Despres (1980) proposed the creation of situations in which pupils can make discoveries. They observed that staff may assist by following five pointers:

a. Manuals must contain programmed knowledge.
b. Simulations must be structured to gradually increase complexity.
c. Structured experiences, such as spreadsheets, should be provided to assist pupils in decision making.
e. Teams should be selected to optimise learning.
f. The indices of performance should be selected and easily understood.

These are self explanatory, though it is interesting to note e. on team selection, and contrast it with the conclusions drawn on team selection in 3.0.

3.5 Competence and the transfer of learning from simulations

It is necessary to address the question of whether learning gained during simulation develops into competencies which are generalizable. The term

`transfer` is used in much of the literature. In this section transfer is discussed and then examined in relation to attitude. Some strategies for developing transfer are considered.

3.5.1 Transfer is a term used by many writers but it is worth questioning before moving on. Menis (1987 p 105) defined transfer as: ---*the ability to utilize concepts from one area, eg mathematics, in dealing with a second.*

The implications are firstly that human experience is compartmentalized and secondly an ability has to be developed in order to take concepts from the context in which they were learned to be applied in another. There is some foundation behind this, as will be discussed later, but the concept of transfer is misleading in that it over-simplifies the apparent mechanisms.

It is the educational system which has established the boundaries which separate `subjects`. Young children do not necessarily apply these boundaries, though they are probably soon conditioned. The definition also fails to identify the role of confidence in `transfer`.

Experience as a teacher indicates that many children and adults do have difficulty applying concepts learned in one subject to another. This may be the case both within a subject boundary or across one. However, is this not more a question of competence?

Competence could be defined as the ability to generalise and operate concepts and skills in a range of contexts beyond the initial learning experience. Competence implies a degree of effectiveness; the condition of being able. Competence also recognises the personal nature of learning, including confidence, whereas the term transfer is more mechanistic. Competence is increased not simply by repetition but also by exercising that competence in a range of different contexts. The competence is expanded and strengthened and the learner should develop a greater confidence in applying it.

Competence is more useful to this enquiry, but much of the relevant literature refers to `transfer`.

3.5.2 Menis (1987) focused on `concepts` which could be seen as sub-sets of competence. He saw concepts as operating across 'areas' of conventional subject domains such as mathematics. This may be an over-simplification, transfer would be necessary within a subject area for that subject to be developed in an hierarchical manner; basic arithmetic is a building block which is used to develop other mathematical concepts. As these concepts develop they support each other and a mathematical competence grows. This competence should be capable of being applied in other contexts at appropriate times and levels as it develops. The contexts in which learning takes place need to be generalized so that the information, schema or strategies developed should be available for use in new contexts. These contexts may be close in structure to the one from which transfer had occurred, or they may be dissimilar. The position in time may vary from immediate to lengthy.

3.5.3 Hesketh et al (1989) used the term `schema` in relation to transfer and in a similar manner to competence. Schema could be defined as principles which enable the learner to understand or to unify experiences; they help shift behaviour from specific to general levels. In this respect schema can be seen as super-ordinate to concepts and part of the structure of competence. Hesketh saw schema acquisition as central to transfer. Schema guide the organization of incoming information into clusters and allow the learner to infer 'default values' when some information is missing, so allowing a picture to be built.

Examples appear to help extract principles and develop schema. Hesketh observed that in mathematics pre-worked examples resulted in a better extraction. The number able to solve a problem increases only when two examples are worked through with the principle made explicit. A single example does not cause significant improvement. More examples apparently increase the chance of the learner recognising the relevant principles. Hesketh did not make any observations as to whether over-use of worked examples could lead to motivational problems as the learner is not as actively involved as when calculating personally.

3.5.4 Latin and computer programming have been claimed to develop processing skills transferable to other areas. Analysis does not support these claims

(Pea 1987 p 641). Some educators make claims for the benefits of learning experiences in Design and Technology in relationship to life in general. These claims often revolve around the ideas of 'problem solving', communications or aesthetic judgement. Are these claims any safer than those rejected by Pea?

There has been a growth in the number of 'thinking courses' such as deBono`s course developed for the British Broadcasting Corporation (1982); but there appears to have been little research as to the long term effectiveness of such courses. The Cognitive Education through Science project (CASE) (Adey et al 1990) may be one exception to this. Claims have been made that a short course on thinking skills at the age of 12 appears to have lead to a significantly positive result in improving GCSE results at age 16. The thinking exercises were short and designed to surprise children who had to go back and iteratively test their explanations for observed phenomena.

3.5.5 In general transfer is an elusive condition for researchers and shows resistance to being taught (Sugden and Newall 1987). In part this may be because the concept itself may be inappropriate as discussed above. If it is seen in narrow, specific terms and tied to traditional subject boundaries there is a danger that children will be effectively encouraged to maintain tight contextual limits on concepts developed. This may be why many teachers experience difficulties in encouraging children to use concepts from one subject area in another. Nevertheless, many workers have adopted the concept of transfer and have taken various positions in attempts to explain it. Most work has been based on 'common elements' theory. This considers that transfer is improved when there are elements common to the situations across which transfer is intended to occur. Subsequent research has shown the situation to be more complex.

3.5.6 Voss (1987) focused on search as a processing concept in relation to transfer. This has relevance as the learner must search for appropriate background information to enable a learning task to be completed. The learning and competence generated must then be searched for in subsequent tasks. Four principles were identified:

a. That in general the smaller the amount of information the easier it is to find a given part of it. Whilst this may be a reasonable assertion in a general sense it has obvious faults in terms of human information processing. Paraphrased, those who know more about a given subject should take longer to find specific information. This would not appear to be the case. The other principles put forward are more helpful:

b. Finding appropriate information depends on the individual's ability to use 'operators'. Voss saw three functions: expanding the problem space; reducing the size of the space and identifying specific information.

c. Finding information is dependent on the way in which it is organized in memory. Information stored as isolated pockets is very difficult to find. Information organized hierarchically is easier to find as there are routes linking super-ordinate and subordinate concepts.

d. Cues make information retrievable.

Searching is clearly directed rather than random otherwise principle a. would stand. The three other principles illustrate that ability to search is dependent on the way information is organized and the way individuals are able to use tools such as cues and the functions outlined in b.

Voss argued that that transfer is super-ordinate to learning and retention. Transfer is seen as a problem solving activity in which information is interpreted, stored and subsequently utilized. Voss observed that problems which are `well` structured tend to have solutions about which there may be general agreement, whereas `ill` structured problems may receive little agreement. This would appear obvious, but is worth mentioning as it reinforces the points above that well structured problems tend to cause the same routes to be followed by a range of individuals, hence an increased possibility of congruence. Voss used the terms `well` and `ill ` structured, but these may be misleading as value judgements may be associated. The implication may be that a teacher should structure problems `well` but this would tend to lead to congruent thinking. Creative thinking is less likely to be encouraged by such structure and the idea that problems can be `well` structured is misleading. An alternative phraseology of open and closed structure may be more helpful.

3.5.7 Pea (1987) took common elements theory as a starting point on transfer but adopted an interpretive perspective. He considered that the elements perceived by the learner as common are not given `in the nature of things` but influenced by the learner`s culturally determined categorisation system. Transfer is socioculturally defined to some extent.

This sociocultural effect indicates that one person will learn from a context or materials differently from others or from what the designer of the materials intended. Putnam (1987) effectively supported this by asserting that learning is an individual active processing of experience.

3.5.8 Transfer is not automatic. Klauer (1989) observed that teaching needed to be explicit on the concepts required to be transferred and over two or more examples (as with Hesketh 1989, above). Similarly he considered there had been little empirical research on what represented an optimum exemplar.

Klauer noted that apparently similar problems do not necessarily result in transfer. Transfer improved if the learners are told the relationship of two problems and if the more difficult is done first. Learners observed were not generally uncovering the similarity of technique when the structure was of a similar depth. Klauer appears to contradict the normal teaching principle of progression, but this need not be the case. Once transfer has been established on a simpler example confidence will rise and the learner may move onto more difficult examples.

Klauer suggested it is necessary to give the learner opportunity to acquire the basic concepts involved in a problem, including the solution and checking procedures. Then the learner should be helped to recognize different structures and to transfer to new field of application.

3.5.9 The difficulties in transfer indicated by Klauer were illuminated by Putnam (1987) in the area of mathematics. Putnam observed that many children appeared to keep any mathematical concepts and procedures they acquired outside school quite separate from those learned in school. These children appeared not to recognise the linkages and considered the

mathematics learned at school to be sets of rules and procedures with little or no relevance to them.

These difficulties with mathematics are not confined to children of low intellectual ability. Menis (1987), working in higher education, noted that in teaching chemistry there were problems in transferring appropriate mathematical procedures into context. This was not confined to complex mathematical procedures but was also evident in basics. Menis cited Bent (1976) who echoed his points. Neither of these authors explored the reasons for this phenomenon, but it will be considered further in 6.0 in relation to fieldwork where, again, the transfer of mathematical understanding emerged as a factor.

3.5.10 Sugden and Newall (1987) worked with children with learning difficulties and noted that the transfer of learning was usually poor. They reported that concepts appeared to be 'welded' to the situation in which they were learned. These authors took transfer to be based upon memory, unlike Voss who saw transfer as super-ordinate to 'retention'. Sugden and Newall employed strategies to improve memory. It was an apparent assumption that this would improve transfer. They reported an experiment in which children with learning difficulties were encouraged to talk to adults about their work, in order to boost their memory of a topic. This technique was found to have some limited success in improving transfer, though the effect on memory was more positive. This reinforces the idea (Voss 1987) that memory is a sub-set of transfer. Sugden and Newall, like Hesketh et al (1987) and Klauer (1987) emphasised the need for multiple settings for work in order to improve childrens' ability to identify the concepts or principles required for transfer in different situations.

There appears general agreement in the literature that transfer is facilitated when the learner has understood the principles behind a range of concepts rather than simply knowing procedures (Hesketh et al 1989). Principles are general, can be applied in more contexts, and appear to be remembered more easily. Hesketh considered that this may be because the principles are used in a range of situations. This echos Klauer's point on the use of several examples. Hesketh pointed out that procedures are remembered better if the underlying principles are understood. Klauer considered that teaching should be aimed at principles, categories and

structures rather than subject matter. This should be done via suitable examples. It was also suggested that learning may be improved by reducing subject matter. To some extent this complements Boreham's point (1985) that performance in simulations may rise when the fidelity of the simulation is lowered (discussed in 3.9.2).

3.6 Transfer and Attitude

Childrens' feelings about their learning ability may affect their interest in learning. Pea (1987) noted that if children conceive intelligence as a stable quality, rather than one which it is possible to increase through effort, then they are more likely to view errors as failures. These statements open the possibility of a loop leading to poor motivation, self concept and attitude to learning. Pea considered affective and motivational factors to directly affect transfer and hence learning.

McKeachie (1987) considered transfer to be dependent on the analysis of situations and the determination of those aspects considered relevant. The contrast between teaching cognitive skills directly or via a domain of knowledge was considered and it was observed that the use of real world situations may aid motivation. Pea (1987) adopted a similar socio-cultural perspective and pointed out that much school based education is orientated at transfer from school to every-day life, but that there should also be thinking about transfer from every-day life to schools.

Salomon and Globerson (1987) introduced the concept of 'mindfulness'. This was defined as: *A mid level construct which reflects a voluntary state of mind and connects amongst motivation, cognition and learning. It is both a general tendency and a response to situational demands.* (p 623)

This statement is helpful in that whilst it considers there may be a form of base level mindfulness in any individual there is also a response to the specific learning situation. Increased interest will raise mindfulness. Salomon and Globerson described a 'zone of proximal learning' as the gap between what a learner can do and what they actually do under normal conditions. Increased mindfulness was considered to narrow this gap, maximising potential.

Salomon and Globerson (1987 p 625) described a mindful process as one where individuals do not put forward the first ideas which come to them but examine and elaborate situational cues and underlying meanings, generate alternative strategies, gather necessary information, examine outcomes, draw new connections and new abstractions.

A mindless process would be where the individual relies on salient structural features, often erroneously, taking them to represent a familiar underlying meaning. Salomon and Globerson considered that mindfulness did not correlate with effort. This raises questions as to what factors do influence mindfulness. Four areas were listed: a general tendency of individuals to prefer problems and situations which are mentally demanding, the socio-cultural and intellectual climate, situationally specific motivation, the perceived demands and value of the task. They also considered that teamwork may increase mindfulness, an important point in relation to this enquiry. The relative degrees to which these factors would influence mindfulness were not discussed and would be difficult to evaluate. However, the situationally specific motivational aspects and perceived value of the task are capable of manipulation by staff.

3.7 Strategies for developing transfer

A series of possible strategies emerge from the literature.

a. Focussing specifically on memory; the use of techniques based on rehearsal, organization, visual imagery and semantic elaboration may assist memory and indirectly transfer. Developing from rehearsal is the possibility of promoting transfer by the utilization of a range of different contexts for a given area. In this way a variety of associations may be built, assisting future retrieval. Research on memory indicates that rehearsal should initially follow quickly and then subsequent rehearsals may follow at increasing distances in time (Buzan 1985).

Rehearsal, in relation to transfer, is very similar to the emphasis on iteration in simulation literature. Iteration, besides allowing the development of the learning context in measured increments, rehearses learning. Handled correctly, confidence and competence grow, effectively increasing the range of `transfer` possible.

b. Staff need to teach overtly for transfer. Problems or situations should be categorized in such a way that similarities are apparent. Children should be helped to recognise the principles involved and to see that they are using them in different situations or examples.

c. The difference between one example and another should be initially minimal in order for the similarities to be more obvious. Frequent repetition allows this similarity to become more obvious. The scale of the differences or the time and frequency of repetition required are not made explicit in any of the work reviewed here. It may be reasonable to assume that these will vary depending on the individual and the specific situation and structure. Staff would have to establish optimum values by gaining feedback. This again reinforces the value of iteration, in this case so that staff may tune the structure to match the learner(s).

d. Within a simulation the lowering of fidelity may remove some confusion caused by peripheral factors and so improve transfer (Boreham 1985).

e. Learning should take place in functional contexts.

f. School and non-school problem solving contexts should be bridged in order to improve perceived relevance. Staff should be aware that transfer appears to be partially dependent on socio-cultural factors.

g. Subjects should be integrated in a synergetic manner (Pea 1987). Pea claimed that the synergistic design of learning contexts enabled a greater yield of understanding than the study of disaggregated subjects. This assertion is not supported but will be discussed further in section 6.0.

h. Staff should explain transfer and help children clarify the areas of similarity in different examples.

i. Children should be encouraged to ask questions on their learning. This will be more difficult when a novice in a given area. Staff should focus on helping children to be able to frame questions. Iteration would assist here.

j. Salomon and Globerson considered that 'teamwork' may increase mindfulness. Their paper did not amplify this and they admitted the evidence was indirect, but in relation to the section on groupwork it further strengthens the conclusion that group or teamwork has value in learning.

3.7.1 In conclusion transfer can be seen to have some value in exploring the development of competence. However, in relation to simulation two key points emerge: the need for rehearsal and for staff to make structure and commonality explicit. These echo the general iterative principles explained elsewhere in section 3.0 and the role of the teacher at briefings and debriefings in helping learners extract the principles from each episode.

3.8 Time in relation to learning

This section examines time as a resource in relation to the learning approach under enquiry. There are three areas of consideration.

The management of time within the curriculum. Some aspects of efficiency in conventional timetabling relating to pupil time on task. Suspension of the timetable as one method of achieving concentrated study.

3.8.1 The management of time in schools is, to some extent, linked to the way in which knowledge and experience are viewed. Conventionally, knowledge is divided into `subjects`. Most of these have built foundations through centuries of specialist study, but this differentiation has to some degree established a separateness which does not exist in life. A child does not have such a compartmentalized view of the world initially, probably seeing it wholistically (Merritt 1972). This is generally reflected in primary school practice but not in secondary. Growing intellectual maturity requires increased depth and specialism is the usual reaction to this. The common primary school model of one teacher covering most, if not all, subjects could not operate in secondary education.

The categorisation of knowledge and experience is necessary. Order is established on complex phenomena by the process of categorisation, making thinking and communication more efficient.

The ways in which time is managed in most schools, especially as years 10 and 11 are reached, is based on conventional subjects together with some basic attention span psychology. This gives rise to a timetable of exposures to each subject in periods typically of 35 to 75 minutes. Whilst the timetable serves the curriculum it then becomes the organising structure around which the school revolves.

Much has been written on timetabling but fundamental questions as to the way time is handled as a resource are few. A survey of publications on timetabling would find consideration of period length; five, seven or ten day timetables and `continental days`, but few address questions as to whether time should always be used as a series of short periods with complete changes of focus.

Associated with this Osbourne (1986) observed that there is a disciplinary and custodial tradition in schools which considers that pupils should be supervised directly at all time. Equally, all pupils of a similar chronological age are generally given equal blocks of time in subjects irrespective of their progress. These points lead to a tendency to study subjects in classes as small as possible and with the maximum teacher contact. The literature tends to concentrate on how this contact time can be maximised rather than asking questions as to how children may gain by sustaining their own work.

The emphasis on contact time means most schools have little time for administration and no slack time for thinking and responding to opportunities, let alone emergencies. The timetable tends to be centralised and set for the academic year. This limits opportunities for experimentation or response to opportunities.

There have been attempts to take fresh perspectives on time management. Knight (1984) used the terms `time shifting` and `time flexing`. Time shifting consists of manipulating the hours of the school day rather than the basic structure. Examples include altering period lengths; 4/5/7/10

day timetables and continental days. These are often based on logistical rather than educational reasoning. Time flexing often arises from disillusionment with the conventional day and the effects on learning. Examples of flexing include the Stantonbury campus `day 5` (later day 10) or `activity weeks`. The learning approach explored in this enquiry could be described as time flexing.

3.8.2 Whilst recognising the logic behind the conventional timetable there are sources of inefficiency which are directly relevant to this enquiry. Movement at lesson interfaces, including time spent clearing up and subsequently refocusing groups after having moved to a different classroom and teacher, may add to a substantial proportion of the school day. Lindsay (1988) pointed out that 10 minutes lost per day can add to as much as five school days per year. Break times similarly mean time is required to refocus. The question of the degree to which children require breaks receives little attention especially if questions are asked as to frequency, duration or quality.

Academic Engaged Time (AET) and Academic Learning Time (ALT) are concepts which help illuminate the question of efficiency of time usage. Fisher and Berliner (reviewed by Rosenshine1986) defined AET as time allocated multiplied by the percentage of student engaged time. ALT is AET multiplied by student success rate. There is a positive relationship claimed between AET, ALT and student achievement. Whilst ALT suffers from the lack of definition of `success`, the concept is still useful.

AET may be increased by positive reinforcement techniques. Myers (1990) observed that AET increased when teachers circulated, checking work rather than staying in one place with children coming to them. Interestingly Fisher and Berliner considered that whole class instruction generated a higher AET than small groupwork. However, these authors indicated that this was due to individuals working alone in the groups rather than receiving reinforcement from whole class teaching. Despite the fact that small groupwork should enable staff to set more appropriate work levels, limiting reinforcement lowers AET. More imaginative groupwork which gives pupils the required feedback may raise the AET.

3.8.3 There is relatively little literature on the suspension of conventional timetables in order to release substantial blocks of time for dedicated use. Such techniques have been used for `activity weeks` but these have been largely seen as of a recreational or vocational nature. Little serious evaluation has been produced on the educational value of using time in this way. Activity weeks have usually been examples of time-flexing from a logistical need; to provide whole days in order for pupils to travel away from site.

`Crash courses` are a device used by language teachers and increasingly for other training/education from driving to watercolour painting courses. These have tended to be used in specialist centres where timetables are unnecessary and large blocks of time are used for concentrated study. A similar technique is `total immersion`, often applied in languages where learners are taken to another country and put with families on a one to one basis so that use of the language under instruction is maximised.

These techniques have established credibility. Work by Grimes and Niss (1989) on the concentrated study of economics via distance learning supported the view that concentrated time periods may lead to improved effort. Students in the Grimes and Niss study appeared to have learnt as much as students following the course over a normal timescale.

Parlett and King (1970), working with a group of undergraduate physics students, experimented with `concentrated study`. They defined this as full time study of a single subject for a short period with no concurrent academic commitments. They observed that the majority of students became fully involved and seemed unable to leave their work alone. Similarly the staff concerned report that the teaching itself was more rewarding and that it was possible to get to know individuals better.

Parlett and King were careful not to claim that the students learned any more than those following conventional courses but there were clear indications that the levels of effort (endeavour?) rose. Parlett and King pointed out that the experimental group may have developed higher levels of laboratory skills and conceptual insight through concentrated study, though these were not established. The majority of students were reported as being strongly for the concentrated study model. Parlett and King felt

concentrated study was more efficient; generated more participation and encouraged a greater degree of questioning from students. From a student point of view worries and rush appeared reduced, confidence grew and students reported enjoying the style of study.

The time structure used by Parlett and King was concentrated but work varied from lectures to tutorial, group work and project work.

Concentrated study does present some problems. Students who fall ill may miss substantial blocks of work whereas in a conventional timetable it would be easier to catch up the larger number of smaller pieces of work. Some students reported that once the study was over they tended to forget the work if it was not reinforced by use.

The number of properly recorded concentrated study enquiries or experiments are few and so there may be a strong Hawthorn effect and, as the innovator is often the teacher, experimenter effects. Questions must be asked as to the effectiveness of such work over a prolonged period of time.

3.8.4 In conclusion the tradition of maximising staff contact within a subject based curriculum and multi-period day appears to be inefficient due to time wasted in movement and re-establishing concentration. It may be more relevant to look at maximising student success by increasing AET.

Whether suspending the timetable to allow concentrated study is more effective than most conventional structures cannot be fully answered with the limited research available in the literature. It is possible to state that the indications are that such structures may be no worse than the conventional. It appears that most pupils and teachers prefer to work using concentrated study and increased effort has been observed. Nevertheless extended observation would be required to confirm this. If these effects are only due to Hawthorne and novelty effects they may diminish if the form of study is used more frequently.

3.9 Simulation design, objectives and strategy

This section deals with the design of simulations. General strategy and objectives are discussed followed by questions of time, fidelity,

competition, the use of computers and software, roles within simulations and briefing/debriefing.

If simulations are to be purposeful they should relate to the broad aims and objectives of the teacher. Methodology may be chosen for the wrong reasons. It is possible to choose a commercially produced simulation and fail to recognise that the author designed it to achieve objectives which may not be the same as intended by the user. A simulation, like any teaching material, will need to be adapted to a specific situation by the staff using it. Familiarity with the principles involved is important in order to be able to adapt simulations effectively.

Rediffusion (1986) suggested trainers use a performance analysis based on costs; safety; availability; efficiency and product quality, prior to making a decision on methodology. If simulation is appropriate the trainer must determine: type; scale; fidelity; evaluation and cost. These must relate to the learning context in question. In a school the facilities available, time span and the way in which time is managed must be considered together with the experience of staff in designing, adapting and running simulations.

In designing a scheme of work a teacher would normally be considering a broad range of objectives spanning knowledge, values and attitudes. When designing an exercise within a scheme specific and limited objectives are brought to the fore whilst maintaining an awareness of general objectives. Listing large numbers of objectives at one time would be counterproductive as the teacher would be overwhelmed. The assessment of all these objectives would be difficult, consuming more time than could be afforded.

Shirts (1975) considered the setting of specific objectives prior to designing simulations to be counterproductive. Specific objectives cause the design focus to be narrow and the range of ideas to be limited. Increasing the range of objectives may augment the width of focus but become unwieldy. Shirts proposed that rather than specific objectives the simulation designer should operate from a *general intent and purpose*'(p 148).

This may appear to contradict the statements above. However, the professional role of the teacher requires the constant awareness and understanding of a broad range of objectives whilst any specific learning event is designed. Record keeping will ensure that all objectives are addressed over an extended period. Some objectives may be hidden from the participants (Roebuck 1978).

It is difficult to propose a sequence for simulation design. Every design episode is unique due to the interplay of factors involved. Nevertheless the following are a series of factors which should be considered. They are not exhaustive and do not represent any order of priority.

3.9.1 Time as a factor within simulation design

Simulation allows time to be compressed. This can maximise learning opportunities by increasing the number of significant learning incidents experienced. Within simulations time may be to a specific scale, for example one hour may equal one month in the simulated environment. Time may, in effect, be dictated by the flow of events which are under the control of staff.

Time may also be frozen by staff in order to examine the current position in a simulation. A given experience may be repeated after a given episode and debrief, in order to maximise the learning benefit from it. This also means that individuals who may have had difficulty with an episode may go back and gain competence before moving on.

It is possible to distinguish between time which is controlled by the designer and that by the participant. Lovelock (1990) used the terms exogenous and endogenous respectively. The designer may set a structure which is exogenous and allows the participant(s) no freedom to use time as a part of their strategy. It is also possible to set an exogenous structure which allows participants some endogenous control.

Time may be manipulated exogenously to raise the level of stress experienced by participants. Typically more information may be required to be assimilated in a shorter time. This technique may be combined with a

shortening time scale so that more stress may be induced as the simulation proceeds. Such techniques are common but ignore the point that stress is an individual's reaction to a situation. Given the same simulation one individual may suffer considerable stress whereas another may be relatively unaffected.

A common simulation technique is for 'decision points' to be set exogenously at regular intervals. New information must be assimilated and decisions made at these points. This gives the simulation structure and establishes a pace. This may give the impression that decisions must be made on a frequent and regular basis and that all incoming information must elicit a response. An important decision may be to do nothing. Similarly the participant(s) may have some endogenous control, that is be able to decide when to act.

The time span over which simulations operate may vary. If the simulation is totally based on a computer two hours may be a reasonable maximum (Rediffusion 1986). This would be as much due to the physical reactions of working with Visual Display Units (VDU's) as the psychology of learning. If a simulation uses other media and more particularly mixed media, there would appear to be no reason why it may not operate over extended periods of time.

3.9.2 Simulation fidelity and complexity

Fidelity is a term used to express the degree to which a simulation accurately reproduces the character of the simulated system or environment. High levels of fidelity may mean the simulation is complex. Much work is done on improving the fidelity of systems such as flight simulators making them very realistic but it is an assumption that fidelity represents higher learning benefits. Rediffusion (1986) considered that for complex skills there is greater learning transfer from careful practice rather than high fidelity. Evans and Sculli (1984), writing on games, considered that learning benefits are not related to complexity. High levels of fidelity often also mean higher costs. This may be justified if the cost of training in the real situation is expensive or difficult to use, for example learning cockpit procedures in a new aircraft. Nevertheless much useful

learning could be gained by simpler procedures such as pilots studying examples and exercises of instrument readings from a prepared text.

Boreham (1985) indicated that transfer of learning may be improved by lowering fidelity as peripheral factors may be removed enabling learning to focus on central aspects. Similarly Shirts (1975) warned not to be over dependent on 'reality'. There are many realities, the question is what aspects are to be simulated and at what level of abstraction. Rediffusion pointed out that only those aspects of the task that are relevant to the training purpose should be selected. Simplicity may also offer greater versatility.

Fidelity has several sub-sets. Physical fidelity can be illustrated by the pupil learning the 'rules of the road' by moving models on a diagram of a street layout or by riding a cycle through dummy junctions and traffic lights on a training ground. Fidelity may be operational in that it offers the dynamic reactions of a real life situation together with being structured in the same way. Finally fidelity may be instructional in that there is a learning transfer taking place. Any simulation may have these aspects of fidelity at different levels.

3.9.3 Competition

Competition in commerce is inescapable. Competition in group and teamwork has been discussed in 2.0. Most of these points may apply in simulation. Evans and Sculli (1984), evaluating business games for the development of managerial talent, referred to work by McKenny and Dill (1966) and Ghiselli (1971). These indicated that competition does increase motivation and sustain effort. However, a ---*highly competitive environment detracts from the game's value as a teaching aid* (p10).

Evans and Sculli did not clarify what they meant by `highly competitive` or what they saw as value, nevertheless these results support the work discussed in 2.0. Competition appears to assist motivation but high levels detract by causing teams to adopt rigid structures with often authoritarian leadership. Levels of discussion drop whilst teams become insular and mistrust of other teams builds.

It is not clear whether it is competition or the increased motivation generated which becomes dysfunctional at higher levels. Research is necessary to question the origins; whether levels can be measured, and controlled; and what levels in which conditions provide optimum motivation with minimum dysfunction.

3.9.4 Simulation and the computer

Computers may be used in many ways within simulations. At a simple level they are tools like a pencil or dictionary. Participants may use standard software for word processing, design, or data handling.

Computers may also be used by staff to minimise time consuming procedures such as marking, maintaining records or producing reports from simulations. Rediffusion (1986) also considered the computer may be used to relieve staff of mundane tasks, allowing them to concentrate on 'more creative aspects'.

The computer may support the simulation via the use of software designed for this purpose. This may be illustrated by the many business simulations which are computer based. The programme may contain various sub-routines, formulae and visual displays to enable the participants to react to the programme without direct staff supervision. This enables staff to act in a supportive role, as 'adaptive interventionist' (Roebuck 1978). Staff may be freed from the administrative and basic instructional role and so be able to selectively intervene with individual or group learning as they recognise opportunities to discuss aspects and draw out points. Such freedom may be of particular advantage in mixed ability learning situations.

A simulation may be completely computer based. In this way the software would offer information and process data and decisions entered by the participant. Results would be produced which could take many forms including numerical data or written statements related in the programme to specific levels of performance. As computers become more sophisticated they offer more processing power. This gives the designer flexibility in visual display, better and faster data handling and 'user friendliness'. The designer may also offer differing and controllable levels of difficulty, or

speed so that participants may be challenged realistically at various levels of ability.

A simulation which is completely computer based would need to be sensitive to the problems of using a computer and VDU. People vary in their confidence in using a computer. In this respect the simulation may offer a misleading result if it is representing a system where the participant would not normally use a computer.

The computer is not an essential part of a simulation but it should be considered in the design stages. Megarry (1978) writing on computer based educational games, considered there was consistency with the following educational themes:

a. The programme may create learning opportunities and manage resources for the teacher.
b. Pupils may take an active role, processing information, making decisions and testing.
c. Pupils may take responsibility for their own learning and assessment to some extent.
d. Frequent feedback is possible.
e. Individual differences may be accommodated.
f. The simulation of situations beyond the classroom is possible.
g. Pupils nearing leaving age may see relevance and realism in such activities.

Megarry`s points have as much relevance to computer based simulations as games. The points are also not exclusive to computer techniques.

3.9.5 Roles within a simulation

A distinction has already been made between roles within a simulation and role play. In simulation any role should be described by function; each role should be played with personal autonomy rather than be constrained by a description of the personality with which the role should be played. The functional role of a bank manager may be set within a simulation; instructing the individual to play an 'unsympathetic bank manager' is to

enter role play. Jones (1989) and Shirts (1975) both supported autonomy within simulation.

Many simulations set certain roles. Typically in a business simulation there may be a managing director, sales director, production manager and accountant. This tendency may be contrasted with Buchanan's (1989) observation that vertical management structures may limit performance. Whilst Buchanan was not ruling out the roles described above he was reflecting on rigid systems. Similarly Hampden-Turner (2.0) reported that companies with a rigid structure and hierarchy performed less well than those with looser and 'flatter' management. The approach adopted in the case studies of this enquiry was to let the pupils in each team decide on how to set roles, how those roles may be defined and the degrees of flexibility of roles. This approach was adopted to stimulate discussion on the management of the task set.

Staff supervising simulations should be aware of how roles are set or develop whether by staff or participants. Bias may emerge based on gender, age, ethnicity, personality or even body physiology. Such bias may be allowed to take place and become one of the points raised at debrief.

3.9.6 Briefing and debriefing

Briefing and debriefing are dealt with collectively as it is essential to see the process of learning in a simulation as a continuous cycle. Kolb`s learning cycle was mentioned above and Hampden-Turner`s work discussed in 2.0. Debriefing has been covered to some extent in 3.3.2.

From the participant`s perspective the simulation begins with a briefing, this is followed by practice and debrief. In a short simulation the cycle may end here, although there would be planned linkages with future work. With longer or more complex simulations it is usually better to have a number of cycles. The first may be short and a simplified version of the simulation. This would introduce the material gradually and `warm-up` the group. The debrief to this first cycle would be used to discuss points, clarify issues and in effect become the briefing for the second cycle.

The briefing is important but it should be as short as possible to gain time for experiential work. In contrast the debriefing requires time. This is because it is at the debrief that fundamental learning takes place.

The briefing should be organised to put over necessary information concisely. The following is a list of points which should be considered:

a. A brief explanation of the activity and why simulation is being used.

b. The assessment objectives may be listed. These would be only those relevant to the participants.

c. Time scales should be made clear. Meeting deadlines is often a part of simulation.

d. The sequence of the simulation briefing explained in a. should now be made explicit.

e. Participants may be asked if they wish to clarify points. This should not be allowed to develop into a lengthy discussion. If there is to be a series of cycles it is better to use the first debrief as a forum for clarification.

f. A warm-up activity may be planned (see 3.10.1). In this case it may be appropriate to brief only for this, run the warm up, debrief on it and proceed into the briefing for the simulation as such. Warm-up may be achieved by a simplified or slower version of the simulation, or a completely separate activity may be planned.

During the simulation staff act as facilitator and observer.

The debrief is essential to the process of transforming experiences into learning. It is important to stand back and reflect if the immediate experience is to be transformed into learning (see also learning transfer).

It is first necessary to break the activity and refocus the participants into debriefing. This may sound obvious but as a completely different style and pace of working may be involved it must be considered with some sensitivity. In the case of pupils they may view the debrief as

uninteresting in comparison with what may have been an active and exciting simulation. The very act of breaking off the simulation and the form of the debrief then become important.

Most authors consider that debriefing should immediately follow the activity. The logic is that the experience is fresh in the minds of the participants. Whilst accepting this it may also be advantageous to consider a two stage debrief. This would consist of an immediate debrief to clear essential points. A period of time may then be allowed for reflection and to enable participants to take a better perspective before holding the second half of the debrief.

The debrief should be a discussion rather than a listing of staff observations. Thatcher's (1986) point on the need for active articulation by learners was raised in 3.3.1. Discussion takes time, participants must be allowed to express their feelings and consider ramifications. As the experience usually immediately precedes the debrief it is fresh and much discussion can be generated.

Debriefing may also use written reports and/or questionnaires. The logic behind all is similar. Van Ments (1983) wrote in relation to debriefing role play, but the principles would also apply to simulation:

a. Allowing participants to express immediate points.
b. Draw conclusions.
c. Develop action plans for:
    further classwork
    work outside the school
d. Provide support.

Allowing participants to express immediate points should be done on finishing the simulation. At this stage it may be necessary to lower tension, pace and any competitive anxieties. Participants must be allowed time to make points they, rather than the staff, consider important. There may also be misunderstandings that have arisen during the simulation which require clarification at this point.

These aspects can never be neatly closed; a point is reached when staff may move the debrief towards the second stage of drawing conclusions. The majority of this stage may relate to the objectives put forward at the briefing, but other points may arise during the simulation and initial phase of the debrief which are of general relevance. Simulation is always liable to generate a wide range of teaching/learning opportunities beyond the specific objectives identified by staff. Typically debrief would identify the processes developed by participants and clarify factual aspects together with concepts or principles used (Thatcher 1986). This phase may also consider emotional response to the simulation and draw conclusions in this area.

The third phase of the debrief looks forward by developing action plans. These plans could be intended for experimentation in the next cycle of a simulation or for other work in school or beyond.

Van Ments' final stage is to provide support. This could operate either within an ongoing simulation or other work. This support would be incorporated within long term schemes of work.

3.10 The simulation in action

3.10.1 The warm-up

Simulation designers should never underestimate the potential for anxiety in participants. This may arise from: unfamiliarity with new colleagues; the method of working; the complexity of the simulation; the threat of assessment.

It is necessary to reduce such anxiety in order to create a receptive group. This should be balanced against previous observations on the possibility of engineering stress into simulations. Nevertheless, it may be desirable to use an anxiety reducing warm-up prior to a simulation intended to build stress.

The simulation may have, as an objective, the changing or development of attitudes. In this case careful preparation is particularly important as attitudes, particularly those closer to the individual`s self concept, are difficult to change (Purkey 1970).

Warm-up techniques need to be flexible to accommodate context, participants and the time and facilities available. There are two main areas which require attention: inter-personal relations and the structure of the simulation. In the case of a group known to each other and familiar with simulation techniques the warm-up may be simple or even unnecessary.

Interpersonal warming-up may vary from simple introductions to more sophisticated activities designed to bring people closer together via shared experiences. These need not relate to the simulation itself. Van Ments (1978) suggested that physical movement during a warm-up may be used to relax participants.

A form of warm-up to familiarise participants with the simulation structure is to use a shortened and possibly simplified form of the simulation. Participants may quickly go through one cycle and be prepared for the main event.

3.10.2 The teacher`s role within the simulation

Glandon (1978) observed that the teacher`s role in simulation changes, to some degree, from that of most normal classroom teaching. The teacher becomes more of an interpreter or guide rather than expert or judge. Glandon oversimplified these situations in relation to role, but the observation provides a starting point.

Several authors use the term `facilitator` to describe the role of the teacher within a simulation (Shirts 1976, Rediffusion 1986, Perry and Euler 1988). Here the facilitator promotes learning by others rather than the more conventional role of `expert` passing on certain bodies of knowledge. The role would change with the progress of a simulation.

Initially the teacher would probably be involved in the modification or design of the simulation to suit the specific learning context. To do this requires a degree of familiarity, confidence and creativity. The limitations of using simulations, which may have different objectives to those of the teacher, without modification have been discussed above.

During the briefing the role will be as a giver of information, there will be little promotion of discussion.

During the working sections the role will be as facilitator and observer. As a facilitator staff should attempt to stand back and allow participants to take control of their own situation. Standing back provides opportunity for observation and selective intervention. The teacher adapts the mode of intervention to match the learner and context, helping the participant draw meaning from the simulation rather than attempting to impose meaning.

As an observer the teacher may operate in various manners. Dawson (1990) proposed four sources of observation, though these should not be seen as mutually exclusive:

a. Direct and neutral, the teacher is present but avoids contact.
b. Direct and participative.
c. Indirect, via video or audio recordings.
d. Self report. This is not observation as such but the use of some form of report by participants

Jones (1989) considered that staff should adopt non-interference during a simulation, that is avoid a participative role. This gives participants a greater degree of autonomy. Within a school situation with young children it may be more appropriate to be an adaptive interventionist so that errors or misjudgements by participants are not allowed to demotivate entirely. Staff need a great deal of experience and sensitivity in order to know when to intervene and when to stand back. No outsider can advise here, it is a question of being close to the group and to the ambience of the simulation.

Indirect methods are unlikely to be used in schools as the primary source of observation, though they may provide additional data. Similarly self reports may be of considerable value if juxtaposed with staff direct

observation. Dawson warned against accepting participants` declared intentions as representing their subsequent behaviour and similarly staff need to be cognizant of participants altering their behaviour when aware that staff are observing.

At debrief the role of the teacher should remain, to some degree, as facilitator, but it is also necessary to act as a chairperson, drawing out observations and discussion from the group. There is a danger of reverting to an authority role at this point. The teacher may take the lead and impose their own perspective on the debrief. Having made this point teachers can never abandon their position of authority completely.

The form of the debrief may vary but the objective is to help participants translate their experience into learning. This requires high levels of professional competence in areas which may not normally be a part of the teacher`s work. Firstly acute observation is necessary during the running phase in order to have a comprehensive perspective on the performance of the simulation and the individuals within it. At debrief it is necessary to be flexible and be prepared to allow participants to move in a direction which may not be that seen by the teacher. Confident and sensitive chairing of a debrief, when handled as a discussion, may be used to bring out aspects without imposing them. At this point the teacher will be handling a class of individuals very much in a mixed ability and possibly cross-curricular manner. As experience is gained this will be possible but the teacher would be advised to gain experience using simple simulations over limited periods of time.

3.10.3 Evaluation

Every teaching episode must be evaluated in order for staff to measure the degree to which intentions are being met and also as a part of the constant quest for improvement in methodology. This is not to say that every teaching technique or episode may be effectively evaluated by the same technique.

It has been established that simulation is not a suitable vehicle for factually based learning. Most simulations focus on the affective domain and the development of broad skills such as communications, problem

solving, decision making and interpersonal skills. Staff may wish to incorporate previously learned factual information into a simulated context in order to rehearse or integrate into a broader knowledge base but in this case it would be the integration rather than the factual information that would be the focus for evaluation.

Objectives in simulation tend to be pitched broadly, though specific objectives may be highlighted at various times. Evaluation techniques which quantify the learning of specific facts are unlikely to be suitable for a set of affective and cognitive objectives in a simulation. A further difficulty is that simulation episodes rarely have a finite ending. Iteration, added to the difficulty of quantifying typical objectives, means that simulations are essentially open-ended, the emphasis being improvement rather than the achievement of a quantifiable level of attainment. The dynamic effects of participants responding with autonomy and being allowed to raise points during debrief also combine to make the outcomes of simulation relatively unpredictable.

Evaluation instruments should be chosen to suit the objectives under consideration. These would include observation, questionnaire, attitude scales, interview and NGT. In addition various tests could be used to evaluate knowledge based learning which may be part of a simulation. As in any research situation it would be appropriate to triangulate methodologies within the resources available.

3.11 Summary

The literature appears to build a case for simulation having certain advantages over more conventional classroom based teaching and learning. There are also warnings that, improperly understood, features of simulation may be dysfunctional. Practitioners need to understand the limits and limitations of the techniques contained within the overall concept.

Simulation is based on experiential learning and so is in tune with National Curriculum Technology. There are indications that it is motivational if only via novelty effects. Nevertheless, if motivation is generated by

novelty staff may use the effect to good purpose, though the effect would probably diminish with frequent use. There are questions here requiring further research.

Competition has also been shown to be a possible factor. In business and military simulations it is often an overt factor within the design of the simulation. Within schools the question of competition becomes more problematic and will be explored further in section 6.0.

Competition may build motivation but also builds anxiety and stress in individuals. Everybody is susceptible and the way in which individuals respond is complex. Nevertheless it is apparent that there may be a relationship between competition and the areas of anxiety, stress and performance. Whilst the stress response is individual the causal factors are, to a large degree, controllable by staff. More research is needed to clarify this area of simulation.

4.0 The methodology of this enquiry

It is the mark of the aware researcher to pay customary tribute to the imperfection of his instruments and to show knowledge of the recurrent criticisms. But once these official regrets have been made it is business as usual. Hampden-Turner (1971 p 2)

4.1 Introduction, motives and their influences on the enquiry

This section relates the motives and context of the enquiry to the working methodology. To do this methodological decisions are examined at three broad levels as a form of hierarchy:

An organizational paradigm.
Case study as the operational level.
The specific methodological instruments employed.

This enquiry had no finite starting point but evolved from the pre-enquiry events. The central motives which shaped the enquiry were the need for understanding, development and dissemination. This meant that:

Understanding. I was conducting the enquiry partly from the perspective of the practitioner. I was concerned that limited resources would mean that to use quantitative methods associated with a hypothetico/deductive paradigm would mean that little would be revealed of broad value to practitioners. Parlett (1980) had shown that quantitative methods had failed to offer insights to teachers because of their tightly focussed nature. Similarly a closely focussed ethnographic approach would reveal a great deal of pupils` reactions to the approach but at the loss of a broader practitioner perspective. A broad, rather than reductionist perspective was needed.

The methodology employed had to enable factors to emerge and then be related rather than isolated. As Hampden-Turner (1971, p 29) put it: --*breaking down of the life field into fragments must be recognised as a potentially regressive process.*

Development. The pre-enquiry phase had effectively been action research in that there was intervention in the events under study and an examination of the effects of this intervention (Cohen and Manion 1980). Often points would emerge during an event which were then immediately incorporated in order to give an improved learning experience for pupils. As Suggett (1986, p 4) put it: *It is axiomatic that professional considerations must always outweigh research concerns.* As the learning events in both pre-enquiry and enquiry phases were `live` and to commission it was not possible to use experimental techniques such as control groups or to hold variables constant.

Similarly working within an educational environment and necessarily responding to opportunities for fieldwork meant that the detailed course of the enquiry could not be charted in advance. It was important to be able to react flexibly to emerging factors.

Dissemination. Freeman (1986) emphasised that the results of educational enquiry should be acceptable to participants in a common sense way. Teachers were necessarily participants in the fieldwork of this enquiry and it was intended that findings should be disseminated broadly to the profession. This has been done to some extent by writing articles in professional journals. However, I also wanted the enquiry as a whole to be accessible to the profession.

Considering these three central motives together suggested the enquiry should focus on case studies of the learning systems typified in the pre-enquiry phase. This would ensure a broad perspective with value to the profession whilst admittedly lowering the depth of understanding achievable on specific aspects within. The logical way forward appeared to be in the development of understanding through a series of case studies with both sufficient variety and commonality to build a level of reliability in observations. Having stated this it is necessary to firstly take a step back and discuss, at more depth, decisions made at the level of general paradigm for the enquiry.

4.2 A working paradigm.

Initial reading in search of appropriate methodology can cause the individual researcher much concern, as Freeman (1986 p 196) indicated: *Some researchers have an almost evangelical zeal about the correct way in which to do research.*

Appropriate methodology is essential and there can be no excuse for a lack of rigour. However, it was necessary to maintain a firm grasp of the central motives for this enquiry and not become method bound.

Whilst there is a plethora of terminology it was apparent that much is synonymous and it is possible to elicit two broad paradigms. The terms hypothetico/deductive and illuminative/qualitative are used in this enquiry. From a practical perspective the establishment of such apparent dichotomies is misleading as one may be eclectic, depending upon the nature of the task. Cohen and Manion (1980) pointed out that the paradigms are complementary rather than competing. Within this enquiry methodologies were used which could form part of both paradigms. Nevertheless, at this point it is relevant to address these broad paradigms separately.

4.2.1 The hypothetico/deductive paradigm

This paradigm has roots in the physical sciences and synonymous terms are the scientific, classical, normative, quantitative or agricultural/botanical paradigms. Based on cause and effect, this paradigm uses the hypothesis as an instrument. Experimental methodology under this paradigm centres upon the principle of holding all but one variable constant. Any observed change must be due to the variable manipulated. The hypothesis can then be accepted, rejected or modified.

This model is capable of considerable sophistication when used by experienced workers. It is possible to utilise this paradigm even within the social sciences where the number, complexity and interaction of variables are considerable. A good research design can produce results with great clarity. These may be reliable in that they are capable of reproduction and valid in that they are addressing a clearly made point and can be generalised within set parameters. Nevertheless, the highly complex inter-relationships of variables in social sciences mean that research using this paradigm has to be focussed precisely in order to be sure of cause and effect. This means that hypotheses and methods tend to deal with severely limited objectives and are frequently criticised by teachers for being trivial in impact (Freeman 1986).

Parlett and Hamilton (1983) pointed out five limitations of what they termed the `classical` paradigm in relation to research in education:

a. There are numerous relevant parameters. These must be randomised using very large samples or strictly controlled. This is expensive on time and resources and divorces the study from the real world.

b. Before and after designs (ie hypothesis - pre test - treatment - post test) assume that a programme undergoes little or no change during study.

c. The paradigm imposes artificial restrictions on the study. It can neglect data not easily quantified.

d. Large samples and statistical generalisation tend to be insensitive to local situations.

e. The paradigm often fails to articulate the various concerns and questions of the participants

Gilbourne (1987 p338) warned that: *The first lesson a lone researcher must learn is that one cannot study everything and everyone.* One may agree, but if we are to improve the reliability of observations by limiting the variables studied there is a danger of losing the potential wholism of the learning experience under study. If this enquiry had adopted hypothetico/deductive principles and methodology it would have been necessary to focus so tightly that it would have contravened the stated motive that the work should have broad relevance for teachers.

The use of experimental technique and control groups was impossible for ethical reasons but we should also recognise that such techniques in a social science setting are fraught with difficulties. Blumberg and Pringle (1983) described the problems of using control groups in an organizational setting - the Rushton coal mine in America. Here the `bush telegraph` soon informed control groups that experimental groups were getting `special` treatment. This effectively established the control groups not as control but as being negatively treated from their own perspective. Such a situation would also arise in schools. As these authors put it: *The concept of the organizational experiment may well be illusory.* (p 413).

Following point b. note that because the case studies were done in `live` education settings it was often necessary to tune the events as they proceeded. Professional ethics meant that if improvements were possible they must be

incorporated. Such tuning would invalidate any before and after research design.

Following point c. it was evident that much data were not easily quantifiable. In addition it was not possible to be sure that the appropriate phenomena had been addressed. Work under a hypothetico/deductive paradigm could prevent the collection of relevant data which emerged during the enquiry and did not fit any hypotheses established.

Point d. refers to local situations. The paradigm of enquiry had to be sensitive to each school and learning episode as a unique setting. Case studies ranged from residential weeks at the University to school based events in both inner city and rural settings from London to Leicestershire and Nottinghamshire.

Finally point e. refers to communication with participants. If results are to be generalised into new situations the reductionism necessary within the hypothetico/deductive paradigm would make the work of little value to teachers. It was necessary to maintain a wholism in the enquiry. The limitations on reliability, validity and ability to generalise are recognised. The enquiry could not offer teachers high levels of validity but it could offer something that they would value. The opportunities for fieldwork were generated by communicating the results of fieldwork to the profession (Denton 1986a, b; Denton and Flood 1986; Denton and Bhandari 1987a, b; Denton 1987).

It is not intended to take this discussion of the hypothetico/deductive paradigm any further. It was clear that operating broadly under this paradigm would make it difficult to remain true to the three broad motives for the work. There is little point in continuing with what has become traditional in many theses - an analysis, in depth, of the drawbacks of a paradigm which the worker subsequently does not use.

4.2.2 The illuminative/qualitative paradigm

The broad paradigm complementing the hypothetico/deductive has been variously termed qualitative, interpretative, illuminative, naturalistic, phenomenological or ethnographic. This range of terms can be confusing especially as some have more specific meanings at a methodological level.

Essentially illuminative/qualitative approaches attempt to examine social systems in a more wholistic manner than hypothetico/deductive approaches. The complex relationships within social systems are recognised as are the dynamic nature of such systems and the idiosyncratic perception of them by the actors within. Rather than generate data to test a hypothesis data is used as a source for interpretation and the generation of theory or hypotheses.

Parlett and Hamilton (1983), used the term illuminative evaluation and observed that: *Acknowledging the diversity and complexity of the learning milieu is an essential pre-requisite for the serious study of educational programmes.* (p 14).

The *learning milieu* was defined as the social - psychological and material environment in which students and teachers work together. It represents: -- *a network or nexus of cultural, social, institutional and psychological variables. These interact in complicated ways to produce in each class or course a unique pattern of circumstances, pressures, customs, opinions and work styles which suffuse the teaching and learning that occur there.* (Parlett and Hamilton p 14).

These authors also differentiated the *instructional system.* This is more than the traditional aims and objectives: *Its constituent elements are emphasised or de-emphasised, expanded or truncated as its administration, technicians and students interpret and re-interpret the instructional system for their particular setting.* (Parlett and Hamilton p 14).

The juxtaposition of these two concepts means that any learning situation is so complex that we must look to methodology which will illuminate the interplay of actors and system within. Describing such a system simply with aims and objectives and attempting to measure whether the objectives have been met is inadequate. MacDonald and Walker (1983) pointed out that: *At all levels of the system what people think they are doing, what they say they are doing, what they appear to be doing and what, in fact, they are doing, may be sources of considerable discrepancy.* (p 6).

Glaser and Strauss coined the term `grounded theory` within a qualitative paradigm. Here the emphasis is on the development of ---*theory as process;*

that is, theory as an ever-developing entity, not as a perfected product. (p 32). They emphasised that theory should be seen in two senses. Substantive theory is developed for a substantive or empirical area of enquiry. In contrast formal theory develops for a formal or conceptual area, for example deviant behaviour. These authors encouraged an iterative approach to research in which fresh perspectives are used to test and modify theory in an organic manner.

A continuing problem in any research is being able to distinguish data from the researcher's interpretation of that data. Hopkins and Bollington (1989) were clear that much qualitative work is flawed in this respect and called for more explicit description of methodology when writing up, so that due weight may be attached. They observed problems of validity in qualitative work but noted that if an observation is tested repeatedly against data, validity grows. Similarly Glaser and Strauss (1967) emphasised the need for `theoretical saturation` in qualitative methods; that is a point by which no additional data is being found from further samples (or methods).

Cohen and Manion (1980) pointed out that all methodology acts as a filter. When generating data, distortion should be assumed. It is necessary to combine techniques to triangulate perspectives gained. If the methods employed differ substantially and yet give significantly similar results then confidence in the reliability of the results grows as the distortions and `blind spots` of one method should be covered by another. Triangulation, as a term, originated in navigation meaning the use of a minimum of three bearings to fix position. In a research sense it simply means a number of perspectives. The greater the number and diversity the greater the confidence.

Triangulation is applicable to both general paradigms but becomes essential within an illuminative approach due to the limited reliability of single methods such as interviews. Cohen and Manion described six forms of triangulation:

a. Time, when longitudinal designs are used to check on change and process.
b. Space, which uses cross-cultural perspectives to reduce parochialism.
c. Combined levels, individual, interactive and a collective or organizational level.
d. Theoretical, which draws upon alternative theories rather than one.
e. Investigator, when more than one observer is used.
f. Methodological, when either the same method is used on different

occasions or different methods are used on the same object.

In sections 4.4 and 4.5 triangulation will be examined in relation to the methodology employed in this study.

4.2.3 Limitations of the illuminative paradigm

Before discussing the operational level of case study it is relevant to consider the limitations of illuminative perspectives. Humberstone (1986) felt many workers consider `qualitative` research to be soft, subjective and speculative, whereas quantitative research is considered to be hard, objective and rigourous. Freeman (1986) considered that `ethnographic enquiry` is often seen as a `soft option`, criticism centring on:

a. Bias.
b. Replication and the ability to generalize.
c. The collection and treatment of data.

This assumes that quantitative research is immune to prejudice, experimental bias or human error. This is not the case: any paradigm may be mis-applied, producing flawed results or interpretation.

Nevertheless, Glaser and Strauss (1967) pointed out that many qualitative studies are lengthy, detailed descriptions which result in very small amounts of theory. These criticisms are valid and must be addressed whilst also recognising that quantitative methods can suffer similarly, being open to bias, reductionism, superficiality and poor collection and treatment of data (Freeman).

The effect of the researcher is always present and cannot be fully designed out. It is important to be explicit about reflexivity. Hampden- Turner (1971) considered that the `existential` worker cannot practise traditional scientific detachment as that person is a part of any social episode under study. He pointed out that it is important that the person suspends self concern in order to be able to recognise the perspectives of others, ---*that is to switch from self involvement to other involvement. (p 34).*

Mullen et al (1985) identified a similar aspect of reflexivity - the false consensus effect. This is a tendency for people to consider their own behavioural choices and judgements as being relatively common and

appropriate whilst seeing alternative responses as uncommon, inappropriate and deviant. There are lessons here in terms of cultural differences between observer and the learning milieu under investigation.
Any worker tends to have a predisposition towards looking at certain factors. It is necessary to be constantly aware of this threat and seek to minimise it via triangulation.

The way in which data are gathered, collated and analysed is a decision of the individual or group conducting the research within either general paradigm. Hopkins and Bollington (1989) pointed out that there is no established convention for doing this and this may lead to poorly reported research. After an interesting review of a number of cases of qualitative research they established a table of eight ways of making qualitative research more valid:

a. Be alert to threats to validity.
b. Be clear about analysis.
c. Call things by their right names.
d. Know what you are looking for.
e. Triangulate data.
f. Be catholic in use of data sources.
g. Reduce and display data.
h. Use case study systematically.

Several of these aspects have already been covered (a, c, e, f). Validity, as a concept, has several sub-sections. Cohen and Manion (1980) considered internal validity as being concerned with whether the treatment does make a difference. They saw external validity as asking whether the effects can be generalised to other situations. Hopkins and Bollington (1989) also considered construct validity as meaning that the research must focus on the operational issues it purports to reflect.

It is impossible to develop validity if the data is not reliable. Reliability can be defined as whether the research could be carried out again, under the same conditions, and give the same result. Further than this every method acts as a filter and could effectively give `reliable` results, but it is important to also ensure that triangulated methodology builds a coherent picture; so reliability assumes a slightly different meaning.

Point d. is interesting in that it appears to clash with other statements within illuminative work. Cohen and Manion (1980 p 115) quoted King in his study of infant schools: *I was not able to give her any clear idea of what I was trying to do because I did not know exactly myself.* Similarly my own M.Phil work (Denton 1984) opened with a very general statement and a programme to clarify appropriate directions. This enquiry looked at the question of children with learning difficulties in the context of Design education in a specific school. By adopting an open approach initially, it was possible to identify more categories than may otherwise have been the case. Eventually, as these categories became established it was possible to focus using the criterion of maximum effectiveness for the time spent.

Points g. and h. will be dealt with in section 4.4 on methodology employed.

4.3 An illuminative paradigm applied; case study and this enquiry

It had been decided that in order to reflect the central motives behind the enquiry it was necessary to adopt an illuminative perspective. Understanding, development and communication were more important than proof and quantification. In addition the apparent complexity of the phenomena to be studied were such that only an illuminative paradigm could give the flexibility to uncover critical factors which may not have been recognised at the commencement of the enquiry.

The complexity of the social setting in educational research often makes it difficult to chart the course of an illuminative study in advance. In many respects it is better to become actively involved in observation rather than firstly attempting an exhaustive literature survey. Indeed, Suggett (1986) considered delay in fieldwork whilst achieving a grounding in theory to be a handicap. The pre-enquiry phase had effectively consisted of a number of separate case studies, using observation and a number of other instruments. An element of action research was also present. As I wished to maintain relevance and accessibility to the teaching profession it was more appropriate to study the subsequent events at a general operational level. A case study approach appeared to emerge as a logical route to understanding without compromising the central motives for the work.

Stenhouse (1983) stated that case study work was: ---*trying to build understanding towards theory through the patient cumulation of and comparison of studies of cases.* This echoed my motives and work within the pre-enquiry phase. Research, like design, requires an iterative approach constantly improving perspectives and grasp of the situation. MacDonald and Walker (1983) pointed out that *The case can generate a theory as well as test one --- instances and action go hand in hand in an iterative process of cumulative growth.*

Case study is often incorrectly seen as a method. In fact it is an umbrella term for that kind of activity which is intended *to focus an enquiry around an instance* (Aldeman et al 1980). Methodology can be eclectic and data generated in qualitative or quantitive forms. Typically these may be documents, observations, whether participant or non-participant, interviews, or the collection of statistics by various means. Methodology more usually associated with the hypothetico/deductive paradigm and quantitive methodology is an accepted part of case study work as much as illuminative techniques. These can all contribute to the whole perspective. The important characteristic is protracted immersion in the cases studied (Stenhouse).

MacDonald and Walker (1983) observed that case studies are almost always partial accounts involving selection at every stage. This would include choosing cases for study, specific methodology and the editing and presenting of material. Typically case studies are almost always conducted under constraints of time and resources. Reliability and validity are particular problems under these circumstances, but as discussed above, triangulation can build validity.

Parlett (1980) suggested four basic requirements for case study:
a. The study should be based on examining principles, practice and the interplay between them.
b. It should focus on the centrality of the research and audience.
c. It should acknowledge the significance of questions to do with authenticity.
d. It should recognise issues of professional conduct and research, for example research as an intervention and the need for confidentiality.

Within these requirements case study should be seen as a versatile approach to enquiry. Linking this to the principle of iteration in research we can see that as Adelman et al (1980) put it, case studies can move between the general and

the particular, much as MacDonald and Walker (1983) pointed out. Adelman isolated six advantages of case studies:

a. Data is strong in reality (though it may be difficult to organise).
b. Attention may be paid to subtlety and complexity of cases.
c. Can represent divergent items - complexity and embedded social truth.
d. Can form the basis of an archive for future study.
e. One step to action.
f. Can contribute to making research information accessible.

Again these points reflected the motives for this enquiry. Both the philosophical position in relation to the enquiry and the resources available indicated that the study of live cases was the most appropriate way forward. Similarly these case studies were dependent upon schools and so professional ethics overrode preferred methods of data collection. In each case study it was necessary to be eclectic in method. The research design was outlined before each case but was not a static segment of the process, rather it was dependent on opportunities as they arose. In addition case study work and literature survey proceeded in parallel, each offering impetus to the iterative process of understanding.

Stenhouse (1983) listed four broad styles of case study, though it is apparent that they are not mutually exclusive:

a. neo - ethnographic, usually a single case at length and depth.
b. evaluative, either a single or group of case studies at such depth as evaluative policy or practice will allow.
c. multi - site, where a team offers alternative perspectives.
d. Teacher research, classroom action research.

In this enquiry it was evident that elements of b., c., and d. were present. The enquiry was essentially evaluative but the depth of perspective gained in each case was limited by practical and professional aspects. There were multiple sites offering different perspectives and data gained in each case was used to update the next.

By selecting a case study approach the enquiry could be naturalistic: it allowed the investigation of contexts without research considerations influencing the events rigidly. There would clearly be effects such as novelty and Hawthorne to contend with, but triangulation of various forms enabled a `thick description`

and verification by virtue of the variety of perspectives gained. In this enquiry the term case study is used to describe fieldwork carried out to illuminate the subject matter. A case account is the written description of the case study and may be found in appendices 1 - 5.

4.4 Methodology used within this enquiry

Case study work in schools is a moment by moment existence. One must gain the best perspective possible at the time with the resources available. The methodology had to respond to changing situations and changing perceptions of what was under investigation. There were also the professional considerations alluded to above. Adelman et al (1980) pointed out that case studies are carried out in real situations in which the professional responsibilities of those concerned may interfere with the purity of research methodology.

A further consideration was that I was central to the research as a teacher/leader/developer. The degree of enthusiasm shown and the teaching skills employed in managing the learning environment directly influenced the way children and teachers reacted. It was necessary to develop a professional detachment for the enquiry whilst maintaining a teaching zeal within each learning context itself. This was not easy but was not impossible. The process and discipline of research enabled this to a large degree. Interest in an area need not disqualify relevant observation.

As I and other teachers were `in the thick of it` during each case study our observations became a natural source of data. Similarly it was possible to interview participants informally at almost any time, whether as individuals or in groups. The third major source of data was Nominal Group Technique. All are explained and evaluated as data collection methods below.

The enquiry took the form of a progressive focussing, using triangulated perspectives from within each case and across different cases. The process of enquiry became a close parallel with the structure that Hopkins and Bollington (1989) later suggested:

a. A preliminary, anticipatory stage.
b. Immersion in data and the generation of categories/hypotheses.
c. Validation of categories/hypotheses.
d. Interpretation by reference to theory, practice or professional judgement.

e. Action for improvement and presentation of theory.

The pre-enquiry events provided the preliminary stage including the recognition of the enquiry as a project and the clarification of initial directions. Data was then generated through the case studies and triangulated using method, time, space, investigator and level. This data allowed the development of initial categories which could be validated, modified or rejected, by being tested against the data. In parallel to the fieldwork the literature was being surveyed in the initial categories. This process allowed a form of grounded theory (Glaser and Strauss 1967) to be established and suggestions for improvements to be proposed. The process was iterative and continues.

4.4.1 Observation

Observation was the most frequently used technique for gathering information. The reflexive limitations of observation were reduced by triangulation in time, investigator and space. Time, in that the case studies cover a period of three years. Investigator, in that there were observations from myself, teachers and other researchers (for example from the Banking Information Service). Space, in that contexts and events were studied in different geographical and social areas, both within schools and on a residential course.

Whilst observation techniques are normally differentiated into participant and non-participant the usual form taken in this enquiry was a combination. Observers could participate, as facilitators, with the work of a team or an individual, and then stand back and become the `fly on the wall`. It was noticeable that the activity within teams allowed an observer to break contact and be forgotten by pupils. This was evident from the fact that staff often heard `strong language` in their presence which was never used when they were participating.

All observers were experienced teachers and were able to begin to interpret social action in the settings under study. There are two riders to this. Firstly as all were teachers there may be a common bias in terms of the type of action they were predisposed to perceive and the way in which they interpreted it in reporting observations. Secondly the style of learning was unfamiliar to many and generated a degree of uncertainty initially. The inclusion in some events of

observers who were familiar with the style of work and those who were unfamiliar goes some way to minimising bias.

In the case studies with small groups there were two observers as a minimum, larger events had a proportionately larger number with the ratio usually about 1:15 pupils.

In all cases observation was unstructured in order to prevent response only to preconceived factors. Teachers were briefed to make note of any factors they thought were of merit in terms of understanding the event. Normally observers compared notes at a meeting immediately after each observation session, usually in the late evening for the residential events or after pupils had gone home for school based events. These meetings allowed free discussion, helping observers to recollect any points they may have witnessed but been unable to note. In some cases I received notes made by teachers and researchers, in others I made notes on the basis of informal interviews with teachers immediately after events.

While reflexivity was reduced by gaining the perspectives of different observers there still remained the problem of reflexivity in my interpretation of this data.

4.4.2 Interview

During an event there were episodes where observers moved in and held informal, unstructured interviews with individuals or teams. These episodes were not always pre-planned but seized as opportunities presented themselves. As episodes were usually short observers did not use notes or recordings, but completed notes immediately on withdrawal. This technique allowed an informal relationship with the individual or team, helping elicit responses in an open manner. These notes were added to observation logs so are not recorded as interviews as such.

In case study 5 two researchers from the Banking Information Service (BIS) observed and shadowed one team in depth. In this case a number of informal interviews were held as above but also tape recorded. These researchers gave access to their data and report. This report was used in the compilation of account 5 and is not included directly.

Teachers were interviewed very much as a professional discussion in an informal and unstructured manner. As in the observation logs this was intended to open the range of response. Interviews were either one to one or in groups. Generally the depth and quality of data improved in group situations as teachers effectively reminded each other of points. This raises the question of bias but this has been discussed.

Interviews were used in two typical situations: following observation of an event witnessed, to clarify points raised and triangulate observations, and following events I did not personally observe in order to elicit an account.

In all cases I was known to the teachers and a relaxed rapport could easily be established. Previous experience (Denton 1984) indicated that teachers tend to be more wary of tape recorders than pupils. Therefore, it was decided not to risk losing rapport by using one. All interviews were recorded by notes which were reviewed within hours to clarify points and include omissions.

A variation on the interview was the group report back session reported in the account of case study 3. Here a group of 25 teachers from 6 schools reported back on innovation in their own schools based upon the INSET course conducted. Reporting was by the group of teachers from each school making a presentation to the whole group. This was immediately followed by general discussion in which points could be clarified or developed. In this case a tape recorder was used as the flow of data was too fast for note taking. Like an interview it was possible to intervene and clarify points during this session.

Some workers have suggested that all accounts generated from interviews are subsequently confirmed by interviewees. This would enable a check on reflexivity. In this enquiry this was not done for two reasons. Firstly confirmation would have been administratively difficult on most occasions considering the limited resources of the enquiry and this would have considerably slowed down the work. Secondly the formality of written notes made up and returned for confirmation may have prevented teachers from being fully open in their observations. This approach necessarily means that this check on researcher reflexivity was not made.

4.4.3 Questionnaire

Questionnaires were used in the pre-enquiry phase as evaluation instruments. The results of these questionnaires were not kept as the work was, at that time, not seen as research. Each questionnaire used an open structure with a minimum of questions. This was done to focus attention generally in a number of areas but then encourage pupils to respond in an open-ended manner. Questions focussed on aspects of the task given, the style of the work, teamwork, and general administration. A teacher designed questionnaire was used in account 2 to evaluate the `project` done by pupils in that case study. This was a very simple, open-ended type. I was given access to this data.

Following the pre-enquiry events Nominal Group Technique (NGT)(see below) was used in the enquiry to elicit pupil responses in preference to questionnaires. This was done for two main reasons:

a. Questionnaires were focussing on those areas I, rather than the pupils, felt important.

b. Whilst the design of the questionnaires was open, responses rarely went beyond the most superficial.

Responses to the pre-enquiry questionnaires were, on the whole positive but were not furthering understanding. There are several probable reasons for this. Firstly the questionnaires were administered in the final hour of the residential week. The exercise was over and there was a profound change of pace from a climax of effort to sudden stop. Due to the freedom teams had been given to work and play most had slept little especially on the last night. The majority were very tired and this, combined with the sudden change of pace, probably lowered their ability to respond in depth. A second factor may be that after a week of intense teamwork the sudden solitary task of filling in a questionnaire was unfulfilling. Discussion was not allowed after a period when discussion was important in developing ideas. It may be that the solitary nature of the questionnaire limited idea generation. Thirdly it may be that within the mixed ability cohorts some pupils were reluctant to use writing as a means of communicating inner thoughts.

It was decided that other techniques would be necessary to elicit a better understanding of pupil reaction. A technique based about group discussion was seen as offering more potential in that the group aspect would encourage

discussion. If ideas were recorded without pupils having to write this would also maximise response. Group discussion techniques, however, do have disadvantages (see below) and so Nominal Group Technique was used, as described below.

4.4.4 Nominal Group Technique

Group discussion is an established enquiry technique for evaluating learning programmes. Such techniques allow participants to respond with items central to their perceptions, rather than those identified by the researcher. Group techniques may stimulate thought in others, the 'brainstorming' effect, and so increase the range of responses. Despite these advantages group discussion techniques suffer from a number of problems:

Dominant personalities can cause pressure to conform to their opinions. Similar effects are prevalent in terms of minority / majority opinion (Levine and Russo 1987).

The data generated can be confused and difficult to interpret, especially if conflicting views are presented. The researcher cannot quantify opinions without further stages which may be open to pressures to conform.

If staff lead group discussion this will influence the way individuals respond.

Discussion can be prolonged and tend to focus on specific aspects, so preventing a range of observations emerging.

Nominal Group Technique (NGT) differs from group discussion techniques in that interaction is limited to prevent associated problems. Brainstorming continues because individual ideas are made public and others may use them to generate further ideas. Personality, and majority effects are minimised by appointing a member as a 'scribe' rather than leader. The use of a scribe eliminates the potential for resistance to writing which may limit feedback in questionnaires.

The method has been used by several investigations, usually in higher education, to evaluate learning programmes (Lomax and McLeman 1984;

O'Neil and Jackson 1983). In this enquiry the technique was applied as follows:

a. The group was established. In the case of the large residential events several groups were used with a maximum membership of 18. Scribes were appointed.

b. The method was outlined to the group/s and the task set. In this enquiry this was simply "To evaluate the experience you have just had." This was kept open to prevent biasing replies. After any points of clarification I withdrew to prevent bias. Each member had a sheet reiterating the verbal instructions and including space for responses. It was pointed out that names should not be written on the sheets, anonymity was assured.

c. Members were allowed ten minutes to note down their own responses. There was no discussion to prevent dominant personalities imposing directions. This part did not necessarily entail writing, though pupils were invited to make notes.

d. Each member then gave their first 5 responses. These were noted by the scribe on a flip chart so that all could see. The scribe was not allowed to interpret what was said. Once all had listed 5 the process was repeated, members listing their next 5 and so on until there were no new points to add. Members could add to the list ideas which were stimulated by others' ideas - hence a `brainstorming` function took place.

e. At this point members could ask for clarification of any points, no criticism was allowed.

f. The scribe then consolidated the list with the agreement of members. This was done to reduce the list to a series of statements to which members could agree/disagree or feel important/less important. The statements on this list were then numbered for ease of reference.

g. Members then responded to each statement with a weighting from 1 = disagree or of low importance, to 5 = strongly agree or of high importance. This was done on the sheet each member had. These sheets were then collected.

The data gained was entered in a spreadsheet where the mean weighting and standard deviation were calculated for each statement. This gave an indication of the strength of agreement in the group on a given statement. However, a standard deviation could not distinguish a situation where there was polarisation from one where there was a broad range of responses.

Where several groups had been used it was necessary to consolidate the lists produced. While there were differences it was possible to do this as statements

from different groups often carried very similar meaning. If a statement could not be consolidated easily with another group it was left and the reader can recognise this when the sample size is smaller. Such consolidation introduces reflexivity but care was taken and the data used in conjunction with triangulated sources.

Observations on NGT in use.

NGT generated a wide range of observations relatively free from the influences discussed above. Some statements were ambiguous and difficult to use and some centred on aspects of accommodation and food rather than the learning event. Groups did not find the technique straightforward and great care needed to be taken in explanation.

The data produced was valuable in that it minimised researcher bias, was prolific and, due to the quantitative aspect, easier to handle and analyse. This quantitative nature of the data does give a degree of confidence which it does not fully merit. NGT is based on qualitative techniques with their limitations but gives a unique view of the events through the eyes of the participants.

4.5 Reduction and analysis of data

Few guidelines are agreed for the analysis of qualitative data, and the methodologies employed in this enquiry generated a great deal of data in forms which were awkward to handle. Nevertheless, a method evolved which echoed that later proposed by Hopkins and Bollington (1989).

a. The pre-enquiry phase allowed the identification of the general directions of the subsequent enquiry. By its nature this phase was centred on teaching rather than research and data are not available for examination. Nevertheless this work did generate triangulated data of a form which enabled initial categories of study to be established. No reliability could be claimed from such a pre-enquiry phase, but as the result of professional experience it has some value as a start point.

b. The case studies each followed the core of thinking explained in 1.0. This core was thus examined from differing perspectives. Observations were

accumulated which were triangulated in time, method, space and observer. By comparing these observations within a case study a measure of reliability could be established. This enabled consideration of the categories identified in the pre-enquiry phase, their evolution, clarification, expansion or reduction. Triangulation also enabled the frequency and distribution of phenomena to become more explicit. Glaser and Strauss (1967) referred to validity by `saturation` when additional data fail to develop a category.

In addition to illuminating the central core each case study offered unique elements enabling the extension of this core, though with less reliability. Each case study generated an account which was an opportunity to organise and analyse data at that time.

c. A summary was established on completion of the final case study (section 5.0). This enabled a further iterative cycle in which all accounts were compared. As data was qualitative in form all analysis was done by comparison and identification of those areas which tied together and those which disagreed. This process was, of course, reflexive and a source of potential bias. This is accepted and so the data is made as explicit as possible in the case accounts in order to enable the reader to see where conclusions were drawn and decide whether those conclusions are reasonable.

d. The literature survey conducted in parallel with the case studies similarly generated a wealth of data (sections 2.0 and 3.0). By examining this literature within these sections areas of commonality were identified together with inconsistencies.

To some degree the points raised in the literature survey were used iteratively, as they arose, in the series of case studies enabling improved illumination.

e. The literature was then used as a data base against which to compare and contrast the summary of cases. Section 6.0 represents this discussion.

f. Finally it was possible to draw from this discussion the key conclusions of the enquiry and identify those areas that were of interest but required further verification. These conclusions require reading with a degree of scepticism due to the limited nature of the enquiry. Hamilton (1980) emphasised the contextual setting of all social sciences and that the primary aim should not be

generalization but interpretation in context. Kemmis (1980) similarly emphasised the nature of conclusions drawn from case study work:

Case study may provide illumination; it does not achieve revelation.

The methodology adopted allowed this interpretation and illumination. In turn, it also meant that the three motives for this enquiry; understanding, development and dissemination, were fulfilled to a degree reasonable in the context of resources available.

5.0 Summary of case accounts

The aim of this section is to summarise the case accounts. A very brief pen-picture of each case was given in 1.7. The structure centres on the categories indicated in the pre-enquiry phase.

5.1 The simulation
- 5.2- warm up
- 5.3- task
- 5.4- time management
- 5.5- industry / bank involvement

5.6 Teamwork
- 5.7- base
- 5.8- communications
- 5.9- roles

5.10 Teacher/pupil aspects
- 5.11- teacher role
- 5.12- teacher planning
- 5.13- teacher response
- 5.14- teacher/pupil relations
- 5.15- pupil response
- 5.16- parental opinion

5.17 Conclusion

Cross-referencing with the accounts is achieved by the following system. Firstly the account number is given (1 to 5). Secondly the source of data for example NGT = Nominal Group Technique, TO = teacher observations, RO = researcher observations. This is followed by the reference number of the section in the account. References to Standard Deviation are abbreviated to StDev.

These references are included for ease of verification, the reader should otherwise attempt to pass over them.

5.1 The simulation

5.2 Warm-up

The majority of data on warm-up technique comes from accounts 2, 4 and 5.

5.2.1 In account 2 the teacher was unfamiliar with the rationale of warm-up and this was his first attempt at the learning approach described. The pupils knew each other and so the objective of the warm-up was limited to gaining experience of teamwork. It had been decided to give no specific instruction on teamwork but to allow points to emerge during debriefings. The warm-up planned and delivered confused pupils as it was complex and sudden (2, RO, 6.1). The exercise lasted 15 minutes.

In account 4 the warm-up lasted one day out of a total of five. Pupils knew each other. The objective was to bring teams together and work through a shortened, non-competitive version of the main event in order to familiarise pupils with procedure. Pupils realised the warm-up was a precursor and were impatient.

Pupils worked well (2, TO, 6.21) but staff remarked that pupils were constantly asking how the work would fit into the main event. The warm-up was generally considered to be successful in starting to build teams, but was too long.

In account 5 the warm-up was important as this was a residential event of 5 days with team members unknown to each other. There were three objectives: lowering tension, helping team members to get to know each other and giving an introductory experience of teamwork. This was done using the `chair ` simulation (as in account 1), lasting 90 minutes followed by a debrief. The warm-up was well received by members (5, NGT, 7.4) but TO (5, 9.0/2) and NGT indicated that there were a small minority who were less favourable, though the data cannot illuminate why. Some teachers felt the warm-up to be sudden and over-competitive (5, TO, 9.0/3).

Teachers reported 5 out of the 85 as 'isolates' who responded negatively during the warm-up and who probably account for the breadth of StDev. The majority of pupils felt it was easy to get to know team members (5, NGT 7.4).

5.2.2 Many factors will have influenced the effectiveness of each warm-up exercise. The number of pupils and ratio to staff appeared uncritical, account 5 had a group of 83 and ran with one member of staff over 2 hours including debrief. A small number of teachers observed, without intervening in team processes. The other exercises had more conventional staffing ratios and varied in class size. All exercises used simple facilities and equipment. The type of activity varied from paper exercises to modelling in card and more complete design exercises. None of these appeared to make a significant difference when considered in relation to the time available.

The factors which had the most significant effect on the success of the warm-up in preparing pupils and teams for the main exercises were:

The degree of competition.
The degree of familiarity with people and place.
Individual disposition towards teamwork and competition.
The complexity, pace and timescale of the exercise.

5.2.3 Competition imposed a degree of tension which appears to run contrary to one of the objectives of warm-up; to relax individuals in the new environment. It may be that competitive warm-ups would be more acceptable where the event is run with pupils who know each other and so this element of tension is reduced. The accounts cannot illuminate this as the most competitive warm-up was carried out in what should have been the most 'stressful' scenario (account 5) and least competitive in the least stressful (account 4).

5.2.4 Pupils generally felt they made new contacts easily. NGT in account 5 gave a negative score to the statement `Getting to know people took time`, therefore the majority felt this was not the case. Staff observations indicated that the account 5 warm-up `went very well`. Nevertheless subsequent staff observation in the main exercise indicated that pupils were not efficient at forming teams.

5.2.5 Some pupils preferred to work alone. Teacher observations indicated that the proportion averaged 1:17 (account 4, 6.31/1; account 5, 9.0/2). This refers to behaviour which was observable to teachers. There may have been pupils who were less obvious but would have preferred to work alone.

5.2.6 Some pupils failed to work effectively in warm-up exercises as they were attempting to re-establish contact with their normal peer group. When inter-team contact was made less easy, as in account 5 where low screens were used, it encouraged intra-team focus and discouraged inter-team focus. This may be one reason for the effectiveness of the warm-up. This aspect is explored further in 5.7 looking at team bases.

5.2.7 **Summary.** Data on warm-up exercises was available in three accounts. The methods employed in these accounts varied which offered a breadth of perspective but makes it difficult to build reliable conclusions. Nevertheless, some indications can be drawn.

Pupils require convincing of the need for warming-up, otherwise the exercise is seen as unimportant and simply a prelude to the bigger event. The warm-up exercise needs to be designed to match its objectives. For example, when teams are formed of members unknown to each other a more relaxed pace and non-competitive context appears to be more suitable. If members are known to each other the exercise can be competitive and rehearse the procedures of the main event to a greater degree. The warm-up exercise should not be over complex or misunderstanding may lead to poor performance and negative feedback to both teams and staff.

In none of the accounts were pupils or students familiar with teamwork. This indicates that warm-up exercises, especially over short time-spans, could not be expected to establish fully effective teams. Longer warm-up exercises would improve the establishment of effective teams but the indications were that pupils recognised the transient nature of the exercise as a precursor to the main event. This would indicate that extending the warm-up beyond a certain, indefinable, point confers limited extra benefit. Placed in a long term perspective it is possible to hypothesise that as pupils gain experience of such

events they would be both able to form effective teams more quickly, and be familiar with the style of work in the main events. The effectiveness of warm-up exercises may improve so possibly removing the need for them in some situations. This raises the question of progressive development of abilities which will be discussed in 6.0.

5.3 The task

The main exercise tasks varied. All were based on design activity leading to the construction and marketing of artifacts. Whilst different, all related to the principles explained in section 1.0. The response of pupils was generally very positive, but the following observations are of interest.

5.3.1 Account 5 reported a constrained but reasonably `open` task, the design of a promotional gift. This was intended to invite and encourage interpretation. Teams worked for specific sponsoring companies, discussing their proposals with managers from those companies. This openness was interpreted by some students as vagueness. This was illustrated by the number of 'can we ....?' type of questions asked in the opening 24 hours. Students were attempting to clarify the nature of the task, but also the 'rules' of their new social and working environment. This questioning of staff had the effect of using staff time less productively than might have been the case.

5.3.2 The fact that teams were working with real companies was seen very positively by pupils and students in all accounts where this was done (account 5, high NGT, low StDev , TO, 9.19). This was also the case where visits were made to local banks or bank managers were involved (accounts 4 and 5). Despite this there was some frustration, for example: ---*inputs from sponsors often vague* (5, NGT, 7.4).

The medium level score and high StDev show this was not a strongly held opinion within the cohort as a whole. Nevertheless, many pupils showed a simplistic conception of the relationship of designers to companies. It was possible to bring this out at debriefings. As the debrief referred to recent and

personal experience it should have enhanced the impact on pupils as a learning episode.

5.3.3 In account 2 the age range was 11/12 years and the teacher involved decided to make the task more structured. This included setting various internal deadlines and giving inputs on specific skills.

This project ran over 9 weeks at one 90 minute lesson per week. The teacher took one lesson out to cover an input on drawing technique and there were several other whole class inputs (2, RO, 6.0/25; 6.0/28). This class did not develop teams with the closeness and intensity of those which operated within a suspended timetable. There were too many factors involved to draw firm conclusions. For example the relative immaturity of these pupils to the pupils and students of accounts 1, 4 and 5, but this may indicate that team building requires dedicated time with few interruptions.

5.3.4 The cross-curricular nature of the tasks was unusual to some pupils. One statement of resentment for *doing maths in art* illustrates this. This originated from a school (3, 5.20) which was attempting to develop the approach within the normal timetable. In such contexts there are associations with specific subjects due to the location and the teacher's normal subject specialism. This phenomenon appeared strongest in `in timetable` events, but may also be the case in events run under suspended timetable in a school, however there was no evidence for this. It is only when the event is run out of school and with staff from several schools, that these associations may be reduced.

Even so, within the pre-enquiry events some pupils responded negatively to tasks initially as they had clear perceptions as to what constituted activity within a Design and Technology department of a university. A common expectation had been that they were to design and build 'robots'. Two typical tasks were: to design a menu and prepare food and packaging for use on long distance motorway coaches; to design and produce disposable clothing for teenagers on holiday based on spun bonded polypropylene 'paper' fabric. The intention had been to establish gender neutral tasks. The nature of `technology` in some pupils` perception was exposed. In both these events pupils very

quickly came to accept the task, particularly as briefing and debriefing sessions, at the beginning and end of working periods, were able to clarify and 'sell' the concept. This also illustrates the need for briefing and debriefing.

5.3.5 The tasks have consistently shown that pupils have difficulty in applying mathematical knowledge in simple financial planning aspects (5, RO, 11.0/2; 2, RO, 6.0/8). This has also proved to be the case with teachers during INSET based on the approach. In all cases it had been established that the mathematics involved had been previously taught in the normal curriculum, and that the level required should cause no difficulty except for pupils with the lowest mathematical ability.

To some extent this may have been due to the tension generated when working to close deadlines. Teams could delegate accounting to one or more members who had a greater aptitude in this area, and yet the phenomenon emerged frequently. There did not appear to be evidence of this being repeated for other aspects such as applying artistic or linguistic skills in cross-curricula exercises. This will be discussed further in 6.0.

5.3.6 Initially pupils tended to move informally from team to team (5, TO, 9.0/8; 2, TO 6.0/4). To some extent this was for social reasons, re-establishing contact with friends who were then in different teams. However, ideas were also shared cooperatively across teams especially in the early stages of events. Competition grew only slowly and to minimal levels. In all accounts observation indicated that towards the end of an event pupils had become more team centred and played the simulation intensely but inter-team competition was not the focus for this intensity.

The only two signs of inter-team competition across the five accounts were of a team deliberately leaving misleading information where a competitor would find it (2, TO, 6.0/12), and a general decreased frequency of inter-team communication as the events progressed. The latter could be mainly due to increased work load as deadlines approached. Account 5, TO, 9.0/6 showed that early in the event some teams dissolved and friendship groups re-asserted themselves at breaktimes and in the evening. Later in the event even social activity became focussed around the team. In the absence of more evidence for

inter-team competition the indications were that most endeavour was directed against deadlines. More work is required.

5.3.7 One aspect of competition was what teams 'felt fair'. In account 5 staff had been briefed not to release the task to pupils prior to the event. One teacher did so. This caused resentment as pupils felt that others had time to prepare for the event. The feeling in some cases was strong (5, 8.0/11). Similarly there was some resentment where a team had a member who was talented in a useful area (5 8.0/12). Pupils appeared ready to accept that some teams were larger due to an inability to make even teams.

5.3.8 There was a call (5, NGT) for incentives (unspecified) in future events. This gained a high score and very low StDev, but how far this could be explored or translated into action in future events is open to speculation.

5.3.9 The general approach under study was process-led rather than knowledge based. This caused concern amongst some teachers who feared for their knowledge base (2, 10.0/3, 10.0/4). Similarly many pupils felt that a limitation of the approach was the perceived minimal depth of information given in the inputs (5, NGT, and 8.0/17). In all cases these inputs had been designed to give enough information to complete a given aspect of the task. These observations reflect both teacher and pupil expectations from learning experiences - the accumulation of fact based knowledge.

5.3.10 In account 2 the teacher made two inputs which were of significant time scale and depth. One of these was taking a whole lesson to cover perspective drawing technique and another was a video of 15 minutes plus introduction and discussion making a break from the activity of about 25 minutes. The cohesiveness of the teams and work rate dropped after these inputs to a greater degree than in account 5 and took longer to return to the original level (2, 6.0/22; 6.0/25). This was compounded by the fact that account 2 was done in timetable and not using saturation timetabling.

5.3.11 Teachers could use inputs to maintain personal control in a learning context that some found threatening (2, 6.0/25). While there is a danger of loosing team momentum by using inputs this way, this may be counterbalanced by

giving the teacher more personal control while he/she gains confidence in a more 'hands off' approach to learning.

5.3.12 'Time out', when the simulation is suspended for a short period for input, debrief or discussion for all or part of a team, proved to be valued by staff (3 , 8.50/5). It allowed staff to keep personal contact. In addition it allowed a series of micro teaching episodes on a variety of topics which were relevant at those points.

There were two basic forms of `time out`: Programmed, such as briefings, debriefings and inputs. Unprogrammed, when staff respond to a teaching opportunity. In this enquiry `time out` was usually applied to unprogrammed episodes where teachers moved from observation to intervention with a team or individual.

5.3.13 Teachers reported that pupils were able to switch in and out of simulation fairly easily for such 'time out' sessions (3, 8.50/5). However, account 2, 6.0/22 indicated that if these periods were more than 10 - 20 minutes pupils become slower re-engaging. In 8.23/4 there were indications that operating in the normal timetable limited the degree to which pupils became involved in the simulation. This could be contrasted with reports that the intensity of the work rate achieved in most of these events was such that pupils needed to be 'wound down' at the end of a working session (5, RO, 10.0/11; 3, 8.50/6). The debrief allowed a period of quiet reflection after a working session when the intensity of the simulation could be released.

5.4 Time management: Staff aspects

5.4.1 The time required for planning was commented on by teachers in all events. Unfamiliarity with the approach and the nature of coordinating cross-curricula exercises were a significant drain on available time.

5.4.2 Unfamiliarity can cause staff anxiety. This was evident in account 2, where a single teacher planed and executed an event. Being observed both in planning and during the event will have amplified this anxiety. Anxiety may have caused

staff to spend more time planning than if they were experienced and confident with the approach. None of the accounts allow detailed interpretation of planning time.

5.4.3 The cross curricular nature of accounts 3, 4 and 5 meant that staff had to operate in planning groups. This lead to a 'process loss' in coordination. However, there is evidence from accounts 3, and 4 of gains in other directions. Teachers in these accounts reported benefits in cross-curricular understanding and cooperation which was felt to be of value beyond the design of the event in question (3, 7.20, 5.50; 4, 6.10).

5.4.4 `Building the simulation' was important to help pupils become fully involved. Within a normal timetable this process was constantly interrupted. Contrasting events within a suspended timetable there was a clear effect. In these cases pupils became far more involved in the simulation. Considerably higher levels of endeavour were observed (3, 5.10, 5.50, 5.60; 4, 6.40; 5, 9.0/27).

5.4.5 In account 3 two of the six schools operated their interpretations within the normal timetable. The remaining four used suspended timetables of either one or two days duration. This improved perspectives on these two methods of managing time. Staff reported that suspending the timetable was difficult. Colleagues had to be persuaded of the value and many preferred regular contact (though there may have been other reasons).

5.4.6 Time Management: Pupil aspects

5.4.7 Most pupils recognised the value of time-planning (5, 8.0/7; 1, 7.0/4). Some felt that more time would assist (2, 11.0/9) but this was contrasted by their recognition that working to tight deadlines has relevance (1, 6.1/2 ; 5, 8.0/15).

Staff observed that whilst pupils recognised the value of time-planning their ability in this area was very limited (5, 9.0/13, 9.0/5). There was a tendency to rush into action without thinking through the problems involved

(3, 8.60). All accounts showed an early period of confusion and lack of direction (2, 6.0/2; 5, 10.0/6). At this point teams were not fully formed and there was evidence that some pupils preferred to work alone, possibly to avoid contact with unfamiliar team members (2, 6.0/5).

Teachers reported a tendency to want to intervene with team processes in these early stages (see 5.11.1 and 5.13.4).

5.4.8 The degree of freedom and new relationships in the events were possible factors in causing this initial lack of direction (5, 11.0/4). The initial tendency for pupils to question staff in order to ascertain the 'rules' of the event was further evidence of the uncertainty most pupils felt in these situations.

5.4.9 The use of inputs as a hidden structure, helping teams manage time by putting fixed points into the simulation, appeared to have some value (5, 10.0/7). The evidence is not strong, further enquiry is required.

5.4.10 There was a marked effect of an approaching deadline which caused concerted effort (5, 8.0/7, also see section 5.6). Most teams became more integrated and established better communications. Progress reviews became more regular (2, 6.0/27) and similarly the ability to handle several strands of the task in parallel (3, 6.0/19).

5.5 Industry Involvement

5.5.1 Commercial simulation was a key aspect of the approach as outlined in section 1.0. Accounts 1, 2 and some account 3 schools did not include companies other than by simulation, but were generally evaluated as developing high levels of endeavour. It appeared possible to simulate industry to raise endeavour and pupils` perceptions of relevance. The degree of staff preparation and the ways in which they `built the simulation` would probably be important, but it is difficult to draw firm conclusions on the basis of data available. Nevertheless, the inclusion of industrial/commercial personnel in events did appear to enhance the simulation further (accounts 4 and 5).

5.5.2 In account 4 the simulation was centred on the production and marketing of biscuits as this was a significant local industry. The simulation was enhanced by inputs from the manager of the factory. In addition to this three local banks supplied a manager for a day to interview teams on business plans. Feedback from the teachers interviewed was positive, reporting that pupils felt that the involvement of industry and commerce enhanced educational value.

5.5.3 Account 5 used companies more directly. Five companies from the area of the participating LEA contributed managers to both planning and delivery. Pupils gave high credibility to feedback gained from these people, rating these sources above the teaching staff (5, 9.0/19). Teachers concerned with planning found the industrial perspectives a valuable insight and much was learned that could be put into teaching beyond the events under study.

5.5.4 The involvement of companies in these events was not accepted by all staff. There appear to be a number of factors involved:

a. The approach centred on the concept of companies competing in the market place. Competition is potentially dangerous in that it increases the chances of 'failure' for pupils, with the negative feedback that accompanies it. Account 3, 5.50 (school 5) showed that in some cases teachers made specific references to this effect. Similarly school 2 stressed that it did not want to over emphasise profit and school 3 avoided commercial aspects.

b. Some teachers were unwilling to loose personal control over the learning process. There was evidence for this in account 2. This appeared to be based on lack of confidence. The teacher may have been unwilling to share a potentially difficult situation with outsiders beyond myself, or risk the approach failing to meet his or her general teaching objectives.

This is not unreasonable, teachers should be able to experiment and gain confidence iteratively.

c. The process of involving companies is not straightforward. Some teachers in account 3 contacted an appropriate company yet received a negative

response. In this case the short time available for planning contributed to the difficulties but in financially difficult times companies may be less willing to give help to schools in this way.

5.5.5 The teachers involved in account 5 were uniformly in favour of direct industrial involvement (5, 8.0/9). The company contacts had been made by the TVEI unit. This may be an important factor. The TVEI unit had a large number of industrial contacts, establishing support was little trouble.

5.5.6 Pupil reaction to industry, whilst uniformly positive, did show one area of difficulty. In account 5 many pupils reported that communications with the company personnel were difficult (5, 7.4 NGT 16, 17). This has been partly covered in 5.3.2. To some extent this reaction was due to the limited (though adequate) times at which company staff were available. The main reason appears to be misunderstandings. In the meetings between companies and teams, pupils reported that they felt the managers were 'vague'. This is a reaction to what is generally recognised as usual in professional design circles - the client does not necessarily know exactly what is required, the designer must often help identify the specific requirement.

5.6 Teamwork

This section will be covered firstly by looking at some general points on teamwork, followed by an examination of the employment of a team base; the part played by communications, and finally roles within teams.

5.6.1 Teams were selected by a variety of criteria. Simple techniques included random or peer group. Account 4 allowed peer group choice into pairs which were then matched by staff into 4 for a mix of gender and ability. Account 5 used teams chosen by staff on the basis of a mix of ability, strengths and preventing friendship groups. It was also possible to make groups up of students from different schools.

Some schools in account 3 avoided competition and so were `group` orientated. Whilst the sample size for some of these cases was small the indications were

that peer-group selection correlated with less enhanced endeavour. Teams selected to contain a contrast in gender, ability and subject expertise correlated with higher levels of endeavour. The reasons for this appear complex.

5.6.2 Teachers who allowed peer-group teams or groups tended to be those who were less ready to include competition or commercial elements in learning (3, 8.50/1). It is, therefore, difficult to conclude that team selection criteria alone contributed to endeavour. These events appear to have been least successful in raising endeavour. Teacher identification with and confidence in the approach could reasonably be presumed to have been communicated subconsciously to pupils.

5.6.3 Pupils responded to the concept of teamwork positively. The data indicated a very large majority of pupils saw relevance in teamwork to their education and futures. There was no obvious dissent which ever selection method was used.

5.6.4 Pupils generally felt teamwork to be easy (5, 8.0/4 NGT). The profiles trialled in account 5 are relevant at this point. Care needs to be exercised in interpretation.

The profiles (within appendix 5) identified 5 areas: team management, cooperation, initiative, leadership and communication. Performance ratings were 1=extremely high and 6=extremely low. This means that figures decrease with improved performance in an area.

The profiles were firstly completed by individuals. This was followed by a similar profile jointly completed by each team and a profile completed by staff who shadowed those teams.

Area	mean Indiv	team response	staff response
Team management	3.02	2.96	3.39
Cooperation	2.38	2.00	2.85
Initiative	2.52	2.64	2.78
Leadership	3.15	2.92	2.78
Communications	2.80	2.67	3.14
Means down	2.77	2.63	2.98

5.6.5 Looking at the mean scores vertically across the 5 areas we see that individuals rated themselves at 2.77. Cooperation was seen as the highest performance (2.38), followed by initiative (2.52); communications (2.80); team management (3.02) and finally leadership (3.15).

5.6.6 When these results are contrasted with those arrived at by team discussion we see a small but distinct rise in self rating; 2.77 average individual to 2.63 average team. The team response followed an almost similar profile where the most successful area was seen as cooperation (2.00), then initiative (2.64) and communications (2.67). At this point leadership (2.92) and team management (2.96) were reversed. Only initiative was seen as lower when discussed by the team in comparison with the mean individual scores. There may be a team effect. There may be intra-team psychological support generating a more positive response.

5.6.7 Comparing profiles completed by shadowing staff on the same teams we notice the following. Firstly staff rated team performance (mean of the 5 areas) as lower than the teams rated themselves, (mean team = 2.63, mean staff = 2.98). The difference is small but significant. Looking at the separate areas,

the highest rating was given to initiative and leadership (equal 2.78), followed by cooperation (2.85), communications (3.14) and team management (3.39). This shows that not only do staff feel that teamwork performance was lower than the teams felt but that they saw the areas of strength and weakness differently.

5.6.8 Staff rated teams as strongest in leadership whereas individuals put this lowest and teams next to lowest. Looking at account 5, 10.0/5 teams reported they were operating cooperatively and there was even a feeling of resentment against the idea of leaders. Staff observed that leaders did emerge without conscious decisions from the team. It is interesting to note how teams with a cooperative ideal should apparently not recognise or chose to ignore the fact that leaders had emerged. It may be that the concept of leadership did not match their sub-cultural ideal.

5.6.9 Pupil attitudes to teamwork were positive (1, 7.0; 2, NGT 7.1; 5, 7.0/4). High levels of endeavour were reported by observers in all events, but it was difficult to separate the effects of teamwork from other factors such as the simulation and novelty effects.

5.6.10 In all cases teamwork was expected of pupils without any formal inputs being given on techniques. This was deliberate as the general approach was one of working through an event and picking up chosen aspects at debriefing. It was intended that the immediacy of the event would enhance the relevance of points raised at debrief.

5.6.11 The response to this technique tended to be uniform across accounts, but was complicated by the number of factors at work. Whilst teams felt they worked effectively (5, 8.4), observers consistently reported that teams had considerable difficulties at the start of each event (5, 9.0/6; 2, 6.0/4, 12.0/2). These difficulties appeared to centre on the unfamiliarity of team members, method, and in the residential events, place. Even the most efficient warm-up exercise could not establish working relationships immediately. In addition teams had no model of working.

5.6.12 In all accounts observers reported that most difficulties were overcome and a high level of endeavour established. Typically, in a residential event over 5 days, the initial phase of difficulties would last for 36 hours after which most teams would be working `effectively` (staff observations). Levels of endeavour were reached which observers felt far exceeded those normally obtained in conventional learning (5, 9.0/18).

Looking more closely at this a number of points are of interest:

5.6.13 Decision making was initially disorganised but teams rapidly devised techniques of varying degrees of sophistication (2, 6.0/23). Drawing of lots was crude, but effective at forcing a decision. Some teams had discussions and voted. In some cases members `fought their own corner` and personalities dominated. Pupils in account 5 noted (NGT) that `agreeing is difficult`, giving it a weighting of 4.75/5, indicating a high level of agreement.

Where teams were selected on a random basis, one case emerged where two `weaker` pupils, who were friends, were separated for a week by the illness of one. The remaining pupil withdrew, contributing little to the team under the influence of the two more dominant members. This pupil recovered immediately as his friend returned. It appeared that peer support was very important to this pupil, in this context.

Dominant personalities existed but there was no clear link to factors such as ability or gender.

5.6.14 Meeting to coordinate activity was infrequent at first and some members would miss meetings. This was more marked in account 5 which also had the largest teams of 7 members. In addition, this event had the greatest degree of pupil flexibility and allowed teams to decide when to work and when to take recreation. In some cases members would be taking sport when a meeting had been called. This may have been caused by ineffective and unclear decisions which failed to register on all members, however there was a clear element of social loafing by a small number of pupils, particularly in the early stages.

5.6.15 There were pupils who were willing to let others take the load (2, 6.0/15, 11.0/3). As events developed there were cases of teams encouraging less involved members to make effort (4, 6.31/3). Also teams valued individual member`s strengths.

5.6.16 Pupils did not immediately identify with the competitive element of the general approach (2, 6.0/4; 5, 10.0/9). Inter-team competition was identified but at a very low level. Endeavour appeared to be primarily focussed by approaching deadlines.

5.6.17 Accounts 2 and some account 3 schools describe events designed for year 7 pupils. It had been assumed that the recent primary experience of these year groups would assist both cross-curricular working and teamwork.

5.6.18 It was observed that the form of teamwork adopted was beyond pupils` experience (2, 6.0/7). Group work experienced at a primary level was mainly sharing books, they were unfamiliar with concepts such as delegation. In contrast to this, school 1 in account 3, found that pupils quickly responded to teamwork and the general approach. Staff observing assumed that there was a good carry over from primary practice in this case. The accounts appear to contradict each other but primary practice is not uniform, the pupils from the account 3 school may have engaged in teamwork or cooperative groupwork rather than collaborative groupwork in the other situations. The data was not sufficiently detailed to draw firm conclusions.

5.6.19 Discussion on the long term development of teamwork skills is impossible on the data available from these accounts. Longitudinal studies are required. However, one point of interest was that in account 5, 10.0/3 two students who had attended an `enterprise course` previously responded noticeably positively and quickly to the event and teamwork in particular, in comparison with peers. It is probable that previous experience had improved their self confidence in relation to teamwork and enterprise type activities, and this was reflected in the new event. It may be reasonable to assume that a series of such events, calendarded over a pupil`s education, could raise experience and ability in teamskills. Even the sample of TVEI year 12 students in account 5 reported that very few had worked as teams rather than as groups.

5.6.20 There was no evidence from any of the accounts to identify positive synergy in the generation of ideas due to teamwork. This is not to say it did not happen, it may not have been identified due to inadequacies in the instruments used. However, the focus on deadlines may have caused a concentration on 'economical' design and the production of prototypes by the deadline. In many respects this is closer to professional design practice.

5.7 The employment of a team base

5.7.1 In accounts 1 and 2 teams were not allocated specific working areas but established their own. It was apparent from 2 that this took time and unsettled teams at the earliest stage of the event.

When a team base had been established pupils did not always position themselves in such a way as to gain good visual contact with all members. The events described in accounts 3, 4 and 5 all used staff allocated team bases. The bases were designed so that the team could easily sit around a central table and have good eye contact.

5.7.2 Observation indicated that the close proximity of pupils in the events may be a factor in promoting intensity of endeavour (1, 7.0/3). Proximity can be both intra and inter-team.

Intra-team proximity was established by the use of relatively small tables, though this limited the area available for working. Proximity enabled easy communications orally, aurally and visually within each team against a background of noise from other teams involved in discussion.

Inter-team proximity, whilst promoting an general atmosphere of intensity in the rooms did promote inter-team communication. Much of this communication detracted from building concentration or team identification (2, 6.0/6 and 11.0/4). The subsequent use of larger rooms, enabling more inter-team space in account 2 brought an observed improved intra-team focus but this was complicated by factors such as maturing team relationships.

5.7.3 In accounts 4 and 5 low screens were used to separate teams to some degree. These were 1200 mm high so that by looking up members were aware of the other teams and yet simply by looking in were less distracted. The screens did not surround, only being placed between immediate teams. Anybody standing up was aware of the activity in the room, an important point for teaching staff. This arrangement also allowed close inter-team proximity in account 5, promoting an air of activity. Many visitors remarked on the intensity of activity; subjective reactions, but more reliable for their frequency and the fact that the visitors were at head teacher, adviser and HMI level.

In events using suspended timetabling, teams could use the screens for display and contribute to establishing a team identity.

5.8 Communications

5.8.1 Intra-team communications were weak in most teams and staff and pupils recognised this (5, 8.0/6). The accounts are insufficient to draw detailed conclusions, but two areas were apparent.

Members were ineffective in communicating information from inputs back to their teams (5, 10.0/7). Closer examination shows that this was partly due to low cohesiveness in teams in the early stages of events when inputs were given. At this point some members were turning back to peer groups for interaction rather than the team. There was also evidence that in the early stages pupils attempted to work individually rather than with team members(2, 6.0/5). Coordination and communication were limited. Teams did not recognise the need to debrief members and were inefficient when they did.

5.8.2 On the final day teams gave a presentation on their work. By this point teams were well established but observers reported that the standard of verbal presentation was low, being disorganized and lacking confidence. The visual organization of displays, in contrast, was good.

Teams had been working to tight deadlines and had focussed on the products and displays. The need to organize verbal presentations had been clearly conveyed in briefings, but this appears to have been either overlooked by pupils in the pressure of the event or given a lower priority than the concrete tasks of finishing the product and putting up a display.

5.8.3 This contrasts with the standard of verbal communication when teams approached bank managers. Discussion with bank managers from both accounts 4 and 5 made it clear that the standard of communication was good both in terms of preparation and verbal presentation.

There may be differences in standards between the teachers who observed the presentations and the bank managers who listened to teams at interview. However, it is significant that teams identified the bank interviews as of importance and appear to have planned for this aspect.

5.8.4 In conclusion the evidence indicates that there were communication problems, but that the root of these problems may not be in the method or ability to communicate but organisation. More observation would be needed to develop a clearer perspective on this.

5.9 Team roles

5.9.1 Many `enterprise` type activities place group/team members into specific roles which relate to typical company structures, for example manager or accountant. The approach used in this enquiry allowed teams to generate their own structures. The intention was to analyse the resulting structures at debriefings.

5.9.2 Generally teachers were satisfied with this approach, there only being evidence of one teacher in the planning team of account 5 who felt there should be specific roles (5, 9.0/15).

5.9.3 The question of leadership has been discussed to some extent in 5.6.8, though it is relevant to reiterate the point and expand on it here.

In practice most teams claimed to be operating `cooperative` structures with no formal leadership. Decisions were made by meetings at which all contributed (5, 8.0/5). The NGT results from account 5 show that leadership was not seen as of high importance but the StDev indicated that there was a minority which disagreed with this position. There were indications (8.30/4), that teams appeared to resent the idea of leaders. Cooperative working appeared to be a sub-cultural ideal. Nevertheless, leaders did emerge, although their styles varied from use of force of personality to leaders who were able to recognise abilities in other members and make use of these abilities in a fairly sophisticated manner.

5.9.4 As events progressed individuals were delegated for specific tasks. Usually teams based the decisions on members` areas of strength. These roles were not seen as permanent and it was expected that members would rejoin the team ready for further tasks once that specialist task had been completed. There was no evidence of permanent roles being adopted.

5.10 Teacher / Pupil aspects

5.11 The teacher`s role within the event

5.11.1 The approach used in these accounts required teachers to adopt the role of facilitator. The accounts indicate that not all teachers were comfortable with this role for a number of reasons.

5.11.2 Some teachers reported anxiety caused by attempting to break away from pupils. These teachers were used to a continual and very close interaction with pupils (5, 9.0/33; 2, 6.0/11)).

Account 5 had been preceded by two days of INSET for staff. This covered the approach to be adopted and established staff roles. The teachers recognised the value of breaking away in terms of giving pupils more autonomy and being able to selectively intervene. In addition the time available for observation allowed a better staff understanding to be developed of the learning processes in the

class. Despite this staff anxiety persisted, to some degree centred on knowing when and how to intervene.

5.11.3 A second reason for anxiety, prominent in account 2, was that there were few opportunities for formal teaching based on knowledge and skills. The teacher in account 2 became very concerned about his need to ensure that the class received a sound grounding in specific knowledge and skills (2, 10.0/3). This is reasonable, however underlying this there appeared to be a concern about control of the learning process. This was further into the hands of pupils than this teacher would normally have allowed for that age range. Formal inputs, in normal teaching, often have a hidden agenda in terms of the control, direction and pace of the learning situation together with the reinforcement of the conventional role of the teacher as central to the classroom.

These are powerful elements of the teacher's normal role. By loosening control anxiety is promoted which is difficult to remove by a single session of INSET.

5.11.4 Teachers did report positively on the value of debriefing sessions (1, 6.2/7; 3, 5.10), recognising their value as learning contexts due to the immediacy of the process.

5.12 Staff Planning

5.12.1 Several points relevant to this have been covered above. These included the planning time required, cross - curicula staff planning and potential spin - offs, warming up, and use of time-out.

5.12.2 A key aspect of normal curriculum planning is progressive development. A limitation of these accounts was that each cohort of pupils experienced an event which was not part of a longer term development plan.

5.12.3 Currently some account 3 schools and the account 4 school are developing the approach on the basis of an event each year for year groups within their schools. These will make relevant follow up work to this enquiry.

5.12.4 One aspect of progression which can be identified from these accounts is the link from primary to secondary practice. This has been discussed to some extent in 5.6.18, but requires reiteration and expansion here.

Account 2 and some of the account 3 schools worked with year 7 pupils specifically because the staff felt that primary experience would lead into the work more easily. This was thought to be because primary practice involves a greater degree of group work and the curriculum is not broken down into specific subject areas to the same degree.

5.12.5 The indications are that this logic was not correct. Generally pupils found adoption of the approach as difficult as other age ranges did. Similarly they appeared to adapt as quickly as other groups and respond positively. In discussion with pupils it became clear that groupwork experienced at primary level was collaborative, sharing resources to individual ends (2, 6.0/7). The commercial element to the work in these accounts was unfamiliar to pupils. Working in a cross-curicula manner may have been familiar to year 7 pupils and eased transfer but there was no direct evidence.

5.12.6 Accounts 2 and 3 showed some teachers found a process led approach incompatible with preparing pupils for eventual GCSE. In these cases the staff were concerned that they were not covering the basic skills and knowledge required for subsequent work and examination. This is a factor that teachers must consider.

5.12.7 Several schools within account 3 used preparatory periods, in timetable, before a suspended timetable event. This enabled staff to cover aspects they felt necessary for that event. These included (3, 5.10) giving the 'brief' out one week in advance to enable pupils to research the area in their own time. School 3 used small group projects within English and maths prior to commencing the main task. School 4 used a year 8 class within the timetable to pilot a suspended timetable event for the whole of year 9. In this case the preparation was intended for staff rather than pupils. Warm-up sessions immediately before an event such as accounts 4 and 5 could be used to front-load knowledge and skills to varying degrees. In account 5 some pupils were

given the `brief` prior to the event and enabled to prepare themselves unlike the majority. This caused resentment amongst other pupils, being seen as giving an unfair advantage. It is interesting to note this reaction in comparison with the acceptance by pupils that team numbers may vary.

5.12.8 These techniques were used to acquaint pupils of the procedures they would be using and also to front-load certain knowledge and skills. This can be juxtaposed with concerns over GCSE coursework and foundation knowledge and skills discussed above. The residential events such as the series which account 5 illustrates only front-loaded enough information to enable teams to complete the tasks. This was done to minimise time spent on inputs and maximise team process. However, to front-load just enough information to complete a task is artificial. Pupils do not appreciate the need to filter information for that which is necessary and are always protected from a situation where they may not have enough information. Being able to identify what information and skills are necessary and then being able to identify where and how to get them must be as important as being able to filter excess information.

5.12.9 Staff giving specialist inputs in an event may perpetuate pupil perceptions that certain work is only done with certain staff or in a certain location (3, 5.20/3). Yet it is not reasonable to expect staff to abandon their specialisms and give inputs on any area. A balance is necessary; if a teacher lacks confidence in an area such as accounting they may perform badly and so disadvantage pupils. Staff need to be sensitive to the fact that they, as specialists, are often expecting pupils to work as generalists.

5.12.10 Teachers may require specialist advice when planning. The pre-enquiry events and account 5 were planned without specialist financial advice. It became apparent in account 5 that there were weaknesses in this aspect (5, 8.0/14). The complexity of events such as accounts 4 or 5 is such that an efficient and effective staff planning group, including appropriate specialists, needs to cover all aspects.

5.12.11 Some teachers in account 5 felt that too much emphasis had been placed on production and not enough on business aspects. This is a development of the point above and reflects the expertise and perceptions of the designers. Section

1.0 explained why the design and production of an artefact was chosen for such events. The approach is flexible, a task could be coupled to an enhanced business aspect and practical production minimised. There is much research already done on the use of `paper` or computer based teamwork simulations some of which has been covered in 4.0.

5.12.12 Account 5 raised the point of the clarity of objectives as presented to pupils. The question of ambiguity in designer / client relationships has been raised but in this context it is also an element of planning for progression. As pupils progress they should be helped to recognise ambiguity and learn to handle it in simulated contexts.

5.12.13 Team size must be considered in planning. The teams in these accounts varied from 3 to 7. All were satisfactory in their contexts but observation indicated that it is important that the task generates enough work to support the number. Failure to ensure this can mean that pupils may not be fully employed and loose interest.

5.12.14 An important aspect of the approach adopted has been the responsibility of teams to develop their own strategies. Access to information is essential. Pupils may need access to suitable computers and software, telephones and text books. In accounts 4 and 5 large noticeboards were used as focus points for some information, but there were indications that this needed to be developed into a broader resource base (2, 13.0/8).

5.12.15 Computers are a valuable tool for processing information. Programmes can be used to offer structure to the task without that structure being obvious. In this way the team may feel in control and yet the programme is guiding and supporting. In the pre-enquiry events the author designed a programme with the assistance of a programmer in order to achieve this support. This programme is not being seen as a part of this enquiry but was made public (Denton and Bhandari 1987, Denton and Bhandari 1988). This programme was effectively superseded by similar programmes from commercial groups such as British Petroleum and The Banking Information Service (BIS).

5.12.16 The BIS package was used and evaluated by BIS researchers in account 5. Their accounts triangulated observations made in the pre-enquiry events that a small minority appeared to use computers as a means of avoiding interaction with their team. These were always boys, but the small number prevents the conclusion that it is gender based. The computer equipment in account 5 was more sophisticated than pupils were used to and there may have been a deep interest pulling these boys away from their teams rather than a personal disinclination to mix.

5.12.17 Computers were of value in offering structure in account 5 and the pre-enquiry events which preceded it. However, in account 2 system failures caused frustration for both pupils and staff and the use of the programme was eventually abandoned. In this case there was only one computer. This had caused log-jams as teams were not efficient at working out what they were going to put into the computer prior to use. Linking this to the point of the pupil who is reluctant to leave the computer, one proposal may be to include a clock in the programme so that computer time may be logged and used within the commercial simulation as a debit.

5.13 Teacher response

5.13.1 Teacher response to the approach adopted in these accounts was generally very positive. Out of the six schools in account 3, two are using the approach on a yearly basis for whole year groups. Similarly the school in account 4 has adopted the approach and uses it on a yearly basis with a whole year group. The LEA involved with account 5 continues with yearly residential events which now operate both in this country and in France with mixes of students from both countries. It is interesting to note that in accounts 1 and 2 only one staff member was involved whereas in accounts 3, 4 and 5 there were several. This appears to be a factor in whether such developments are adopted on a regular basis.

5.13.2 Despite a positive response some teachers were wary of specific aspects, particularly the commercial and competitive elements (2, 6.0/10; 3, 5.20, 5.40). Resistance to competitive aspects appears to centre on teachers

perceptions of the dangers of children receiving negative reinforcement from `failure`. This is a real concern and will be examined in section 6.0. The commercial aspect has competition embedded within it. It may be that the incidence of personal experience of commerce or industry within the teaching profession is low. Might this be a case of fear of the unknown?

5.13.3 Teachers valued micro teaching opportunities as being immediately relevant to pupils. However, even at debrief sessions, it was difficult to share all that came from these opportunities because of the numbers of pupils present and because not all aspects would be personally relevant to every pupil. This caused a degree of frustration amongst staff (2, 6.0/13).

5.13.4 A point which has already been covered has been teacher concern as to when to intervene and when to allow teams to proceed (2, 6.0/14; 3, 5.30). Some teachers in account 5 (9.0/31) admitted that they had intervened when it was not necessary in order to maintain personal contact as they felt too remote observing. This appeared to be a lack of confidence arising out of inexperience with the approach. There were numerous examples of a lack of confidence; account 3, 5.20 in the generation of events for a single class; account 3, 6.12, in communicating experience from INSET back to colleagues in school; account 3, 6.14 where teachers were reluctant to approach industry for assistance (though there was a shortage of time here).

5.13.5 Control of the learning situation also raised points on confidence. The teacher in account 2 was concerned because this was a design class in a rotational timetable. The teacher knew that he would not see this class again until the next year. He saw the teaching of foundation skills as very important for preparation for GCSE. The process-led approach could not deliver a uniform experience. This teacher took several sessions away from the event for specific inputs on aspects such as graphics. The lower intensity of this event may have been due to these inputs side-tracking pupils. In seeking to gain some uniformity of input this teacher was also attempting to maintain personal control over the event. He had moved from a highly structured foundation course and had not appreciated in his planning just how far he had relinquished direction to pupils.

5.13.6 This teacher admitted his lack of confidence (2, 6.0/11) but it was clear that assurance did grow over the period of the event (12, 10.0/1). This, and the 'in timetable' events of account 3 raised points on the suitability of employing the general approach in timetable. This will be discussed in more detail in section 6.00.

5.13.7 The stress innovation places on teachers should not be underestimated, especially at a period which is seeing an unprecedented rate of change. Curriculum managers need to be particularly sensitive. This does not necessarily mean stopping or limiting innovation; much has positive value.

5.14 Teacher / Pupil relations

5.14.1 The teacher / pupil relationships described within the accounts are different from most learning situations. The role of the teacher was as facilitator, contrasting with the way many teachers described themselves in their normal teaching - as a resource (2, 12.0/4). This change caused unease for both teachers and pupils which is reflected in other accounts. In account 5 pupils searched for the 'rules' and relationship by constantly asking 'what if?' type questions of staff. These questions sought not only to answer specific points relating to the task but possibly also to ease concern at their new freedoms and responsibilities. This unease passed fairly rapidly and pupils subsequently remarked on appreciating teachers willingness to give them 'space'.

5.14.2 Account 5 NGT offered some apparent conflict, with one statement ' good personal staff relations', receiving 3.00/5 with 1.303 StDev; 'some negative teachers' , receiving 3.043/5 with 1.147 StDev; and 'teachers treat us like adults', 3.391/5 and 0.988 StDev. This showed the latter statement to have the strongest support, with the middle two giving mixed results. It is interesting to compare this with feedback from the pre-enquiry residential events. These had been designed and run by the author with assistance from two university colleagues. The teachers accompanying students had a passive role to observe during the day and subsequently to act in loco parentis during the late evening and night. In these cases NGT and discussion raised the point that pupils saw the university staff positively and the school staff negatively.

This was probably due to different roles. The university staff were directly involved with pupils and yet offered a great deal of freedom; the teachers were passive during the day and early evening and had to control a lively group of mixed 17 year olds in the late evening.

5.14.3 In account 5 some of staff had been involved in the detailed planning and all had attended a 36 hour INSET where they had been introduced to the event, location and had discussed the final details including how they were individually to support the event. This made them directly involved in the event both in terms of personal `ownership` and from the pupils` perspective.

5.14.4 This improved relationship of pupils to staff was also clear in cases such as account 3, (5.50, and 5.10) where a `difficult` class followed the event by producing a thank-you card for staff. Staff reported this as being unusual. It was indicative of a new respect.

5.14.5 The fact that the new relationship was initially difficult for staff as well as pupils is illustrated by aspects of feedback. Pupils needed rapid feedback which they normally got from direct teacher contact and marks for exercise work. In these cases such feedback was limited as the staff stood back from teams. Possibly because of this the `can we...?` questions were frequent. Staff also suffered from lack of feedback and the insecurity it can generate. The teacher in account 2, working over a longer timescale than the other accounts, normally received weekly marks for homework and exercises, in this case this supply of information was removed. He generated input sessions (discussed above) which appeared as much to do with gaining feedback for himself as giving inputs to pupils.

5.14.6 Whilst teachers appeared to need concrete feedback in the form of marks it was apparent that they did begin to see the advantages of improved observation (3, 8.30). This could generate perspectives on the way pupils responded to the work and reacted with each other. Added to this was increased flexibility to focus on a team or individual, as appropriate, including direct discussion if necessary.

5.15 Pupil response

5.15.1 The majority of accounts indicated that after a slow start pupils accelerated the rate and intensity of endeavour to levels which were higher than teachers would expect from normal classwork (1, 6.3/1; 3, 5.10; 4, 6.22; 5,9.0/27).

5.15.2 The reasons behind this pattern have been explored to some extent already. The initial slowness appeared to be due to a degree of shock or tension as pupils came to terms with the new working situation. Pupils were expected to work as teams and the indications were that they had little experience of this beyond sport. In most accounts teams were selected to be heterogeneous rather than based on peer groups. The task, whilst centred on designing and making, had broader perspectives which called upon skills and knowledge from a variety of areas. Again this point appeared to cause difficulties for some pupils. This initial phase was followed by one where the teams slowly integrated and the work rate accelerated. The final phase was one of intense activity - a "very infectious atmosphere" (3, 5.20 TO).

We can recognise three basic phases: meeting / clarifying; forming / acceleration; intense team activity.

5.15.3 Phase 1 - Meeting / clarifying

NGT in account 5 showed evidence of tension amongst students meeting for the first time (5, 7.4/1). However, this was oblique in referring to the effect of the warm-up exercise in relieving tension. Account 5 used teams made up from students from different schools, whereas in other accounts pupils were from the same school and could be expected to suffer less tension.

5.15.4 The task was another source of tension. Some members appear to have been happier handling open-ended tasks and ambiguity than others (5, 9.0/23). At a time when members had to learn to work with each other they were also attempting to clarify the task to their own satisfaction. The frustrations

generated have been discussed above. Nevertheless, these were usually overcome and were a source for useful and immediately relevant discussion at debriefings.

5.15.5 The use of relatively open-ended tasks and structure were intended to encourage teams to develop their own working strategies. Where the approach has been used with year 7 children staff have incorporated more structure based on their experience of the capabilities of their pupils. Events with year 10 and 12 pupils had more open structures. It is difficult to establish the elements of structure necessary to support teams in the simulation whilst offering the freedom to develop their own strategies. This is best decided by the teachers who work with those pupils. These teachers must also be confident in the structure themselves. A general rule would be that more freedom of structure = the greater risk = the most potential for strong gains for pupils, but also the most potential for pupil losses.

5.15.6 Several aspects relevant to this phase, have been covered elsewhere but will be mentioned for continuity. Some pupils were more sensitive to what they saw as appropriate work in certain areas (3, 5.20 - "doing maths in an art lesson"). When working in a residential setting such responses were not evident, though there were prior expectations of the type of work they would do in a university department of Design and Technology.

5.15.7 Changed pupil / teacher relationships have been discussed. It took time for pupils to learn to use the staff as facilitators rather than direct resources. Many questions could easily have been answered by a little thought amongst team members, but by asking staff they were also attempting to clarify the task and context (2, 6.0/26). Another facet of this is the NGT statement from account 5 that the "inputs did not go deep enough" (5, 7.4/26). This was not a strong reaction at a score of 3.154 out of 5 but the StDev of 0.898 showed it was generally agreed at that level. This may have been either due to expectation effects or a wish to gain greater clarification from the inputs.

5.15.8 In this phase teams acted largely as groups, in that there was inter-team cooperation rather than competition, despite the competitive context.

5.15.9 What pupils "felt fair" was discussed in 5.3.7, but we can also add reaction to parental involvement in homework (2, 12.0/1). The general attitude amongst the year 7 pupils of account 2 was that work was a private thing and that discussion with others was "cheating". How far this attitude pervades general pupil culture merits further enquiry. As an attitude it would be a negative influence within a cooperative group/teamwork context. Account 2 was the only one, operating in timetable, which set homework so the data is not triangulated.

5.15.10 Account 5 indicated that pupils needed to be more sensitively critical of each other (TO 9.0/17). Teachers reported that pupils lacked the skills to do this in a constructive manner. The point was not raised in other accounts, but may well have been a factor. It should be taken into account in debriefings and planning for progression.

5.15.11 Generally girls were more positive in putting forward ideas in the early stages of account 5 (10.0/4). They also tended to be more positive in discussing the ideas of others. Boys tended to be negatively critical and were more reluctant to put ideas forward. This may be due to the relative maturity of boys and girls at early adolescence. Similarly the boys may have been attempting to protect their self-images against a girl dominated flow of ideas; maintaining their perceptions of masculine role models. Whether the girls were actually more fertile with ideas is impossible to assess from the data, but it is possible to conclude that they tended to be better able to take advantage of the positive synergetic potential of groups/teams.

5.15.12 Some members were aggrieved if they felt their suggestions were not given due weight (5, 10.0/8). They may then have reduced their effort. The data is not detailed enough to draw a conclusion on this point, but there is evidence from the literature (section 3.0) to indicate that this may be the case.

In account 5 the most obvious rise in endeavour came about at the time that positive feedback was received from the bank manager. Similarly in account 4 the level of endeavour rose at the time that the first trial biscuits were completed. In both these accounts there were many other factors in play but it

may be reasonable to assume that the positive feedback from these situations contributed to pupils increasing their level of endeavour.

5.15.13 Leadership has been discussed. In some teams "leaders" emerged by the end of this first phase. The majority of teams appeared to be attempting to maintain a cooperative management structure.

5.15.14 Phase 2 - Forming / accelerating

5.15.15 Personal integration within teams was generally fast even in account 5 where pupils were unknown to each other and chosen on the basis of mixed sex and academic background. It has been noted that pupils had higher perceptions of their teamwork ability than staff. Even so the majority in all accounts gelled as teams with only a small number avoiding involvement (6 out of 85 in account 5). Of this minority some were persistent in re-establishing relations with friends. This was most noticeable amongst a group from a College of Further Education. These students were one year older than the rest of the cohort and made least effort to integrate. Whether this situation would arise if events were attempted with vertical grouping in schools would be an interesting question, together with what benefits might accrue.

5.15.16 A small number of the pupils who avoided integration appeared to prefer solitary work (5, 9.0/8). This raises questions as to the degree staff should force pupils to use specific workstyles such as teamwork (discussed in 6.0).

5.15.17 One aspect of minimal integration already covered has been that of a minority who perferred to work on computers (see 5.12.17).

5.15.18 Members became more at ease with the team and the task as time passed (5, 9.0/14). Similarly they began to "live" the simulation, gradually getting more involved. One of the reasons for this has been discussed above in the form of early feedback, but to a large extent this may be due to personal integration.

5.15.19 Personality was a factor in integration, especially if dominant or withdrawing. An example of friendship or peer pairs supporting each other within a team has been discussed above. In account 4 staff allowed friendship pairs, put in teams of two pairs, contrasting in sex and ability. Some pupils appeared to feel isolated more easily than others and needed the support of a peer. This peer need not be a close friend as account 2 indicated but a general rule would be to avoid obvious isolation such as one girl amongst boys or a withdrawing pupil amongst extroverts.

5.15.20 Most pupils quickly recognised the freedom they had to gather information (3, 5.10). This was one factor identifying when teams had entered the second phase of forming and accelerating.

5.15.21 Previous pupil experience with "enterprise" type learning approaches appear to have had a positive effect in respect of pupils ability to quickly take the initiative. This indicates that planning for progression would have positive results. The direct evidence for this is limited to two girls in account 5, who had attended an "enterprise" TVEI course. These girls were more self-confident within the context from the start of the event and carried the rest of the team with them. There is the possibility that these girls may have been normally more self-confident or have gained from other team experiences such as sport. This is a narrow base to draw anything other than indications from.

5.15.22 Phase 3 - Intense team activity

5.15.23 Teachers reported the gradual building of the `atmosphere`. *Enthusiasm and pressure, students working hard, stretched, motivated, sense of achievement* (5, 9.0/27). The BIS researchers reported the development of a positive response, with long periods of intense concentration. This runs contrary to popular theory that pupil attention spans are likely to be short. The novelty of the events, together with the developing nature of the task probably combined to maintain interest and concentration.

5.15.24 Staff in account 4 remarked on the levels of maturity and application they witnessed in comparison with conventional work (4, 6.31/7). They recognised this particularly with "lower ability and normally disaffected" pupils. Several schools in account 3 deliberately targeted their events at `difficult` classes (3, 8.50/3) and reported that these pupils were more cooperative in all cases. How long these levels of improved cooperation could be maintained is difficult to say, or whether they could be maintained on returning to normal classwork. Pupils regarded as `difficult` may be less cooperative on returning to normal learning styles as they would have lost something which they valued and which motivated them. This merits further investigation.

5.15.25 The term `difficult` is vague but has common usage amongst teachers. Research into this area (Denton 1984) showed that the term is used generically but that teachers tended to focus on more overtly disaffected pupils. These are mainly pupils who have no disabilities, physical or mental, but have lost interest, whether it be in a specific subject, for specific reasons, or in school in general. These pupils are often disruptive to varying degrees in class.

5.15.26 Account 3, 5.10 specifically referred to `bullies`. In this case teachers reported that they did not act in their usual manner but were more cooperative within teams. The changed approach to learning appears to have boosted the attention and motivation of these pupils for the period of the event together with their regard for team members. To what extent this could be repeated in subsequent events is difficult to estimate. There is a novelty effect and pupils may be less likely to react positively with repetition. The novelty effect will lessen, but the interest and changing stimuli may maintain improved behaviour.

5.15.27 Deadlines appeared to have a significant effect on work rate, together with positive feedback. Similarly pupils recognised the value of learning to work to deadlines (1, NGT score 4.7/5; 5, NGT score 4.485/5).

5.15.28 Continued high levels of endeavour do lead to tiredness (1, 7.0/5; 4, 6.22/4). Staff will have to be sensitive to potential dangers.

5.15.29 General aspects of pupil response

5.15.30 There has been a generally positive response by pupils to teamwork and the approach adopted in the accounts. This included aspects of interpersonal relations such as `making new friends` and `developing personalities and communications` (5, NGT 13, 14) both of which carried high scores and low StDevs. There is a question of to what degree pupils experienced problems or disaffection with the approach without reporting it via NGT or it being observed by staff. Responses such as account 4, 6.31/5, indicated that pupils would like such events more often and for them to be longer, though this was partly because they felt that longer deadlines would make for easier work.

5.16 Parental response

5.16.1 The teacher who designed account 2 incorporated homeworks which required pupils to gather certain information from parents. This was done both to develop pupil ability to interrogate adults for specific information and also to covertly inform and enlist parents in the project. Seventy five percent of parents contributed (2, 6.3), though pupils were very reluctant to talk about parental contribution. There appeared to be an attitude that homework should be a solitary activity and parental assistance was wrong. Discussion with pupils showed that some parents experienced difficulties with year 7 maths.

5.16.2 School 2 in account 3 ran events over a period of up to 8 eight weeks in various subject areas within the timetable. There was no attempt to draw parents into these events as in account 2. However, staff reported a higher parental interest than when pupils were engaged in normal learning (3, 5.20). There was evidence of this in normal teacher / pupil interaction and also (3, 7.10) increased interest at parents evenings.

5.16.3 None of the other accounts generated specific observations on parental involvement. It may be a reasonable assumption that improved parental interest and involvement could lead to improved pupil performance.

5.17 Conclusion

The accounts offered a number of differing perspectives on the general approach described in section 1.0. These can now be juxtaposed with the literature and discussed in section 6.0. The accounts raised points, many of which demand further clarification and/or quantification. The enquiry methodology was intended to open, identifying points as they became apparent rather than respond to a fixed observation schedule. This has had a degree of success but the limitations have also become obvious. These will be discussed in section 8.0.

6.0 Themes, relationships and points of interest: a discussion

6.1 Directions for discussion

a. Was raised endeavour confirmed by the enquiry?
b. The following underlying themes and points of interest are then discussed:
   Novelty and experimental effects.
   Teamwork aspects: selection, size, relation to task, and team base area.
   Competition and reward.
   Simulation aspects such as pupil perceived relevance, autonomy, roles, identification with the simulation, iteration.
   Time management.
   The teacher within the accounts.
c. These are then related to Technology education.
d. The limits and limitations of these observations are discussed.

6.2 Was raised endeavour confirmed by the enquiry?

The literature identified group/teamwork, competition, simulation and concentrated study all as having positive effects on `effort` but does not allow a direct comparison of effect. The fieldwork confirmed that by employing these factors within the learning events, endeavour reliably rose to levels above those teachers accepted as being normal in schools.

The literature focussed on the above factors independently. In the accounts they were brought together by varying degrees. By juxtaposing the literature and accounts it is possible to discuss the range and nature of the phenomena observed to some degree.

There was evidence that levels of endeavour related to the degree to which staff employed these factors. The more factors employed, the greater the increase in endeavour. While there may be a cumulative effect it is probable that there was also an experimental effect. Staff who accepted the approach most were also those who became most enthusiastic and this was probably reflected in the

way they organized and presented the work. This would influence pupil endeavour.

Endeavour grew over the period of an event rather than immediately assuming a high level. This was particularly clear in suspended timetable events over periods of one to five days. Three phases were identified which echoed the four suggested by Tuckman (1965, 2.12.2):

There was a clearly identifiable initial phase of `meeting and clarifying`. This phase was characterised by poor team coordination and individuals asking questions of staff. Whilst overtly these questions sought to clarify the task they also appeared to have an underlying purpose of establishing what the new relationships and expectations were. The minimal structure of the events, intended to offer teams autonomy and responsibility, may have contributed to this slow initial response by not imposing an operating framework for teams. Similarly informal meetings of school friendship groups, split by the event, were dysfunctional to team development.

The degree to which pupils were unsettled was probably related to lack of familiarity with the context including teamwork, autonomy and establishing their own team and task management structure. Observation indicated that the great majority of pupils were unfamiliar with all these factors. In the very few cases where individuals had some experience of working in this manner those pupils settled far more quickly and were soon contributing strongly. If all pupils were to gain experience with the approach this first unsettled phase would probably be shortened. A longitudinal study is required.

The second phase of `forming and accelerating` was characterised by the development of working relationships within teams and movement on the task. The third phase, of `intense team activity`, was characterised by very high levels of endeavour. By this time team relationships and organization were established and deadlines were close enough to ensure urgency.

Tuckman had proposed four phases: testing-dependence, conflict, cohesion and functional. In the fieldwork the first two were effectively parallel, hence the term `meeting and clarifying`. Tuckman`s third phase of cohesion parallels `forming and accelerating` which, in the fieldwork, was relatively short before

approaching deadlines and improved team organization established the fourth phase of `intense team activity`.

Further evidence that high levels of endeavour had been achieved included increasing attention spans. Observation indicated extended periods of intense concentration in the second and particularly third phases. These were considerably longer than is expected of pupils in normal learning contexts. Attention span appeared to respond to increased interest as pupils became absorbed by the simulation, and to a high pupil perception of relevance; though novelty factors must have also influenced this. High levels of tiredness at the end of events (but also due to late nights on residential events) were also evidence of sustained high levels of endeavour. Similarly staff experienced difficulty in breaking pupils away from their work for debriefing at the end of a working session.

It was interesting to observe that `lower ability and normally disaffected pupils` responded more positively to the events than staff would normally have expected of them. This was triangulated over a number of events, improving reliability. This is supported by the literature on both simulation and group/teamwork. There is the danger of a confusion of terms but `lower ability` and `less able` could reasonably be taken to be similar. `Normally disaffected` is a different categorisation but is of equal interest to this enquiry.

These observations on the reaction of lower ability and disaffected pupils may be juxtaposed with literature indications that higher ability pupils achieve as well in groupwork situations as in individual work. This would indicate that this form of working provides a useful platform for mixed ability learning. With the aid of appropriate de-briefing all pupils may be helped to recognise the value of group/teamwork and particularly that all members are important and may contribute positively.

The literature on industrial situations enables the separation of some of the factors under consideration. In these industrial cases group/teamwork is used in conjunction with concentrated working practices; timetabling and simulation effects are removed. Companies are increasingly using teamwork due to evidence of improved output performance. More interestingly there are apparent gains in improved working relationships. The literature indicates staff are happier working in teams than more conventional structures. As

industrial working methods have always used `concentrated working practices` it is reasonable to assume that these results were due to group/teamwork rather than any other factor. Some of these cases have been in operation long enough for Hawthorne and novelty effects to have minimised. However, teamwork innovation in industry has usually been combined with changes in management structures; typically `flatter` systems. This means that the team are usually delegated more responsibility and autonomy and can also more easily recognise the management structure in the company. Teamwork may require increased autonomy and responsibility to function effectively.

It is interesting to note positive worker responses such as improved job satisfaction and reduced absence and compare these with one of the social benefits claimed for group/teamwork in education: improved integration of ethnic groups, gender and possibly other groupings/minorities. It may be reasonable to assume that this may also be the case in industrial teamwork, though no direct reference has been found.

In conclusion the accounts indicated a reliable improvement in levels of endeavour above those staff would expect of those pupils in their normal school situations. The accounts showed that pupils responded positively to simulation, teamwork and concentrated working. Pupils did not appear to respond to competition but were motivated by approaching deadlines. With the exception of competition the literature supports these findings.

6.3 Underlying themes and points of interest.

The accounts cover ten learning events with a degree of variation in which the factors above were employed. By juxtaposing these and the literature it is possible to some extent to identify the effects of individual factors or clusters.

The main themes and areas of interest identified were listed in 6.1. They are separated for ease of presentation but in the working contexts they would have interacted and these interactions may have been complex.

6.3.1 Experimental effects

Various experimental effects will have influenced the enquiry in two basic ways: through pupil endeavour and the data gained. The effects on data will be looked at more fully in 6.4 in terms of the limits and limitations and the conclusions which can be drawn. At this point experimental effects are discussed in relation to pupil endeavour.

Novelty and Hawthorne effects act on pupil perception and influence behaviour. All events were very different from the normal school work of the pupils; hence novelty. In addition it must have been apparent to pupils that they, and the event, were being observed; hence Hawthorne.

Hawthorne and novelty effects are well documented and usually act to boost participant effort. This must have also been the case in the accounts. The question is to what degree the effects can be separated from any other factors involved.

The second type of experimental effect will be those working through the staff who designed and ran the events, including the writer. In all cases staff were volunteers who wished to maximise benefits for their pupils. All believed the events would have a positive effect. This is not an ideal attitude for a researcher and may have led to two basic effects.

Firstly, staff observation, the major data collection method, may have been subconsciously selective in a manner positively biased to the approach. However, some events were also observed by experienced evaluators who were outside the planning teams. The LEA in account 3 used an experienced independent evaluator who observed the planning and delivery including the teacher INSET and elements of all the six school responses. A report was written which has been used as data within that account. Similarly many other visitors observed and made comments. These were not necessarily recorded separately but did influence the responses of staff that were recorded. In all these cases observers felt that there was a marked increase in endeavour above that they would normally expect. This supports the view that whilst staff may be positively biased this need not invalidate their observations.

Secondly, staff would possibly put more effort into planning and running these events than would normally be the case. All events were designed as parts of otherwise 'conventional' curicula and were intended to act in support. The suspended timetable events were seen by the LEA in account 5 and the schools in accounts 3 and 4, as being annual events. This means that they would probably remain out of the ordinary to staff and so lower levels of confidence and experience in these events probably caused more work to be put into their planning than may have otherwise been the case. The accounts include comments from staff as to the considerable time required for planning.

In conclusion novelty and Hawthorn effects undoubtedly influenced results via both pupils and staff. However, these effects may also be seen as influences which teachers may use positively. They do not invalidate the value of the event for the participants.

6.3.2 Teamwork aspects

The profile of teamwork piloted in account 5 raised several issues. Two are of relevance at this point. Firstly, when responding as a team, members rated themselves higher than when responding individually. The closeness of the team may have had a positive effect on self-confidence as team members. The profile must be recognised as of limited reliability and validity as the sample was limited to 43 students (7 teams). This is an area meriting further investigation, particularly to examine levels of self-report at various stages of team formation and over a longer term programme of team-building.

The second point was that the concept of leadership was almost rejected by students. Cooperative working appeared to have assumed a form of sub-cultural ideal. This is an interesting area, again meriting further investigation as this enquiry has only detected indicators.

Leaders did emerge during account 5 despite the fact that teams appeared either not to recognise the fact or to ignore it. On leadership the literature falls into two camps. In one leadership appears to be an assumed requirement (for example Driskell 1987). In the other leadership is minimised and team membership emphasised. Hampden-Turner (1971)

and Buchanan (1989) made strong cases for organizations to emphasise flatter management hierarchies using teams which assume much of the management role. These authors observed that when this was the case companies tend to out-perform those operating more traditional, pyramidical, hierarchies. However, these authors did not call for cooperative, leader-less, management structures. There would appear to be a role for leadership but the quality and style of that leadership becomes one of participation and discussion rather than distance and delegation. The literature does not provide data on any companies introducing teamwork whilst maintaining a pyramidical management structure.

Leadership tends to be a misleading concept; more important is helping pupils to establish a coordinating structure. The degree to which staff impose such a structure and pupils are allowed to establish their own is an interesting area. The original philosophy within the approach explained in section 1.0 was that teams were largely left to their own devices to establish management structures. This was done in order to provide a variety of points for discussion at de-briefings. It was recognised that with younger pupils it may be necessary to offer some form of structure but in no account was a conventional leadership role suggested by staff.

The accounts showed that teams performed better when they established some form of structure which could set goals and coordinate activity. All the events were short, five days being the maximum. This was little time for inexperienced pupils to establish effective structures through a cooperative management strategy and the more successful teams appeared to have been the ones where some form of leader quickly emerged and directed activity. If teams had received training in managing their work would they have been able to establish cooperative structures which would out-perform more conventional structures as Buchanan (1989) and Hampden-Turner (1971) suggest? There was evidence that the very small number of students with previous experience of teamwork and 'enterprise' type activity were quickly able to establish an effective management structure. However, this was done by taking a position of leadership even if the team did not see it in this way. The numbers were so small that this observation can only be taken as an indication. Similarly it is not known whether these previous experiences put members into formal roles. If this was the case

they may associate management structures automatically with leadership and not appreciate that there are other ways in which to organize teams.

To summarise at this point; the literature indicated that cooperative or 'flatter' management structures which employ teamwork are superior in both gaining results and producing harmonious working situations. However, the accounts indicate that forms of leader directed team produce more effective results in short term exercises where members have limited team or task management experience.

Team selection in the accounts varied from peer group self-selection to teacher imposed heterogeneous teams. The latter appeared to out-perform those chosen by other methods, particularly peer self-selection, though no direct comparison was possible. In order to clarify the position it is necessary to turn to the literature on team selection.

Team selection by peers tends to produce homogeneous teams (Perry and Euler 1988). Such teams would have a higher initial cohesion than heterogeneous teams. In a short exercise self-selected teams should perform better due to that probable cohesion, but this is not to say that levels of endeavour would be higher than normal. A group with low cohesion would suffer a large process loss in the initial stages and performance would be low.

Cohesion appears to be an important factor in effective performance. A team in which members are unfamiliar with one another will have low cohesion and will require more time to establish relationships. Such a team would be more likely to be heterogeneous than a peer selected team. If such a heterogeneous team can establishes cohesion, it may also produce an increased assembly bonus effect and possibly positive synergy.

Cohesion is not simply influenced by time or the homogeny of the team, but also by the structure designed by staff to support teams. An example would be warm-up exercises intended to reduce the time required to achieve reasonable cohesion. The teams in account 5 had minimal cohesion initially as members came from different schools and were set by staff on the basis of a range of subject specialisms, gender and ability. It took approximately 36 hours, before teams were generally felt by observers to be functioning

well. The warm-up exercise in this case had lasted 90 minutes and had been competitive, in contrast to advice from the literature. The degree of competitiveness in the warm up may have reduced the development of cohesion though it appeared to be successful to some degree (NGT results). Nevertheless, the warm-up exercise did not, according to observations, fully establish cohesion. The process was started and members had to continue the development in the main exercise, hence the initial phase of difficulty. In contrast the warm-up exercise in account 4 lasted one day with pupils from the same school. It appeared to be more effective but the time taken detracted from the main event.

Account 4 also provided an interesting variation in team selection by allowing friendship-pairs which were joined by staff into semi-heterogeneous fours. This appeared to be generally successful over a five day event. It may be reasonable to assume that friendship-pairs tended towards homogeneous ability (amongst other factors such as gender). Bennett and Cass (1988) indicated that low ability children achieved better when in teams provided they were not the only low ability member. This supporting effect may have acted in account 4 .

Team size may influence pupil endeavour. The accounts cover the range suggested by the literature as optimal for this type of activity. As the enquiry was based on live learning events it was ethically impossible to explore the effects of taking team sizes beyond those felt to be optimum for effectiveness.

Social loafing could be expected to rise with team size as responsibility appears to drop (Leary and Forsyth 1967). Social loafing was more evident in account 5 with a team size of seven, than events which used teams of between three and five. However, it is difficult to draw firm conclusions on this aspect as account 5 had a higher level of observation and would be more likely to uncover social loafing, which is often discreet.

Irrespective of team size, by the third phase of events, social loafing appeared to have minimised and endeavour increased. Heterogeneous teams had established working relations despite gender, culture and ability differences. This supports claims made in the literature for group/teamwork as an integrative factor for cultural differences.

Both accounts and literature indicated that task should match team size; all members must be able to be actively involved. However, this oversimplifies the relationship. Social loafing was demonstrated by a minority of members even when the task made effective demands of them. The observation that this diminished in the third phase raises a number of possibilities: team coordination growth; perceived rewards; the immediacy of deadlines.

Teams were not given instruction on coordination. This meant that teams had to go through a phase in which they both established relationships and a system for managing the task. The intention was that this phase would provide immediate and personal experience at de-brief. Only a longitudinal study can illuminate whether this policy is effective but it was apparent that the majority of teams developed systems which integrated members, established communications and reviewed progress.

Rewards are a form of feedback and a motivational factor. They have been discussed by many authors including Harkins (1987), Hackman (1983), Slavin (1991), Kohn (1991) and Lepper and Hodell (1989). Two basic camps are identifiable:

Those who argue that extrinsic rewards in the form of marks and scores may be counterproductive. Those who accept rewards but argue as to whether they should be focussed at individual or group/team level.

General feedback to pupils in the accounts was at team, rather than individual level. This was to some degree pragmatic due to staffing and time limitations. However, it was also a policy implemented in the pre-enquiry phase based on the assumption that team feedback encourages team focus. Reward was intrinsic in that no marks were offered which would form part of assessment schemes. There was some degree of extrinsic reward in that team performance in the market place simulation established a public performance measure.

Extrinsic rewards may, in many cases, actually lower performance or motivation (Lepper and Hodell 1989 working on individuals rather than teams; Kohn 1991). There are several possible mechanisms. Extrinsic

rewards may encourage pupils to focus only on those elements of the task central to the reward, so lowering performance on peripheral aspects. Similarly there is a tendency in educational assessment to focus on aspects which may be easily and reliably assessed rather than those that may be more difficult such as teamwork ability.

Lepper and Hodell also identified evidence of extrinsic rewards lowering performance on aspects central to the task. An example given was creativity, which they claimed typically falls when extrinsic rewards are applied. The mechanism for this is not clear. It may be associated with raised levels of drive, for example the Yerkes-Dodson Hypothesis covered earlier. The accounts found no evidence of increased creativity as synergetic theory would suggest. The high levels of endeavour demonstrated in the accounts may represent high levels of drive. This would, by Yerkes-Dodson, lower performance (creativity?) as the optimum point for performance/drive had been exceeded. This would require further work as the evidence is far from strong.

The arguments put forward by Lepper and Hodell and others are interesting but far from proven. Slavin (1991) criticised such work for ignoring other studies which indicate that rewards can enhance motivation. Note the use of different terms, in this case motivation. The accounts cannot offer firm support to either point of view as rewards were both intrinsic and extrinsic. However, levels of endeavour did rise for rewards which were primarily intrinsic in that pupils gained no direct or physical benefit.

In an educational context staff are severely limited, philosophically, morally and physically, in the form of reward that may be offered. Rewards within the accounts were primarily intrinsic and aimed at team level. This differed from the advice of Harkins (1987) that rewards at team level cause a tendency for some to make less effort. However, Hackman (1983) considered that rewards should focus on the team, rather than the individual in order to build team cohesion. Slavin (1991), suggested that for maximum performance it is necessary to set group goals and also incorporate individual accountability. In this way the group is rewarded for all members learning, so there are pressures on all members to succeed.

Teams operate by delegating tasks. In the accounts these were essentially interdependent, though a member could `loaf` and other members pick up that member`s work. Nevertheless team goals were set and the team able to compare and value individuals` members` work as Harkin and Slavin have suggested.

As account 5 ran over five days some members appeared not to have felt the immediacy of the deadline and as team coordination was not developed, failed to contribute fully. As deadlines approached and team coordination improved, social pressure pulled members together and ensured work was done. Rather than extrinsic rewards members were responding to possible intra-team social sanctions or approval. Only a very strong `social loafer` could resist this pressure and the accounts show that out of a total sample of 593 pupils and students there were very few who were able to do this.

In contrast to intra-team social sanctions there was a degree of positive pressure which came through staff at de-briefing at the end of each working session. Discussion was possible and staff were able to use praise and encouragement to motivate. Such intermediate de-briefing becomes more important during an event lasting several days.

Deadlines appear to have been a strong motivating factor. Initially the perceived distance of deadlines and poor team coordination encouraged social loafing in a minority and possibly low levels of endeavour in the majority. The third phase demonstrated reliably a strong level of pupil endeavour and observation linked this with the approaching deadline. This is complicated by the fact that by the third phase most teams had gained a reasonable level of coordination including regular meetings to evaluate progress. These factors confused the effect of deadlines as a spur to endeavour. Deadlines will be discussed further below.

6.3.3 Competition

There are two general views on competition in education. The positivists maintain that competition aids personal development and provides a framework for qualities such as initiative, resourcefulness and independence to be developed. Some have claimed that competition can bring out new talents in individuals and that techniques such as handicapping can

be used to enable all abilities to gain. The negativists consider that competition threatens cooperation and undermines personal and social relations. There is evidence to support both views but it is far from easy to extract simple `truths`.

Miller and Davidson-Podgorney (1987) considered that competition increased task focus. Their work on Team Games Tournaments indicated positive gains in knowledge based learning. In these tournaments team members cooperatively learned material for a week prior to an inter-team competition. However, the effects of competition were confused by the potential benefits of cooperative learning which need not be competitive.

Farran (1968) also hypothesized that the use of competition, focussed on knowledge based learning in special schools, would assist in generating a higher pupil regard for that learning. In this case the effect of competition was again confused by the use of groups in `simulation-games`. Again there is cooperative learning but there is also a possible novelty effect from simulation. Both of these factors would have had potential positive effects on learning. Farran`s work did show that individuals who competed appeared to learn more than those in `inter-group` competition. This, to some extent, contradicts Miller and Davidson-Podgorney. These findings have been confused by the use of simulation-games in the otherwise anti-academic atmosphere of these special schools. In the Miller and Davidson-Podgorney work the intra-group learning used peer-tutoring, quizzes and discussion . Nevertheless there is the indication that competition was, at least with individuals, providing a focussing function.

Stazinski (1988) confirms this by providing evidence that individual competition in `Biological Olympiads` enhanced pupil interest and subsequent achievement. In this case the competition was more conventional in that `winners` were produced and followed over a period of 3 years. Little attention was paid to the majority of participants.

These pieces of work all looked at motivating academic learning through competition. None report any other forms of gain through competition rather than cooperation. Similarly none used a broad task orientation such as was the case in the accounts of this enquiry. Hampden-Turner (1971) observed that the therapy groups he based his research on naturally

accepted competition. This contrasts with populations in the accounts where it was observed that competition was not readily responded to. The culture and age of Hampden-Turner's `T group` members were very different from those in the accounts. Despite growing up in a competitive society and being familiar with competitive games pupils did not immediately adopt competitive attitudes. The approach under enquiry used teamwork as a central plank of its philosophy. The indications are that competition appears to have more value in relation to knowledge based learning when related to individuals competing rather than teams competing, though this is based on the fairly limited research above. The value of a competitive context for the approach under enquiry appears diminished. This is not necessarily so as there are other aspects to consider.

Wilson (1988 p 27) considered that much educational practice was aimed at protecting pupils from the effects of competition such as *humiliation .... odious comparisons.* Yet competition is inevitable in society. The distinction which is probably more important is the way in which it is handled by staff. In sport competition has been criticised for leading to excesses such as the `professional foul`. Yet it is not competition as such which produces these effects but over-reaction to it. Competition is based on rewards, both intrinsic and extrinsic, and can be interpreted by focussing only on those aspects central to the reward. In sport this may become polarised into win or lose rather than the skill of playing the game. In the commercial world most companies perform with variable levels of success; it is rare or a company to be so successful that it dominates the market place and actually eliminates all competition. Within the approach adopted in the accounts the simplistic `winner and losers` situation which games tend to generate was avoided for both psychological reasons and realism.

On a more specific level there are dangers to be recognised in adopting competition as a motivating factor. Hackman (1983) observed that 'group ethnocentrism' may develop and become dysfunctional. Similarly Hampden-Turner (1971) observed that competition may build esprit-de-corps but that interpersonal relations may degrade together with a fall in creative thinking and a rise in pressure to conform. Ravensdale (1978) considered that rising motivation may be a factor in improving learning but

that there may be a point at which high levels of motivation become a handicap in a similar manner to the Yerkes-Dodson hypothesis considered earlier.

Staff can recognise the value of competition and yet prevent excess by helping pupils recognise their own reaction and emphasising the broader aspects of the learning context. In this respect the accounts provide evidence that de-briefings do provide the opportunity to maximise the advantages of competition without suffering the negative aspects.

In conclusion the accounts indicate that inter-team competition was minimal and that motivation was most obviously generated by approaching deadlines. This finding was unexpected and merits further investigation. Inter-group competition may have little value in promoting specific knowledge based learning but the accounts showed competition had potential value as a part of a more general task orientated simulated commercial context. Staff, using iterative de-briefing techniques could use this competition as a focus for learning. Use of these techniques also mean that the effects of competition need not automatically follow the lines predicted by Hampden-Turner.

6.3.4 Team Bases.

It has been observed within the accounts that close proximity, both intra and inter-team, may promote endeavour. The literature covered generated little of significance on this topic.

Hampden-Turner's model (1971) of personal development focused on the interaction of individuals. This work was based on T-groups and as such communication would include voice and 'body language'. Proximity would promote ease of communications and interaction. The design tasks of this enquiry required media such as drawing and writing in addition to voice and eye contact. Suitable flat surfaces were necessary, but as the task was team orientated it was not necessary for all members to have enough room to work independently, when appropriate. A small working surface brought the team into closer proximity, facilitating oral, aural and visual communication. In addition this encouraged members to share ideas on a

central worksheet rather than working separately. This approach contrasted with most typical school approaches to design work and requires further investigation to establish whether the quality of design work is improved. This aspect is interesting but not central to this enquiry.

Team members were in physical proximity for only limited periods as time was also spent in delegated work. This was often remote from the team base if specialist facilities were required. It was important to build team processes when together, particularly in the opening phase. In some cases members broke off team relations to seek out peer contacts if an opportunity or distraction arose. The use of low screens was successful in encouraging intra-team focus. Screens gave teams a degree of privacy which may have minimised distraction and so improved team focus.

A team base offered a physical focus for meetings. In early events of the series of which account 5 is an exemplar, teams had been allowed to choose where they worked. Considerable time was wasted looking for what they felt would be suitable meeting places. These were also changed during an event, sometimes without all members being aware. In account 5 the base was specifically allocated; the area of table had been reduced and the low screens set up. There was a noticeable improvement in the rate at which teams established themselves in comparison with the earlier events. Together these observations indicated that the design of a team base may bring considerable benefit and yet is an area which appears to be under-researched as an aspect of group and teamwork. This must represent another area for development beyond this enquiry.

6.3.5 Simulation

Many of the aspects to be discussed are not unique to simulation, nevertheless, together they help establish the role of simulation in developing pupil endeavour and observations of the accounts.

Section 3.0 gathered evidence from the literature that simulation may boost motivation, the accounts confirmed this. A number of factors emerged. Firstly, used infrequently, simulation generates a novelty factor which may boost motivation. Used frequently this may be expected to diminish, but there is no reason why staff cannot use this phenomenon to advantage.

Secondly the accounts showed that commercial simulation raised pupils' perceptions of relevance, this may generate increased motivation and endeavour. Sub-sets of commercial simulation include the ability to build a relevant context for learning and pupil autonomy within a simulation. Finally the iterative nature of simulation practice enabled reflection and improved learning potential.

The degree to which the case studies adopted commercial simulation varied from two schools in account 3 which effectively avoided commerce and competition to accounts 4 and 5 which included personnel from companies in planning and running the simulation. Endeavour rose in all accounts, but to varying degrees and exact comparison is impossible. It is difficult to isolate the specific effect of simulation as there were many other variables. Cross-referencing with the literature it is possible to make a reasonable assumption that simulation had some degree of positive effect. In accounts 4 and 5 endeavour developed along the lines described previously, reaching very significant levels. Here the evidence showed that pupils had a high regard for the relevance of personnel from companies to their education. Account 5 indicated that more work was put into preparing the presentation to the Bank Manager than was done for staff in the final presentation. No firm evidence as to the reasoning was available from team members but a reasonable assumption is that the Bank Manager carried greater significance for students than the academic staff when working against tight deadlines.

An assumption was made that incorporating members of the business community local to schools into simulations would have a particularly heightened effect on pupil perceived relevance. This was done in accounts 4 and 5 but it was difficult to differentiate the levels of perceived relevance between local businesses and those from further afield such as the Bank Managers in account 5 who were not from the locality of the schools concerned. In some respects pupils may have seen these persons as representative of banking in general or of Lloyd's in particular, a nationally established bank. In this respect Lloyd's was 'local'.

Time planning was a specific aspect of simulation which pupils saw as relevant. However, it is interesting to contrast the minimal reaction to the competitive element of commercial simulation which has been discussed

previously. Pupils were being selective in what they identified as relevant. It would be interesting to develop this aspect in further work in order to identify which aspects of commercial involvement maximise endeavour.

The freedom given to interpret simulations was a factor which emerged as being of motivational value. However, this freedom did mean that the first phase of events was often characterised by confusion. This confusion was in all cases overcome and high levels of endeavour achieved. It is interesting to contrast this with work published by the Cognitive Acceleration through Science Education Project (CASE May 1991). Here the principle of `cognitive conflict` was put forward as a key element in developing the ability to think. CASE considered that children need to be made to confront and struggle with problems if they are to develop reasoning. They criticised much school work as being non-challenging and consider; --- *there is a strong temptation for teachers and learners to enter into an unspoken conspiracy to avoid undue mental effort.* (p2).

In the accounts, by not pre-ordaining specific roles and giving freedom to manage the task, teams were caused to confront questions of suitable control and management structures. The very act of struggling to establish effective control with approaching deadlines may develop self confidence and endeavour together with the `thinking skills` reported by CASE. De-briefing sessions represent the `reflection` which CASE also considered important. Staff were able to support pupils in this activity and in some cases teams were assisted by people from industry and commerce who carried increased relevance in pupils` eyes. The CASE results indicated both long term effects and a general one which is demonstrated by better achievement in widely different subject areas. CASE claimed: ---*a profound and permanent effect on the children`s ability to think and learn new material.* (p7)

This enquiry is unable to make such claims, but it may be interesting to speculate whether a long term follow up may support the CASE claims.

Endeavour in account 2 did not rise to the levels observed in suspended timetable events. This may be due to a relatively limited ability to `build the simulation` in a sustained manner. Breaks or inputs would further inhibit this process. Similarly breaks would probably lower levels of endeavour already built, though longer breaks may be possible without

significant effect when a higher level of endeavour has been established. Pupils may then have a higher level of identification with the simulation, be less easily diverted and more easily re-directed back to the simulation.

The manner in which breaks or inputs are managed and presented may be an important factor in determining whether an effective link is re-established with the simulation. No specific data has been gathered on this aspect. However, the probability is that the way in which inputs are closed would be important, particularly whether staff re-direct learners to the simulation effectively. The question would need to be resolved by closely focussed observation of inputs of differing length and structure to pupils in a series of events.

Once underway, the structure of events gave staff more flexibility by removing much of the 'normal' administration. It was possible to use this time effectively to both support pupils and teams appropriately and also to 'build' the simulation, especially at briefings and de-briefings. However, it has already been shown that some staff found this freedom and apparent distance difficult. Further work needs to be done on this aspect, particularly on identifying the nature of the problem and possible methods of assisting teachers to adjust.

Previous experience in 'enterprise' type simulations appeared to increase pupils' and teachers' confidence in the type of work represented by the accounts. This conclusion requires strengthening by further enquiry but has implications for progression. The nature of this apparent increase in confidence will require exploration in order to learn how to incorporate such events within the curriculum and particularly how to establish progression in development.

Simulation, and specifically the approaches adopted in the accounts, demonstrated a change in pupil/teacher relations. The effect has been described as positive, represented by improved pupil respect for staff. There were indications that staff, in turn, viewed pupils differently but this was not concrete enough to record.

Increased pupil freedom to interpret the brief and manage time appears to have been one element in building pupil respect for staff. Some account 3 schools

specifically based events around 'difficult' classes in order to establish whether these pupils would react positively. Staff reported pupils showed a new respect for staff. More work is required to elaborate these observations as they may be important.

Iteration has been shown to be an important factor within simulation in terms of effective learning. The links between this and endeavour are far from direct but there are indications from the literature that iteration, as rehearsal, may lead to greater confidence. Such confidence may be expected to improve endeavour.

Feedback is an aspect of learning which assists reflection and iteration. Pupils and staff require rapid feedback, as observed in the accounts. Myers (1990) claimed that Academic Engaged Time (AET) could be improved by positive feedback. Such feedback may also have effects on motivation and endeavour; positively or negatively. However, the freedom possible within the general approach meant that feedback may be minimised and the evidence indicates that both staff and pupils were uncomfortable with this. On-going debriefing at the end of working sessions during longer term suspended timetable events becomes particularly important.

Lepper and Hodell (1989) considered that extrinsic motivational factors may have the potential to de-motivate as discussed above. They proposed that a broad objective for any teaching should be for pupils to develop intrinsic motivation. This enquiry lacks the evidence to indicate whether operating in the manner described in the accounts would eventually reduce the amount of staff feedback (extrinsic motivation?) pupils required for motivation or whether the work would help develop intrinsic motivation. These are obvious questions for further enquiry.

Iteration has been discussed in relation to learning, via the cyclical models of learning proposed by Hampden-Turner (1971) and Klobe. Hesketh (1989) made a similar point, considering that pre-worked examples were efficient in developing transfer. The worked example provides a model but also a complete cycle in the process of iteration. The accounts do not include the use of worked examples but the warm-up sessions in accounts 4 and 5 were telescoped down examples of the approach of the main events. To some extent they fulfilled the function suggested by Hesketh of a model and also completed one iterative loop.

At this point it is also worth re-considering the points raised on the problems of 'front loading' information and the need to develop skills in being able to identify and acquire necessary skills and knowledge. Hesketh's point may appear to clash with the principle in the general approach of allowing pupils to enter situations without too much guidance. By using an open-ended warm-up it was possible to show teams that a variety of approaches may be successful without imposing a staff preferred model and yet staff could support with their own models if it was felt necessary.

6.3.6 Time management

There are two areas of time management to consider; that relating to staff and that relating to teams.

Staff may operate under a conventional timetable, or suspend the timetable for concentrated study. The literature on concentrated study is not comprehensive but the work of Parlett and King (1970) and Grimes and Niss (1989) indicated that endeavour and 'concentrated effort' do increase when time is used in concentrated blocks rather than in conventional timetabling techniques. The accounts support this.

Suspended timetabling does not automatically bring increased endeavour as both the accounts and literature indicate. Social loafing was observed, though no direct comparisons were possible with those pupils in their conventional learning situations. Nevertheless it is possible that the perceived distance of the final deadline in the early phases of some of the accounts may have encouraged social loafing. As deadlines became closer endeavour rose significantly in all but a very small minority of pupils though this is complicated by other factors such as maturation of team to task. It may be possible to minimise such effects by further experimentation with intermediate deadlines. Such a technique may raise overall endeavour by providing more immediacy for all members but would have to be done in such a way that did not reduce too far the autonomy of the team for time-planning.

The ability and necessity to plan time was seen by pupils as being particularly relevant as was working to tight deadlines. Increased relevance may have been a factor in improving endeavour. This may be supported by looking at sections

which cover the negative effects on endeavour of suspending a simulation for extended periods. In these cases endeavour was seen to be reduced in comparison with short breaks. Nevertheless it is often useful to suspend the simulation to discuss a point that has arisen. The discussion has maximum relevance to pupils as it is immediate and linked to personal experience. Breaks from the simulation should be infrequent and brief. Pupils should be guided back into the simulation if identification with the simulation is to be built and maintained.

6.3.7 The teacher within these accounts.

Staff felt their role had evolved to some degree. The reasons why and how are not unique to this enquiry. Nevertheless, the manner in which aspects of role were brought together is of interest. Some aspects have been covered in relation to other points, only the central issues are discussed here.

A teaching role in a `normal` school context is constantly changing. Pupil age, ability range, type of course and other factors are all influences. Central to role in this enquiry are teamwork, simulation and suspended timetabling; all are established techniques, though the frequency of use have varied depending on context and staff confidence.

The degree to which teachers adapt to maximise effectiveness becomes important. The accounts show that the approaches used represented a significant development from roles teachers were familiar with. The accounts do not carry enough detail to compare roles within events with roles in normal teaching situations. This would be a relevant area for further enquiry as it may illuminate how best to help teachers adapt roles when appropriate.

In adopting new techniques understanding is important. The literature provides warnings (Cowie and Rudduck 1989; Biott 1987) that many teachers need to develop their comprehension of factors such as group/teamwork as there is often misunderstanding and little depth. Similarly the accounts showed that many teachers experienced difficulties adapting to some aspects.

Most of the accounts involved teacher groups in planning and running events. The cross-curricular nature of these groups was new to most teachers, though they were familiar with specific curriculum area planning in groups. The time

required for planning events was difficult to gain against other pressures in schools. Lack of experience in such planning and the fact that they were being observed in this enquiry may have encouraged teachers to over-plan. Experience may bring confidence and competence enabling such tasks to be completed more quickly. There was evidence that the heterogeneous nature of these groups brought benefits beyond the events themselves. Staff were able to explore areas of disagreement or difficulty and to establish a joint position. Teachers reported improved empathy with other curriculum areas and a broader understanding of the curriculum. Professional autonomy need not be threatened.

Staff group delivery meant it was possible to be selective as to the timing of inputs and when individual members of staff were to observe. At some points it was possible for a small number of staff to supervise a number of teams far exceeding the normal staffing ratios. Staff could, therefore, choose when to withdraw for writing up observational notes, other tasks, or rest. The flexibility possible was seen to best effect during the week long residential events represented by account 5. The concepts of maximising teacher - pupil ratios and contact time do not appear to be appropriate all of the time within such simulations as described in the accounts.

Pupil team autonomy raised several points in relation to staff. Teams needed to be supported by a discreet framework so that they experienced what they felt to be autonomy and yet staff could ensure major difficulties were avoided. Various techniques have been described in section 5.0. Typically the approach meant that pupils were not exposed to uniform bodies of knowledge. Several staff found this emphasis on experience of team process to be difficult to integrate with their needs as subject specialists to cover specific bodies of knowledge within tight time limitations. At the point of writing most schools had not gained experience in delivering the cross-curricular elements of the National Curriculum including Economic and Industrial Understanding. However, the work done in the accounts represented one possible way of delivering these requirements. Programming such events into the curriculum may achieve a balance which staff have the autonomy to decide.

Pupil team autonomy also reduced the frequency of feedback between pupils and teachers in both directions. This has been discussed but it is interesting to note the apparent discomfort generated in some teachers by this reduction. Many

teachers admitted involving themselves unnecessarily in team processes. There appeared to be an almost subconscious motive of maintaining contact and gaining feedback. Whilst staff were freer to observe and selectively intervene it would appear that some required more concrete feedback in the form of frequent marks for exercises, homeworks and tests. The process-led nature of the approach did not lend itself to such marks, though the use of profiling has been discussed.

Providing the need for teamskills is accepted staff need to consider priorities and progression. However, as each account was a singular event it has been impossible to make observations on the teacher's role in developing teamskills, or the effects of this on pupil endeavour. There were indications that pupil experience in primary schools was essentially collaborative groupwork and that this experience did not appear to assist teamskill development, but the data was limited.

Computers have been discussed in relation to simulation including their use as a part of the structure of the event. This influences the role of the teacher and is of interest at this point. In the pre-enquiry phase an attempt was made to reduce the amount of routine work for staff by using a computer programme as a part of the structure of events. A data base was set up on a BBC `B` computer. Teams were required to enter certain data at appropriate times. This data was used to indicate `performance` in terms of a simplified financial equation. This was helpful in that it relieved staff of the task of calculating team financial performance. Using this data base also imposed a form of time structure on teams and may have helped them in managing their time. The computer acted as a focusing instrument, forcing teams to think about their planning.

This computer package did appear to provide some support for staff, and so enable them to develop their role as a facilitator. However, problems with programmes `crashing` or mishandling by teams diminished their effectiveness. The extra work involved in these cases possibly outweighed the advantage to staff and caused frustration for pupils. These were teething problems. As all accounts were one-off experiences it is not possible to observe how such problems were subsequently dealt with.

It is not intended to explore this area further as it is peripheral to the main thrust of the enquiry. However, it is relevant to mention it as an area of

potential interest which may influence pupil endeavour both directly through improved structural support and indirectly through supporting the developing role of the teacher. This would require a major enquiry in itself.

6.4 Relationships with Technology education

The genesis of this enquiry lay in an opportunity made possible by TVEI. The position on technology established within this enquiry differed from the specific technology syllabuses of the time. The general approach developed was not intended to be an alternative curriculum but simply another tool which had certain advantages as well as limitations. Because of this it was possible to move away from the over-specialisation of existing technology syllabuses and schemes of work. These were usually highly structured, focussing on specific bodies of knowledge, whilst often failing to recognise the contextual aspects of technology. In contrast there was a growing body which took the position that one cannot `front-end load` pupils with knowledge in preparation for technological `problem solving` (Layton and Yeomans undated) . This illustrates the `dichotomy` that Dickinson (1991 p61) observed as `*open-ended contexts and the structured acquisition of resources*` . Dickinson recognised that both strategies have value, but he tended to preserve the `either-or` aspect of dichotomy. The `dichotomy` is, in fact, better understood as a continuum. Staff may find the complexity of schemes and syllabuses difficult to handle and so polarise the situation for their own clarity. It is possible to programme bodies of knowledge into what is, in pupils` eyes, a reasonably open-ended task. The position to which staff wish to move on the continuum is within their control as they gain experience and confidence.

The approach explored by this enquiry focussed on a technological process. A working definition could be a process whereby groups of people work together to generate products, systems and environments within a general commercial environment. The foci move from materials and specific bodies of knowledge towards process, group/teamwork, production and the context of the commercial world in which we live. This also calls for due consideration of social and environmental issues.

The statutory instrument for Technology changed the context of the enquiry. As an enquiry which was partly action research, the aim was to understand but also to inform and develop. It became important to absorb these changes into

the operating context rather than remain in the original. A detailed analysis of National Curriculum technology and the `fit` with this enquiry would not advance the central aspects of the work. Rather than this several aspects of specific interest are focussed upon:

a. Designing in groups/teams.
b. The integration of elements of Technology: CDT; food; fabric; art and design; business education; IT.
c. Cross-curricular education, including National Curriculum cross-curricular themes.
d. Progressive development of the elements of the approach.

6.4.1 Designing in groups/teams

The literature indicated that groupwork is able to develop positive synergy during design activity. The accounts showed a clear rise in endeavour. However, there was no evidence of an improvement in the range or quality of design work which would be indicative of synergy.

The potential for synergy has been discussed in relation to the general development of ideas rather than designing specifically. Industrial examples of group/teamwork showed improved performance. However these results depend as much on improved attitude, inter-personal relations and commercial ability as design.

Where work has concentrated specifically on design there has been a tendency to use experienced designers or design students as subjects. Tovey (86) contrasted theory with practical examples of designing by individual industrial design students. However, all Tovey`s accounts were based on retrospective evidence of designing such as drawings and models. The process of designing and whether there may have been informal groupwork, such as discussion or the sharing of ideas are not illuminated. In more conventional design lessons staff may employ the potential for positive synergy by encouraging pupils to explore ideas in groups, perhaps in an informal manner.

Questions need addressing when work is assessed for external examinations. Most work in the areas of Technology whether at school or higher education counts towards qualifications in the form of continual assessment and yet such

coursework is not expected to be carried out in complete isolation. Discussion and interaction should be recognised as a normal design strategy and encouraged for that reason. Some GCSE examination boards recognise this to some degree by allowing groupwork to be submitted but staff must identify the specific work of individuals within. This a step forward but is based on ease of assessment, it fails to recognise the nature of groupwork and may fail to give sufficient credit to individuals who help by less direct means than providing the specific ideas or physical modelling.

Scrivener and Palmen (1991) looked at designing in pairs, describing it as `more natural`. Unlike Tovey, they concentrated on observing the process as much as indicators of the process. Whilst based on a small sample, as a pilot to a larger study, the indications are worth considering. Pairs tended to establish two roles, the synthesizer and the appraiser. The synthesizer produced the majority of ideas and drawings. These ideas were both self started and those built on ideas started by the partner. The appraiser was more involved in the evaluation of ideas and drawings produced by the synthesizer. Scrivener and Palmen noted that the process was parallel rather than being a period of synthesis followed by appraisal. There was little verbal discussion; communications centred on drawing. In contrast, within the accounts of this enquiry discussion was more evident, possibly as the samples were not made up of design specialists and pupils lacked the fluency in design modelling such as drawing. However, the roles to which Scrivener and Palmen referred may be similar to procedural roles adopted by individuals in the accounts. These roles were similarly established subconsciously rather than by formal agreement. The roles established were not fixed but the accounts covered periods longer than the one hour periods of Scrivener and Palmen`s accounts.

This work raises many questions: is the role relatively constant, especially in relation to different people: can it be easily identified: how do roles change in larger groups/teams: can pupils be helped to recognise the value of these roles and can exercises be developed which help pupils develop abilities in both roles? Discussion is of limited value without further work on these aspects.

In the accounts work was frequently delegated. If this was to an individual there would be reduced potential for synergy within that sub task. Good communication and effective review meetings could possibly counter this but the accounts show that in these areas teams were ineffective at least initially.

This may, to some degree, explain why positive synergy, in design terms, was not evident. Depending on team size it may be appropriate to delegate a minimum of pairs to a sub-task in order to improve the possibility of positive synergy.

Scrivener and Palmen noted that the roles distributed work by process rather than specific areas of the task. Effectively the pair honed ideas as the potential for synergy was maintained. If the pair had delegated different parts of the task the synergy potential would have been lowered as interaction would have been reduced. It is probable that non-specialists designers would be less able to recognise the importance of the process and would be less skilled in applying it than the undergraduates used by Scrivener and Palmen.

Tovey emphasised the importance of modelling within design. Models are externalizations of ideas enabling more effective manipulation and may be two or three dimensional, using a wide variety of techniques. Models are also of value for communicating ideas to others, both within and without the design team. The range of models can vary according to the task and people concerned. Within an established design team quick pencil and paper sketches are often very effective and flexible. This is largely because members are graphically experienced and understand each others` conventions in drawing. The range of models may also include various other forms of drawing from formal engineering drawings to presentation drawings intended to convey an impression of finished products. Three dimensional models also cover a wide range of types and functions from rapid `lash-ups` in card to architectural presentation models. The essential point is that experienced designers are effective and efficient because they have considerable modelling ability.

The pupils within these accounts were not specialists and lacked such experience. Design ability was limited and any positive synergy in the development of ideas would be masked.

Looking more broadly than the generation and development of ideas, design can be seen in a commercial context: meeting production targets of cost, time and quality. In this respect group process effects are important. The accounts showed that teams did manage to respond to these aspects positively. As all accounts were one-off events it is not surprising that initial communications

were poor. However, positive group processes were built in the great majority of teams and targets were reached.

The development of team bases assisted in building group processes. Teams need to have a central focus which can offer a limited degree of privacy. That base should enable and encourage effective intra-team communications. The use of a small table, encouraging the sharing of ideas on paper failed to show positive synergy in the generation and development of ideas (for the reasons above) but did appear encourage a better team focus.

Competition and deadlines have been discussed. At this point it is worth reiterating that these two influences had effects on teams and the design processes they were engaged in. Competition did not seem to develop in the expected inter-team manner. If the approach were to be used within a long term scheme for technology it is possible that pupils would respond to inter-team competition more directly. This may further improve performance as some authors have suggested (2.0) but staff would also have to be particularly sensitive to negative effects which may be more severe in one individual than another. High levels of anxiety due to competition are likely to encourage teamwork based on autocratic leadership and lower potential synergy in design terms and group process.

Teams reacted to approaching deadlines in a manner which raised levels of endeavour and probably anxiety. Urgency may have caused a more `economic` approach to design with teams ready to accept ideas sooner rather than explore more fully. The data is not detailed enough to draw firm conclusions and so further work is necessary. In itself an `economic` approach to design is not necessarily bad if looked at in terms of a long term teaching scheme for Technology. It is not proposed that the approach adopted in the accounts be used as the only method of delivery. It is important that at appropriate times pupils be allowed and encouraged to explore ideas and develop them under more relaxed conditions without commercial conditions such as deadlines, costings or competition. In this way, whether working individually or in groups it is possible to develop appropriate skills and importantly, positive attitudes - a love of design and designing.

6.4.2 The integration of elements of Technology

Within the documentation on National Curriculum Technology there are numerous statements which encourage staff to consider the teaching of Technology through a form of integrated experience rather than through the isolated `subjects` that it developed from. The approach under enquiry may act as one possible method of integrating those subjects and also other aspects of the curriculum. However, before going further it is worth considering Pring`s (1977) point that many educationalists use the term integration as if it were of self evident value.

Pring`s point is valid. However, it would be incorrect to assume that there were some `natural` division of knowledge into self-evident areas. The division of understanding into subjects is artificial. It has positive roots in that without the act of categorisation it becomes difficult, if not impossible, for the brain to handle and manipulate data: to think effectively. The categorisation of knowledge into areas of the curriculum, therefore, has some logical roots. The danger lies in failing to recognise this as only convention. Learning requires the organization and interpretation of experience. Within a subject area learning is provided with a framework for this organization. This is repeated across the curriculum, but the frameworks differ. If the learner perceives these frameworks as rigid it becomes difficult to organise and interpret experiences which are not identifiable simply within one subject framework or another. The approach under enquiry crosses subject boundaries but the iterative nature of the work and emphasis on de-briefing supports the identification of a framework for learning. Any framework will develop over time and so staff must be sensitive to this aspect in planning for progression. The accounts represent one-off events at various stages of secondary education and so are insensitive to progression.

The general learning value which underpins the approach under enquiry centred on the development of capability. Capability is a term used within the National Curriculum Technology Orders to qualify the two profile components of `design and technology capability` and `information technology capability`. A dictionary definition emphasises ability, especially in many different fields together with a temperament or inclination to act. In contrast the term competence can be taken to be more context specific, being defined as being able or suitable or sufficient for the purpose. The accounts show that some pupils

had difficulty transferring competence in given subjects to general contexts; capability was limited. This illustrates that one may be competent within a specific subject area without that competence necessarily being capable of utilisation in another. The separation of subjects may, to some extent, cause or exacerbate this situation. The educational aim of the approach under enquiry, therefore, was to achieve capability which, by definition means ability across many different fields. It cannot be a finite quality but is one which staff should help pupils develop in both depth and breadth.

The work on transfer (3.4) showed that competences can be brought together, providing a suitable vehicle is used and staff are aware of the strategies which may enhance transfer (3.4.11). These include iteration, emphasising points for transfer, reducing fidelity, learning within functional and out of school contexts and encouraging pupils to think carefully about their learning.

Taking the above into account it would appear that the approach under enquiry may offer a vehicle for learning which can also go some way to integrate learning from subject areas both within Technology and beyond it. Integration is recognised as having value in helping to develop capability but that this must be seen in terms of a broad curriculum and, particularly, progression.

The Orders 'encourage' the coordination and integration of the areas of the curriculum known up to that point as CDT, art and design, food, fabric, business studies and IT. It is important to see this in context. Up to this point many staff in school had been trained predominantly as subject specialists focussing on materials rather than process. The change in philosophy should not be underestimated. Many staff employ a design approach. However, there are few who would be capable of developing an integrated Technology approach with thorough understanding and sensitivity without further learning and experience.

Currently a great deal of thought is going into the question of how to teach Technology. Various approaches can and should be attempted, evaluated and promulgated in order to develop a suitable range of options. From these a series of experiences may be put together to develop capability. Initial and in-service teacher education will be important in assisting staff to develop approaches suitable to their own contexts. The limitations of centre - periphery models of staff development have been established. Kilkenny

(1987) noted that unless staff engage in collective decision making they tend to feel themselves victims of the dictates of others. Randall and Gibb (1988) made the point that staff are also in danger of confusion due to the plethora of literature and curriculum development being presented to them. This may be the case if all staff read and attempted to act on all the literature generated by National Curriculum bodies. This may not be the case but a subjective impression is gained, from visits to many schools, that many staff are unsettled.

Development must take cognisance of existing staff, situations and practices. The implications of development must be thought through if they are not to clash with the existing regime or other developments. Similarly, it is necessary to develop a 'critical mass' for development. Rushton (1989), in a cross-curricular context, suggested staff 'teams' of six with a minimum of two per area and a coordinator who would probably be a senior manager. This is a similar framework to that used in the planning and INSET of account 3. However, setting up a group/team will not automatically bring results. The lessons of teamwork also apply to teachers developing curicula; individual members should not feel isolated by being a minority; communications and discourse should be maximised; time should be put aside for building a team; there should be periods of reflection on team process and senior management should enable and encourage.

Many schools are now adopting suspended timetable / integrated / enterprise type activities as a part of the curriculum as a whole and Technology particularly. This enquiry has identified and explored the following relevant aspects:

a. The development of staff 'ownership' via group based staff planning which is valued and supported by senior management.

b. The recognition of individuals as primarily specialists rather than attempting to make all staff generalists.

c. The need for and design of pupil team bases.

d. The design of a context which pupils recognize as being relevant and which motivates. This includes the simulation of commercial/industrial contexts and ideally the inclusion of personnel from these areas. The task itself must suit the team size, yet stretch members appropriately.

e. The value of concentrated study enabled by a suspended timetable .

f. The need to select pupil teams on suitable criteria.
g. The need to `build` the simulation.
h. The importance of iteration and feedback via de-briefing.

Other areas which must be recognised in a on-going school situation are the need to plan activities as a part of an overall scheme, considering progression and the limitations of the approach. Staff need to develop their skills of observation in order to maximise feedback in this way.

6.4.3 The contribution to cross-curricular education

The aim of this section is to relate the work done with aspects of cross-curricular learning and discuss some of the problems and possibilities. It is also intended to discuss potential relations with National Curriculum requirements for cross-curricular elements.

Cross-curricular learning can be either:

a. The calling for and development of a range of knowledge, skills and attitudes beyond that normally required for a certain subject, whilst working within that subject.
b. A learning experience which calls upon a range of expertise without being identified as a specific subject.

Work on cross-curricular learning has two main roots; staff dissatisfaction with a subject focussed curriculum and pre-vocational work. In addition to these the National Curriculum now requires schools to augment subjects by *an accepted range of cross-curricular elements* (Curriculum Guidance 3 p1). There is no prescription on the delivery of these elements. Much could be done within subject areas.

The literature on cross-curricular work shows many examples but most initiatives have failed to take root in the long term. Ritchie (1990) considered they lacked importance in the eyes of the teaching profession. Informal discussion with teachers involved in the accounts of this enquiry showed that many staff feared loosing subject specific time, especially as pupils approach GCSE. In none of the accounts were there pupils from years 11 or 13 because of this concern. Similarly whilst no specific data was available in the accounts

professional experience has indicated that pupil response to courses which do not lead to externally recognised qualifications has tended to be negative. The positive response of pupils in these accounts is interesting. As none of these pupils or students were immediately faced with examinations perhaps they were not so qualification orientated at that time. Similarly the relatively transient nature of the events was clear to pupils.

Examination orientation by pupils, whilst it may produce narrow interpretations of the value of work done in schools, is corroborated by attitudes in industry. Whilst employers have demanded that pupils should be capable of teamwork, Cowie and Rudduck (1988) showed that they primarily demand academic qualifications at interview.

None of the events in this enquiry contributed directly to external qualifications, though several are incorporated in Records of Achievement (RoA). These events were all considered to be successful in the eyes of teachers and the LEAs. Yet it could not be said that the approach they represent had taken full hold in the curricula of all the schools involved. Account 5 represented a series of annual residential events which the LEA concerned considers carries prestige. However, they have been unwilling to incorporate the message into schools, preferring that they continue as one-off residential events for year 12 students. The school in account 4 now uses the approach on a yearly basis with year 10 pupils and has now expanded so that the whole year group is involved. A similar situation is now the case in two of the six schools in account 3.

A different approach was illustrated by Polto and Rhen (1988) who reported an initiative in an American technical school. Dissatisfaction with academic results, particularly in maths and English, provoked an experiment where subjects were dissolved and staff became part of a number of clusters based on vocational areas. Courses were run around the theme of vocational preparation to which subjects contributed. Results on subject tests rose though there is no report as to any other benefits.

These examples suggest potential benefits from cross-curricular working. Yet few such initiatives survive to become integrated into the curriculum (Ritchie 1990). Skelton (1990) wrote on the Sheffield project which relied on 'teams' of teachers to deliver an integrated curriculum. It was apparent that there was

a retreat from the teams by some members due to disagreements and dislocation from the remainder of the staff.

Other reasons for failure to integrate may also include:

a. A tradition of subject supremacy. Status and power within schools are often tied to academic departments. The staff concerned have a vested interest in maintaining the status quo.
b. Many teachers fear the dilution of subject knowledge or timetable prominence.
c. There is a lack of a common view on cross-curricular matters or a common lexicon to facilitate communication and discussion.
d. There is pressure on staff from a growing number of initiatives, leading to prioritisation.
e. The benefits from cross-curricular activity are often less tangible and easy to assess.

These factors must be recognised by staff about to embark upon development in cross-curricular experience. Enthusiasm is not enough. This enquiry indicates that three main features enhance the possibilities of successful experiences and subsequent integration.

a. A critical staff mass for planning. This should include a member of senior management. Senior management helps confer importance to the work and can act as an enabling mechanism to a greater degree than less promoted staff. Normal group theory should be applied as discussed above, but the group should not be too big as to make communications difficult.
b. There needs to be a process of establishment for the group. Time should be allowed for the development of relationships and clarification of objectives via an analysis of the nature of the task faced. This should include the establishment of a common terminology and understanding.
c. The group should aim to start with small scale experiences which stand more chance of success. This success will build confidence and be communicated to other staff, improving the probability of success on expansion.

Pre-vocational work, as a form of cross-curricular experience, has always had to struggle against a system which gave it a lower value in comparison with academic subjects. This is also the case in the USA (Cantor 1989). The

accounts of this enquiry were not directly intended to be pre-vocational but they did have an enhanced motivational effect on pupils who recognised increased relevance to their futures in the world of work. Traditional subjects often have little relationship with many children's lives (Skelton 1990) and so fail to motivate them.

Pre-vocational work has tended to be a confusion of schemes ranging from visits and enterprise type activities to work experience, careers lessons and work shadowing. The National Curriculum could subsume pre-vocational aspects within some of the cross-curricular themes. This may be important, encouraging a fresh perspective on such work. The approach illustrated by the accounts represents one way in which elements of pre-vocational and cross-curricular work could be integrated. Careful coordination with other methodologies could offer balance, providing a coherent planning strategy was adopted which analysed the situation and recognised the importance of planning for progression. The National Curriculum many give such work much needed importance and perceived value. Nevertheless staff facing a continuing tide of innovation may prioritise cross-curricular issues below those of specific subjects.

6.4.4 Pupil progression in terms of the features of the learning approach under enquiry

It is a general principle that teachers should identify the elements of their subject area and plan for 'progressive differentiation' (Gagne 1967). The body of knowledge and experience should be built progressively, beginning with the general and inclusive before moving onto the more detailed and specific. Similarly learning should be consolidated before the learner is allowed to proceed. The case studies were one-off events. It was not possible to explore progression and yet the accounts are an eloquent message for the consideration of progression. This section discusses progression within the approach explored in these accounts.

When planning a scheme of work to teach a knowledge orientated subject it is usually possible to identify a logical route of progressive differentiation. For example, in mathematics it is necessary to teach pupils to be able to understand and calculate numbers to the power of two and square roots before they could be expected to be able to learn and apply Pythagoras as this involves these

elements. Once an area has been covered it must be consolidated by practice in a number of contexts. This consolidation can then be confirmed by tests and new materials can then be integrated with this learning. The work covered in these accounts complicates these procedures as it is based on process. There is no self evident thread for progression and consolidation of learning within the approach cannot be easily confirmed.

Whilst progressive differentiation may be considered within a subject area this denies work done by pupils in other areas of the curriculum and possibly outside it. In this enquiry, whilst Technology was central, the events were seen as cross-curricular, making progression more difficult to identify, plan and confirm. Layton and Yeomans (undated) supported this conclusion on cross-curricular work. Follow-up work will need to consider progression in the areas of team/groupwork, simulation and Technology. Each may then be sub-divided in detail and interaction considered. The accounts also indicated that progression of staff understanding and experience in relation to the approach under enquiry must be considered.

These areas are process based and include attitudes and higher level competencies such as an ability to make observations, communicate effectively and understand and influence the workings of a team. They are value based, complex and resistant to quantification. Attempts to confirm consolidation are difficult and effectively become statements on the pupil`s values. The conventional psychometric models behind most measurement of ability will not be effective in these situations. Similarly the areas potentially under consideration are not absolutes; staff cannot easily ascertain whether the element has been mastered before the next stage.

Despite urging from many quarters few teachers organise their teaching in such a way as to develop these higher level competencies (Raven 1990). As such competencies are value based, pupils will only react positively if the learning context is one with which they can associate. Motivation is important. There is evidence from the accounts that the simulation of a commercial design process offers a suitable context for a large majority of pupils across the secondary age range. Lepper and Hoddel (1989) listed four aspects which enhance intrinsic motivation: challenge, curiosity, providing pupils with a sense of control and a degree of fantasy encouraging pupils to invoke images. These may be contrasted with the four key principles which may help develop

high level competencies proposed by CASE (1990); cognitive conflict, reflection, bridging and reasoning patterns. Challenge and curiosity (Lepper and Hoddel) emphasise that work should stretch pupils and offer surprise and incongruous or discrepant ideas. This is a similar concept to cognitive conflict which emphasises the need to surprise, confront and a struggle to understand. Yet CASE considered there to be a general *unspoken conspiracy* to avoid undue mental effort (p 2) in education and Lepper and Hoddel have found that older pupils are more likely to prefer simple, but boring tasks which please staff than interesting and challenging work *which is not on the teacher's agenda* (p 75). The conspiracy appears to work from both directions, but ultimately the educational system must accept responsibility as pupil response is to their perception of the value of education to the adult world. Raven (1990) went further to suggest that: *The main benefit offered by the education system is not education at all. It is the certificate that will buy entry to courses of further and higher education.* (p277)

Pupils appear to become conditioned to seek tradeable certificates and teacher approval rather than accept challenge and cognitive conflict. Raven's view may be over stated as the accounts show that pupils, including the older age range, were prepared to put a great deal of effort into events which carried no certification.

Lepper and Hoddel specifically referred to excessive adult surveillance as lowering intrinsic motivation, a point which correlates with observations from these accounts. Both teachers and pupils reported positive effects from greater pupil autonomy. Nevertheless, many teachers had an almost conditioned compulsion to be intimately involved in the learning process at all times. This raises points on progression in terms of staff (discussed below).

There appears to be little research which has directly addressed progression in teamwork skills. Questions as to what teamskills are and how they can be progressively differentiated merit enquiry. As teamwork can be seen as a sub-set of groupwork it would appear logical to begin by identifying aspects of group skills and those factors which differentiate teamwork from groupwork. Staff must consider progression of group/team size, composition, selection and duration (section 3.0). It would appear logical, for example, to begin with small groups, which may be peer group based. Progression would give experience of larger groups and various forms of selection juxtaposing

minorities, culture and gender. Teamwork experience would follow but there is no clearly identifiable route; at what stage would teamwork be introduced in relation to developing groupwork?

The progressive differentiation of simulation is complex. For example, the degree of fidelity has been shown to affect performance. Lowering fidelity can improve performance, yet it may be necessary to raise fidelity to promote familiarity with the real environment. At what level of fidelity should staff begin? It is necessary to remind ourselves that simulation of commercial and industrial contexts must be seen on a whole school basis in relation to other activities which may be used within the curriculum such as industry visits, work shadowing or work experience. During a work experience pupils would see what equates to perfect fidelity in terms of the physical environment though, as pupils, they would not achieve full fidelity as their role within the company cannot be `real`. In a simulation, in school, it is possible to raise role fidelity and responsibility while necessarily lowering physical fidelity.

Levels of competition within the structure of a simulation are a factor which should be considered for progression. Rising levels of anxiety caused by competition may at first be productive but eventually counterproductive following the Yerkes-Dodson hypothesis. Familiarity may be a useful guide. In account 4 the simulation was based on a local company. Many pupils had relatives who worked there and so there would be immediate recognition by most of the cohort. Progression would indicate moving to the management of simulated contexts which are less familiar.

The framework of a simulation may be on a continuum between structured acquisition of specific learning (an aircraft simulator) to open-ended exploration. The accounts describe events which, whilst not knowledge focussed did use `inputs` to convey required knowledge in the context of the simulation. It is not possible to estimate whether these inputs were as successful as similar learning in a more conventional situation. The accounts did show that communication of input information to the rest of the team was usually poor. It was usually the representative of the team who attended the input that was delegated to put that information into practice, so reducing the importance of communication. However, this does identify communication as a dimension for progressive differentiation. Aspects of this would include associated

responsibility for collection, collation and communication of the necessary information.

As pupils gain experience a more advanced stage of progressive differentiation in this area would be the recognition of what knowledge or skills are needed for a task. The team then would be responsible for identifying where that knowledge can be gained most efficiently, gaining it and then collating and communicating back to the team.

Time management is a factor to be considered in terms of progression. Timetabling in periods as opposed to suspended timetabling has been discussed. Account 5 explored industrial type 'flexitime' covering more working hours in a day as it was residential. This may be an example of one extreme of differentiation in time management possible in an educational environment. At the other a simulation may run within a normal lesson or series of lessons as in accounts 1 and 2 respectively.

Technology must be considered in terms of progression, but like other contributing 'subject skills' staff need to tie in with work being done within the curriculum as a whole. Any design or Technological process is based on imaging, modelling and speculation. Imaging can be defined as pictures of ideas in the mind's eye. Modelling is the fixing of these ideas in the real world, allowing them to be interpreted and manipulated to advance the design process. Typically modelling may involve pencil sketches, card models or carefully prepared prototypes. Modelling is both a conceptual and practical activity requiring many skills to maximise effectiveness. Speculation is again a conceptual activity which may be aided by various techniques. In these three basic areas there is a wealth of opportunity for the consideration of progression but again there is no self evident route and consolidation of various aspects cannot be confirmed in a positive or negative manner.

Dickinson (1991) discussed an attempt to develop Technology project work in the local community based on pupils going out and identifying potential areas. This failed to work as expected. Dickinson felt this was due to lack of progression as pupils were not given necessary background skills and awareness prior to the exercise. Dickinson suggested simulation as a step between teaching intended to build necessary basic skills and project work founded in the community.

This point is accepted, but Dickinson is being simplistic in seeing simulation only as a stepping stone between 'basic skills teaching' and open-ended project work. There can be effective progression within simulation in such a way that process and content can be regulated from highly structured to maximum pupil freedom.

Dickinson failed to consider staff expertise as part of the 'failure' or relate this to progression. It was apparent from the account that the staff developing the project did not understand the situation fully and so made mistakes which could have been avoided without pupils having to suffer *dejection and loss of enthusiasm* (P66). There is always danger in staff taking a learning approach from others with experience in that approach and applying it directly to their own classes. Progressive development of understanding and experience are important.

The delivery of Technology or cross-curricular work requires effective staff group work. Yet there appears an assumption that staff can easily and effectively come together as a group for such purposes. There are indications, such as Dickinson's work above, that this is not the case. There still exists a tradition of subject specialists working alone. Similarly, Roberts and Ritchie (1990) observed that senior managers in schools more often delegate and inform each other than form true management groups. Holt (1990) warned against management inability in terms of curriculum development: middle and senior staff, coming from the tradition mentioned above, are not necessarily equipped with appropriate management skills. Harding (1990) pointed out that the Education Reform Act (1988) had caused an expansion in the number of staff undergoing management training, with Busher (1990) observing that there was evidence of a shift towards greater involvement in decision making by non-promoted and middle level staff. These observations can be juxtaposed against calls for staff group work as an aspect of management of staff, pupils and curriculum (Holly 1990; Skelton 1990). Work will need to be done to identify the areas of progressive differentiation within staff groupwork. Similarly senior management will need to be sensitive to the fact that staff need to experience progression in this area rather than simply be expected to produce results immediately.

This section has begun to identify some of the problems and possibilities of progressive differentiation within the general approach illuminated by this enquiry. The area is complex but there are indications that it is possible to identify general areas and potential routes. Dangers exist, such as the growth in modular approaches to education which may limit integration of experience and logical progression. Nevertheless, this problem is not unique to modularisation but can be found in much teaching methodology currently being employed. Education generally and Technology specifically, is moving towards a process led model and emphasis on the development of higher level competencies. These competencies may be better developed in activities which are demanding and employ concentrated study as is the case in the events of this enquiry. It will be necessary to look closely at progressive differentiation in such delivery models.

6.5 Limits and limitations

6.5.1 Limits

The title defines the limits of the enquiry. It became clear that levels of endeavour are capable of being reliably raised in the great majority of pupils. The relationship between endeavour and achievement or capability lie beyond the limits of the enquiry, though some tentative links have been made.

The forms of teamwork observed in this enquiry were narrow in relation to the range of group and teamwork discussed in 2.0 and represent an identifiable category in conjunction with the age range observed. Pupil prior experience of the form of teamwork used in the accounts was shown to be uniformly low. Aspects of teamwork including team size, selection and the degree to which competition was emphasised did influence endeavour as has been discussed.

The forms of simulation employed were similarly specific in relation to the broad field of simulation. Most accounts operated simulation within a suspended timetable and all focussed on companies designing and marketing artifacts. It is anticipated that the focus of the simulation could move to the design of systems or services. Similarly the simulation could be based around the micro-computer to a greater degree, using appropriate software. This could offer certain advantages but the concrete nature of product design,

interpersonal relations and the technological process would diminish with corresponding effects on the simulation and levels of endeavour.

The interaction of teamwork and simulation in their specific forms in these accounts has been unique. These perspectives offer value to practitioners and also directions for further enquiry. However, maintaining a wholistic approach has meant it is less possible to be firm about specific interactive effects. Discussion of the literature has shown that both teamwork and simulation can raise endeavour independently. It would be very difficult to measure levels of endeavour to the degree that enquiry could reliably determine the interaction of these factors, though more reliable perspectives may be gained by other methodology.

The accounts enabled the collection of data from events in which the factors were combined in various ways. The combinations did not cause reactions that were identifiably specific beyond a limited number of cases such as the effects of a suspended timetable in contrast to conventional timetabling. Nevertheless, the accounts are described, analysed and discussed in relation to the literature. The data and discussion generated adds to understanding and has value.

All accounts reported one-off events, limiting understanding of long term effects and development. Such a perspective would assist the understanding of progression, in terms of the elements within the approach, for both pupils and staff. A follow up of the schools in accounts 3 and 4 would undoubtedly add value, but it is necessary to draw a line at which a thesis must be drawn together.

6.5.3 Limitations

The scale of the enquiry precluded a research design which would allow the specification and selection of specific trial groups; it was necessary to utilize opportunities which arose for fieldwork. The use of 'live' learning experiences placed moral limitations preventing the exploration of extreme situations. For example high levels of anxiety may be expected to cause pupils to move beyond an optimum level for endeavour on the Yerkes-Dodson curve, but this could not be explored. This limits the conclusions that can be drawn from data but the literature has assisted.

The methodology was primarily unstructured observation. This was chosen in order to maximise the potential for uncovering factors. The majority of observers were teachers involved in the design and/or running of events. This raised two limitations:

a. Teachers may have had similar pre-dispositions in their observation.
b. Experimenter effects will have influenced their observations.

These are recognised, but the inclusion of observers who were not part of planning teams and observers who were not teachers reduced these limitations. Additionally other sources of data such as NGT and pupil interview were triangulated against observations.

The approach illuminated by the accounts was essentially process led. However, information, specific knowledge and skills were delivered through 'inputs', attended by one person per team in order to emphasise responsibility and communication. The literature indicated that simulation is an imperfect medium for knowledge focussed learning. This emphasises that staff should not use such an approach for areas where it is important that pupils master a specific knowledge base. Staff may use the approach in conjunction with other methodologies in a coordinated manner in order to deliver a broad education.

The uniformity of pupil experience within the accounts was lower than most conventional learning experiences due to delegation. When integrated with other approaches and planned for progression the lack of uniformity of experience need not be a problem, indeed it may be seen as a positive feature. Within events, debriefings may focus on sharing experiences to gain some commonality of understanding if not direct experience.

Teacher experience was shown to be an important limitation within the accounts. All teachers were volunteers and could be expected to have an association with the approach. The majority of teachers lacked experience of the forms of planning and delivery necessary for this form of work. Similarly they had little experience of pupil teamwork or simulation. The literature has shown that a full understanding of the advantages and limitations of these factors is necessary if staff are to maximise the learning effect. Minimal understanding can lead to situations which are counter-productive to learning.

Developments in education are making staff groupwork increasingly necessary for both planning and delivery, particularly in the field of Technology. This has ramifications for both initial and in-service teacher education. Staff cannot be simply put together and expected to work effectively and efficiently as a group. At a time in which the introduction of Local Management of Schools (LMS) has sharpened attitudes to spending on INSET senior management should be aware that staff groupwork requires investment. This would include time, money, sensitivity and understanding if groupwork is to develop beyond the level of specialists sharing a task, to a level where synergetic effects repay dividends above that investment.

Similarly the enquiry has shown that one cannot expect all staff to immediately recognise the value of this approach to learning and work effectively with it. This is particularly important as the staff used in the accounts were volunteers and can be expected to have been more receptive than a normal cross-section of teachers. Staff need to be helped to recognise the approach as of some value to them. It would be ineffective INSET to describe the process and show teachers end results. Ideally staff should have time to observe events in progress without directly being a part. In this way they are not under threat. Once staff recognise that there is potential the process of analysis can begin. The gaining of confidence by low level, incremental steps appears to be the more effective way forward. Again the financial consequences of these points cannot be underestimated.

This enquiry has taken place against a backdrop of what is probably the greatest expansion of educational initiatives and imperatives in the history of this country. Staff are learning that they must prioritise. At present the approach under enquiry would have little priority in most schools because of the pressure of ERA developments. This is despite a potential role within cross-curricular elements and Technology. Nevertheless it has been shown that a number of the schools involved in accounts have recognised enough value to continue events against such pressures.

7.0 Conclusion

This section has three objectives:

a. To draw together the central points illuminated by this enquiry.
b. To highlight original contributions to knowledge and understanding.
c. To highlight areas of significance.

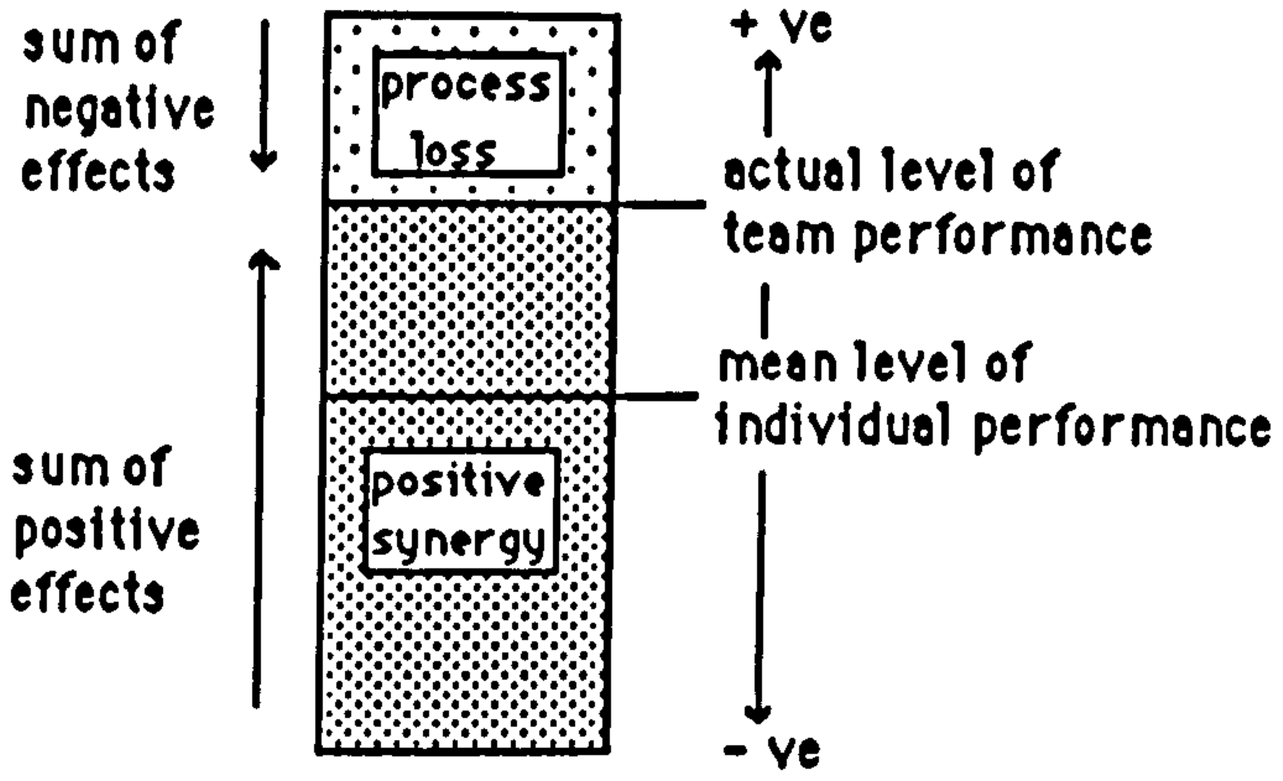
7.1 The central points illuminated by this enquiry

It was confirmed that the approach adopted in these events reliably raised levels of endeavour in the great majority of participants. These levels eventually exceeded those that staff who normally taught these pupils would expect in more conventional school work. The accounts also indicated that attention span followed a similar pattern, though the evidence for this was less firm. Rather than rising immediately endeavour developed over three identifiable phases of team activity:

a. Meeting and clarifying.
b. Forming and accelerating.
c. Intense team activity.

The enquiry identified several channels through which this rise in endeavour could be explained. Interactive effects between factors proved to be more difficult to identify. However, the variation in form of different events allowed certain conclusions to be extracted. Similarly through the juxtaposition of the literature further indications emerged. It is possible to present a range of conclusions but the limitations of the enquiry mean that the weight of evidence is insufficient for these to be highly reliable and several remain indicators rather than firm conclusions.

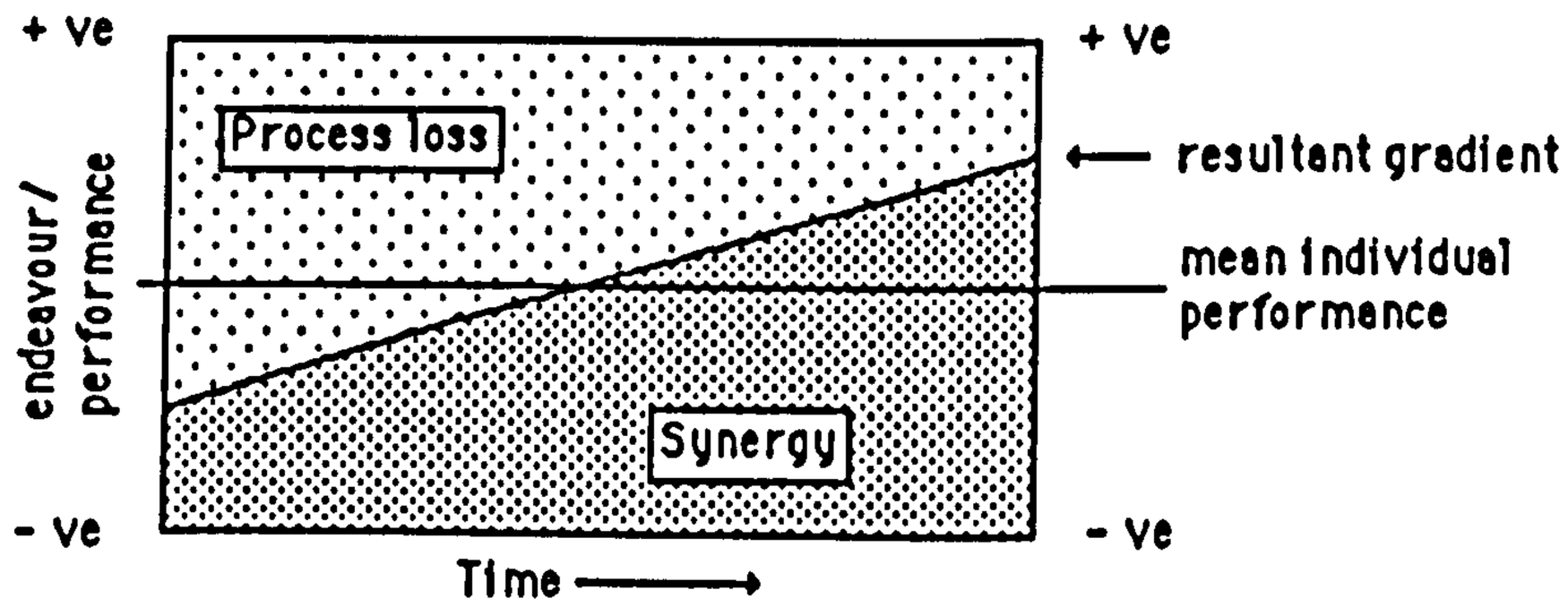
A working summary of the factors and their sub-elements is given below. All factors were found to be able to act both positively and negatively in relation to endeavour at any given moment, depending on how they were manipulated. In practice, the overall outcome was governed by the resultant of the effects of these factors, both positive and negative, at any moment. A simple model can be established.



A model of the interaction of factors acting both positively and negatively on endeavour

The positive effects relate to positive synergy and could be imagined to be pushing upward. The negative effects relate to process loss and push down. The horizontal line in the centre relates to the mean level of performance that might be expected if the individuals in the team acted alone. The interface between process loss and synergy is the actual performance of the team. In the example above the overall effect is positive.

As time is a factor the model can be modified:



A modified model of the interaction of factors acting both positively and negatively on endeavour against time

A vertical line from the time axis to resultant gradient would indicate a hypothetical level of performance of the team at that time. In the early phases process loss will exceed positive synergy and so the resultant may be lower than the mean individual performance. After the team is established the resultant will usually exceed the mean individual performance. The gradient is shown as a straight line. In practice this could be more complex.

7.1.1 Teamwork and simulation are independently capable of raising or lowering levels of endeavour. Understanding is required if teachers are to ensure the result is positive. Teamwork used independently of simulation can develop high levels of endeavour as indicated in the literature relating to both schools and industry. These findings hold even when teamwork is used regularly when novelty effects could be expected to have diminished.

Simulation is a broad area. In this enquiry it was used specifically in relation to the simulation of industrial or commercial enterprise. Most companies employ groups of people who cooperate together, complete delegated tasks and, as a whole, must compete in the market place against other companies. The terms group and team may cover a variety of conditions but the essential difference is that a team is in competition with other teams. In this context it is difficult to run simulations without incorporating teamwork.

The literature gives strong indications that simulation has positive effects on endeavour. Simulation is more effective in situations where achieving a required outcome effectively is the criterion of 'success'. Simulation is less effective if a knowledge base is to be mastered.

Two aspects were identified which may account for improved endeavour in relation to simulation :

Firstly, novelty effects. Simulation was used infrequently in the case study schools. The technique was novel to pupils and could be expected to produce raised interest. It is anticipated that frequent use of the approach would cause a diminishing return in interest. However, the data does not allow a firm conclusion to be drawn without appropriate long term observation.

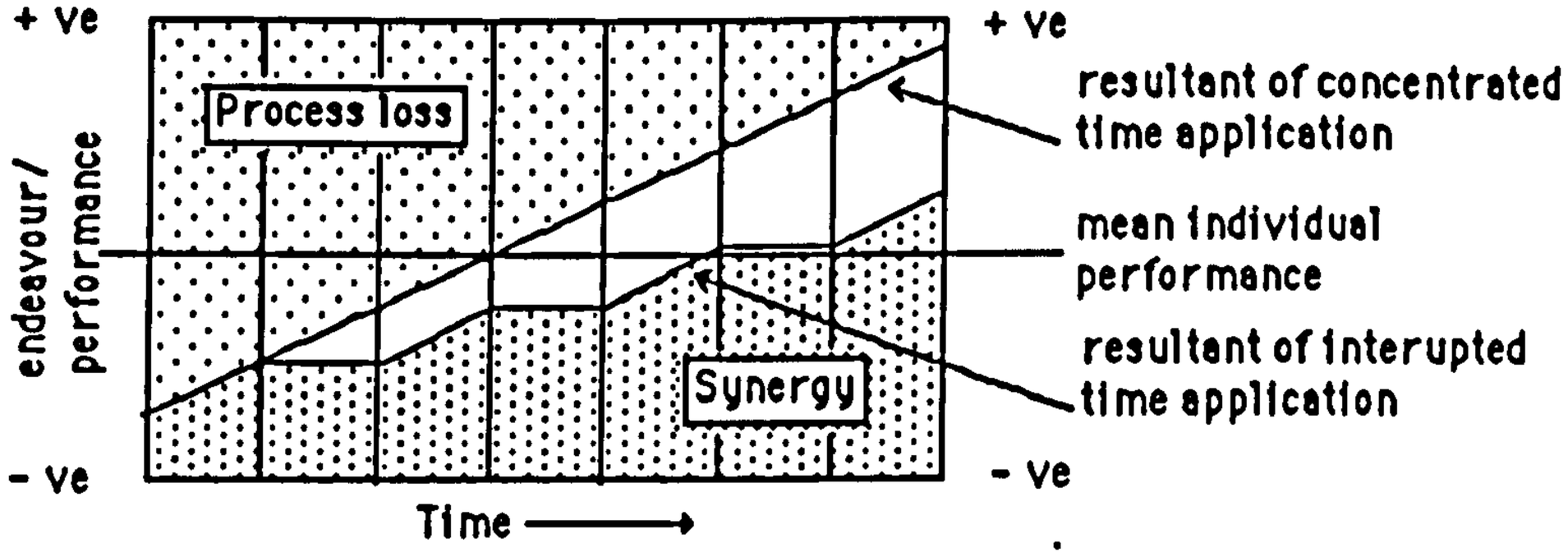
Secondly, raised pupil perceptions of relevance. Pupils perceived the simulation of industrial and commercial contexts as relevant to their futures in the world of work. They also perceived the relevance of personnel from industry and/or commerce as greater than teachers.

It has been assumed that there was a relationship between increased levels of perceived relevance and levels of endeavour. However the data do not allow a firm conclusion on this point. Endeavour rose over the three phases discussed. The model proposed is based on the resultant of process loss (negative synergy) and positive synergy. The specific part played by simulation in this model is not easily separated, but it appeared operate in two ways.

a. Initially all events were out of the ordinary to pupils, causing them to be unsettled. This effect was increased in events where staff selected heterogeneous teams and the events were residential. Pupils struggled to come to terms with the new context, relationships and requirements. Any disposition towards an immediate rise in endeavour, caused by novelty effects or perceptions of relevance, was reduced or masked by these difficulties. As events proceeded pupils established their positions in relation to each other and the simulation and process loss diminished. The rate at which process loss was reduced depended on a number of factors including the degree to which the event was unusual to participants, the method of team selection, whether residential or in school and the effectiveness of any warm-up exercise.

b. The emphasis on iterative learning processes, particularly briefings and de-briefings enabled factors to be identified, discussed and developed. Pupil perceptions of relevance grew as they were helped to recognise relevance beyond their initial perceptions. Briefings and de-briefings were also intended to build identification with the simulation.

Events which ran within conventional timetables did not raise levels of endeavour to the extent of those which operated under a suspended timetable. Concentrated work allowed higher levels of identification to be built without the interruptions of the timetable. Suspending the simulation for inputs or timetable requirements interrupted the process of building pupil identification. This could be represented by the model as:



A model of the effects of interrupted and concentrated time

In practice the resultant probably diminished while pupils were out of the simulation rather than being constant as shown above.

More work must be done on this but the indications are that suspending the simulation should be minimal, for short durations and that staff should be aware of the need to re-build identification at the end of the suspension.

There were indications that there was a cumulatively beneficial effect from the use of various factors. When schools chose not to include teamwork, competition, suspended timetabling or commercial personnel the levels of endeavour were not as high. The conclusion is a difficult one to substantiate in detail and requires further illumination.

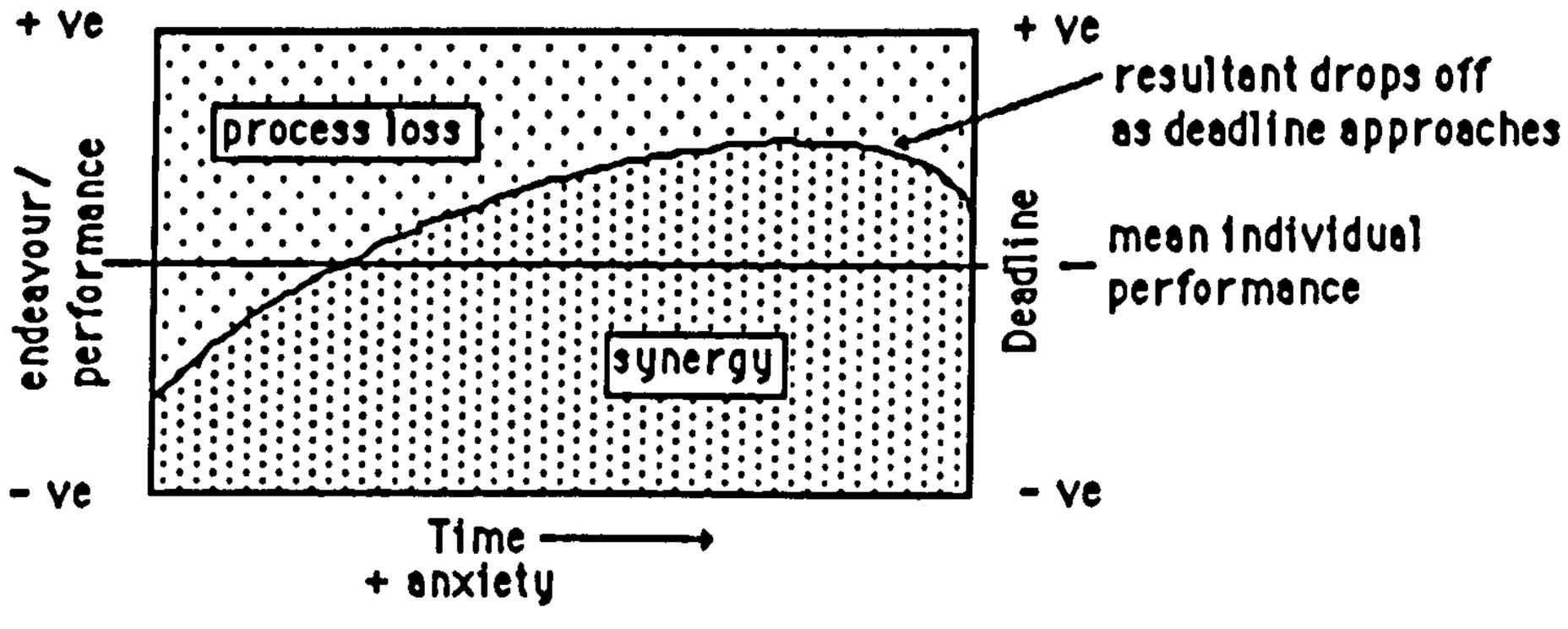
This conclusion is further complicated by teacher/ experimenter effects. It was apparent that those staff who fully accepted the principles and techniques of the approach also employed more of the factors discussed. In these cases it could be expected that staff would put more effort into preparation and convey the benefits of the event more convincingly to pupils.

A key question is one of effectiveness. Which of the various factors discussed has the potential for the most effect on endeavour? This enquiry cannot draw firm conclusions. Further work will be necessary on this aspect.

7.1.2 At this point it would be appropriate to briefly summarise other aspects of the approach which were seen to influence endeavour.

7.1.3 Teamwork proved to be a complex area which needed a good level of staff understanding if certain difficulties and limitations were to be avoided. Teamwork was identified as generating increased pupil perceptions of relevance which may have been translated into the observed levels of endeavour.

The enquiry expected to identify synergy as positively contributing to both levels of pupil endeavour and the quality and range of design work. The former was established but the latter was not. This may have been due to inadequate instruments. It is also possible that this may have been due to rising pressure from deadlines and the nature of the event causing individual pupil levels of anxiety to rise beyond optima. The model would show this as:



A model of the effects of deadline induced anxiety on performance

This would lower the quality of design thinking, following Yerkes-Dodson.

Synergy is complex as it deals with interpersonal relations. It is not automatically positive. The selection of a team structure and membership can

be critical to effectiveness. Once established, time and understanding are required to nurture positive synergy.

The accounts indicated that pupil self-confidence rose when an established member of a team. This may be a mechanism acting within synergy or simply be associated with it. Initially members of heterogeneously selected teams could be expected to be unsure of themselves and have a lower self-confidence in that context. As the team became established a member support mechanism appeared to raise self-concept. This could translate into more positive approaches to the work and increased endeavour.

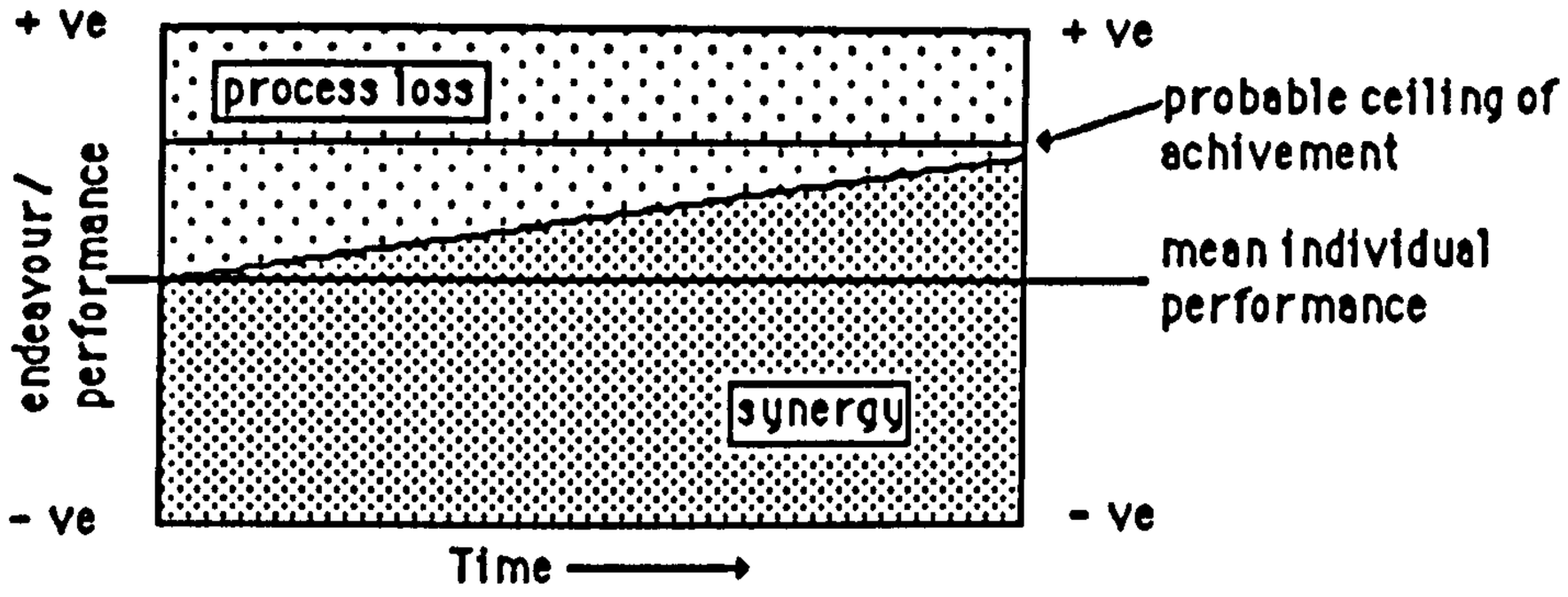
The following factors emerged as being influential:

a. Team selection criteria. Self-selected teams did not perform as well as teams selected on the basis of a mix of abilities, subject expertise, gender and avoiding friendship groupings. Self-selected teams may have tended towards being homogeneous in terms of attitudes, abilities and gender in comparison with teams selected by staff. Homogeneous teams were less able to make use of the assembly bonus effect discussed in section 2.2.11.

A homogeneous team may perform better than a heterogeneous team in the short term as there is less negative synergy due to team formation process loss. Cohesion was likely to be initially higher in a self-selected, homogeneous team and lower in a staff-selected heterogeneous team.

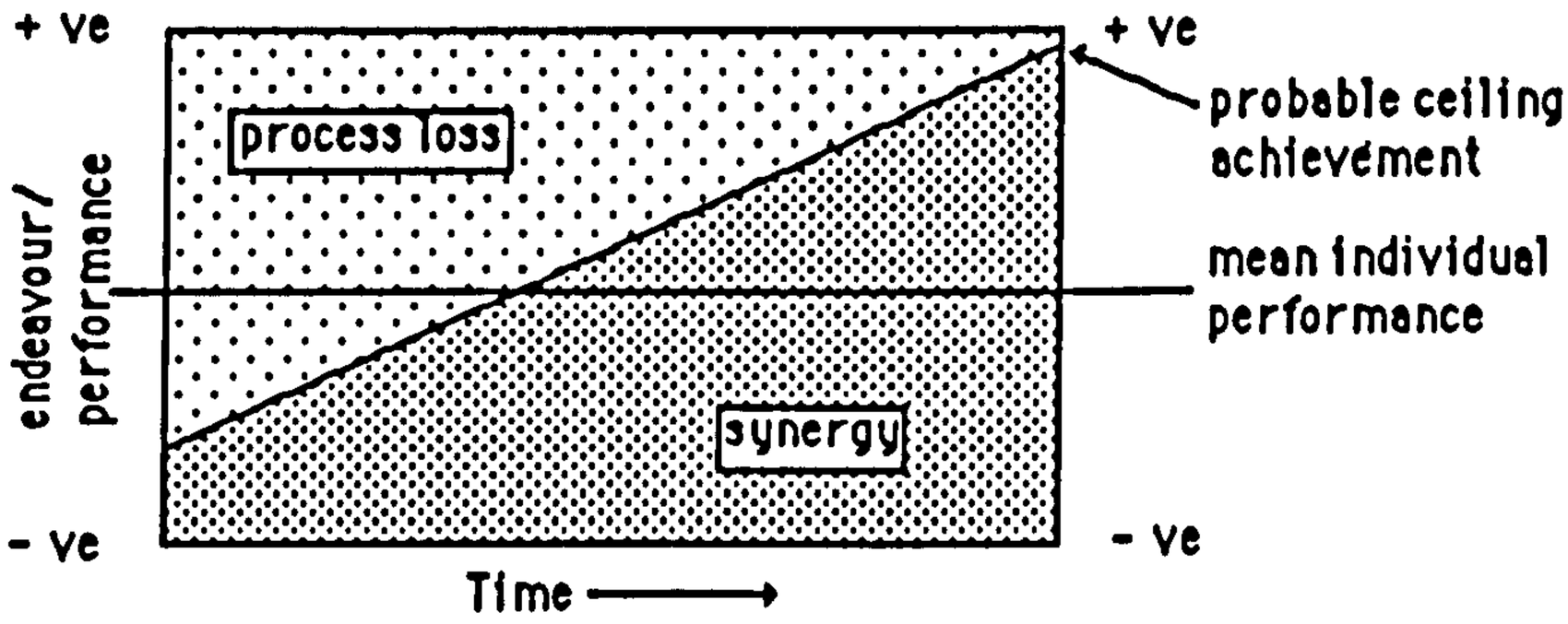
Heterogeneous teams may be characterised by conflict, especially in the early phases, but this does not necessarily mean poorer outcomes. Such teams benefit from `assembly bonus` but results quoted in the literature cannot be explained simply by this phenomenon. Synergy moves beyond assembly bonus.

The effects of homogeneous/heterogeneous team composition could be represented as:



Model of homogeneous team outcome

Note the high starting point, low gradient and low probable ceiling of achievement. In contrast the model for heterogeneous team outcome would be:



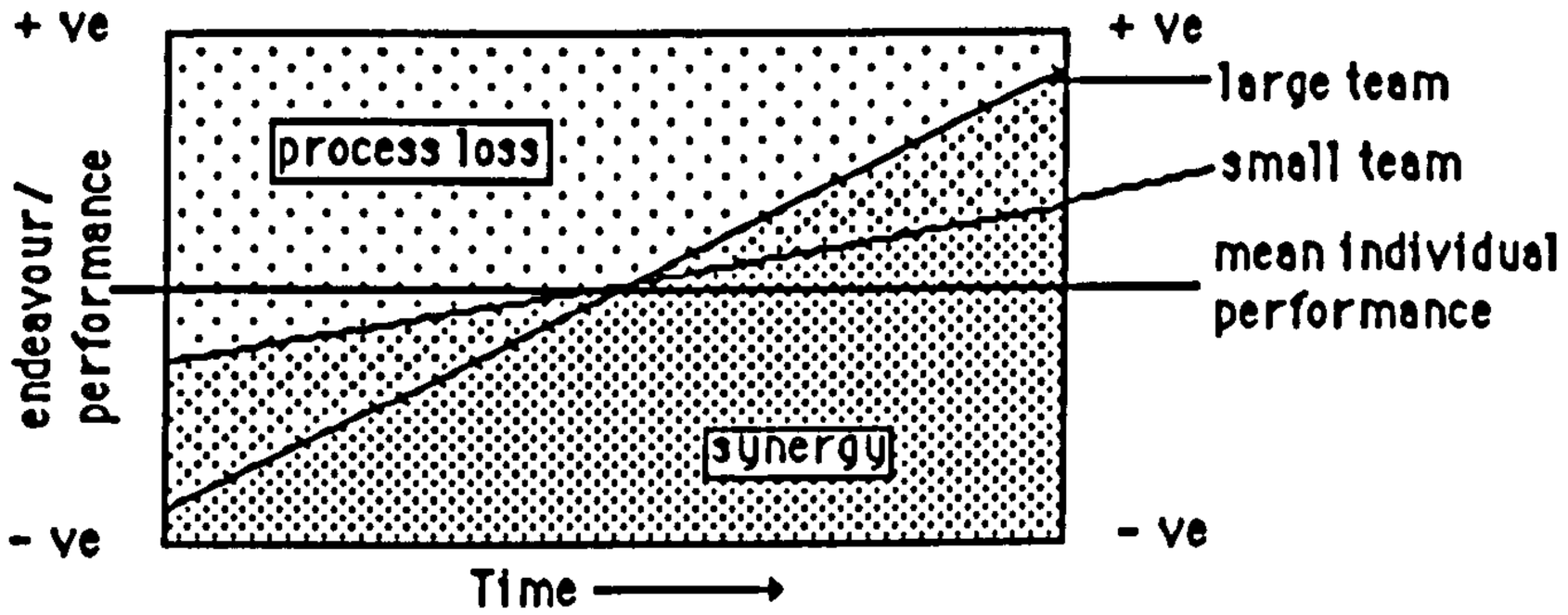
Model of heterogeneous team outcome

Note lower start point, steeper gradient and higher probable ceiling of achievement.

This indicates that teamwork requires time before the investment is repaid. The objective should be to raise the start level before the main task is begun. Warm-up exercises pay dividends if correctly designed and run.

b. Team sizes. The indications were that smaller teams establish cohesion more quickly than larger teams. Nevertheless, it is expected that larger teams, once established, would offer more perspectives on a task and so possibly a greater assembly bonus and synergetic effect, though the accounts do not allow this to be reliably confirmed. The largest team sizes occurred in account 5, which was

also residential. These teams found it difficult to work together initially but by the second half of the week were well established. It may have been more difficult to achieve this if these teams had not been residential. Diagrammatically this could be represented as:



A model of team size against team outcome over time

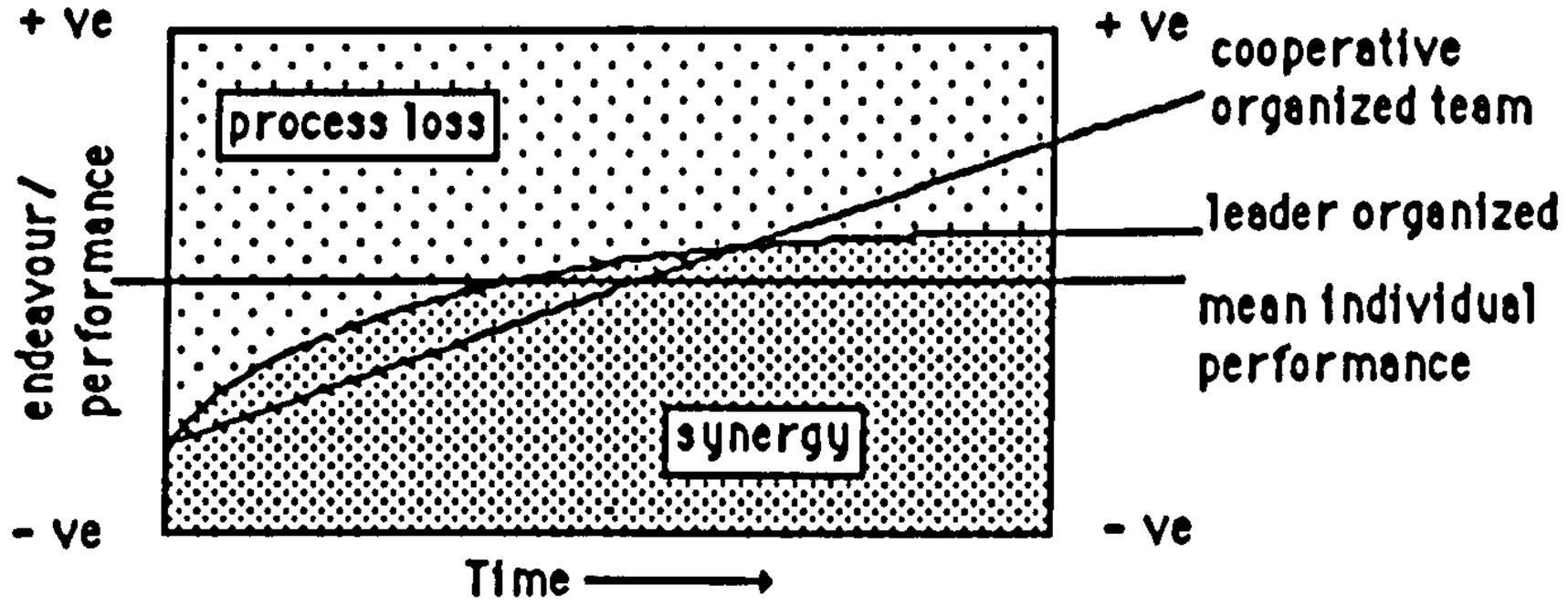
It may be that as team size grows beyond an optimum the gradient starts to decrease. The optimum would depend on many factors including experience, personalities, preparation, task and so on.

c. The relationship of team size to task. There must be adequate work to challenge all members without the task becoming impossible within given deadlines. Delegation to individuals reduces the possibilities of positive synergetic development, delegation to pairs would probably be more appropriate.

There is a danger of teams `ganging up` on the task if they do not accept it. Pupil perceptions of relevance in these accounts may have assisted in the task being accepted.

d. The establishment of a team base area. A base should be for the exclusive use of that team during the simulation. It should have a limited degree of privacy whilst being open enough for staff to observe non-intrusively. The base should ensure effective communications including verbal, aural and graphical. A small table assists in encouraging a central focus. In contrast delegated aspects of the task require individuals or small groups to be able to work effectively .

e. Pupil/team autonomy. In all accounts teams were allowed to decide their own structure and tended to attempt to adopt forms of cooperative model. Account 5 indicated that the majority of participants had negative attitudes towards the concept of leadership. Nevertheless, the most successful teams in that account were those where an individual assumed a leadership role and coordinated teams. This was not necessarily done by conscious decision. Such leadership could improve effectiveness over the short duration of the events where loss of coordination could impair the achievement of the task by given deadlines. In contrast some leaders who emerged through force of personality were not necessarily as effective. It may be hypothesized that cooperative teamwork, without direct leadership, requires sustained periods of time and experience to enable the team to become fully developed. Over shorter periods a more conventional leader-directed organizational structure assists, if the leader is effective, but may be translated into inflexibility over long periods. These periods appear to be months and years rather than the periods typified in these accounts. Diagrammatically this could be represented as:



A model of team outcome potential over time for cooperative and leader organized teams

The accounts show that pupils tend to consider teamwork to be unproblematical; observation contrasted with this. Pupils were unfamiliar with teamwork and struggled to come to terms with it. Having said this, the great majority of pupils were able to establish reasonably effective teamwork over the period of each account. This raises questions on the progressive development of teamskills which must be examined in follow-up work to this enquiry.

f. Competition. The accounts included competition as a central aspect of the commercial simulation. This aspect will be dealt with in more detail in 7.2.3.

7.1.4 Teachers saw their role in the design and running of such events as unproblematical. In contrast both literature and accounts indicated that teachers often had a poor understanding of the nature of this form of work. This is important as the situation is complex and many pitfalls are present which the uninformed may not appreciate.

Novelty effects, whilst a difficulty in research terms, can be used positively by teachers to boost pupil endeavour. Further work is required on this as it is anticipated that repeated use of the approach would diminish impact.

This links with progression. The enquiry has not been effective in illuminating the factors which govern the development of teamskills, or able to identify a clearly common perspective as to what teamskills are. While the accounts included pupils and students from years 7, 8, 9, 10, and 12 there was no long term perspective on development. This must become a major area for extension beyond this thesis. The accounts have shown that progression must be considered in terms of both pupils and staff.

The teacher's role within the event will be discussed further in section 7.2.4.

7.1.5 The pre-enquiry events were all residential. The limitations of the opportunity led approach meant that only account 5 examined a similar residential event, all others took place in schools. Due to the difficulty of quantifying levels of endeavour and the complexity of factors involved in each account it is impossible to draw firm conclusions on the effect of a residential structure on endeavour. Certainly high levels of endeavour were achieved in other accounts. Nevertheless it was apparent that in account 5, as the second and third phases of the event were entered, participants were both highly involved with the simulation and using time far beyond the normal school day to develop their work. The data does not inform whether pupils in other accounts met and worked beyond the school day, though staff reported that it became difficult to stop pupils working at breaks or the end of the day. Contrasting the work above on time management and the building of pupil identification with the simulation, it would seem reasonable to assume that a residential event offers staff more opportunity to develop identification.

7.2 Findings which are considered to be original contributions to understanding.

The enquiry presents a wholistic perspective on a form of multidimensional learning context. The contributions to understanding lie in part with the wholism of the account and in part with aspects within it:

a. Designing in teams in these contexts showed a synergetic response in terms of endeavour but not in terms of design work.
b. There appeared to be a positive team effect when members responded to a teamwork ability profile in comparison with individual responses.
c. Pupils did not respond to the inter-team competitive element of the simulations. In contrast they did respond to the deadlines within the simulations.
d. Many teachers, whilst recognising the value of granting pupil teams autonomy, found it difficult resist intervening unnecessary.

These contributions, by virtue of the scale, perspective and methodology of the enquiry, must be recognised primarily as indications. Nevertheless, within the specific contexts of these accounts the triangulated methodology has established a degree of reliability.

7.2.1 Designing in teams. The enquiry has contributed a perspective on non-specialist pupils and students designing within the context of these learning events.

It had been expected that teamwork would generate positive synergetic effects in both endeavour and the quality and range of design work. This was the case in terms of endeavour but not in terms of design work. Anxiety induced by approaching deadlines appeared to have reduced the quality and range of design work. It is possible that the instruments were ineffective in distinguishing levels of design quality, which is an issue raised in 8.0 for follow up work.

All events, but for account 1, ran with normal populations of pupils rather than those specialising in design. These populations were, perhaps, less able to capitalise on design opportunity and teamwork. The literature on synergy in design contexts has used specialist design students in higher education which is not directly relevant to this enquiry.

The initial phase of the events was characterised by teams struggling to come to terms with the new context and relationships. Coordination and communications were, typically, poor. This would imply that the cooperative design work embedded within the event would suffer from the same negative synergy. By the final phase of the events teams were better coordinated and communications and endeavour had risen. This would imply the conditions for positive synergy in design work should be optimal. Nevertheless, design work was not strong. The reasons for this centre on the nature of designing and team response to approaching deadlines.

Practical design work in response to the opportunities presented in the accounts was complex, but a much simplified model would be: identification and clarification of the opportunity, the initial generation of ideas, the development of the adopted solution and finally the construction and evaluation of the model/prototype. Initial design work, the foundation for subsequent phases, was mainly done in the first phase of the event when the teams were disorganised and not working effectively. The quality and range of design ideas must have suffered from this. As teams became organised through phase two of the team process they recognised the imminence of deadlines. This meant that teams had to rationalise their design work and optimise to meet the deadline. Ideas could not be developed to the degree that teams may have been capable, teams had little time and they were not specialists. The final team phase of effective operations coincided with the constructional phase of design by which time the final design was more or less firm.

Whilst warm-up events were used, teams were not well enough established to approach the initial phase of design work with positive synergy. The closest to this was account 4 where a whole day had been spent on a warm-up exercise of a design nature. Follow-up work should look at this particular aspect and examine the effects on design process of building teams effectively to the second team phase before releasing the main task. The hypothesis would be that design work would improve in the range and quality of ideas. It would also be relevant to look at cooperative group design work where competition and deadlines were removed so optimising the conditions for positive synergy in design. Nevertheless, designing to deadlines, at least part of the time, should be a part of every pupil or student's experience. This is because it has greater relevance

to professional design practice and also has lessons for non-specialist designers in terms of general education.

The second potential reason for the limited design response was rising anxiety due to approaching deadlines. As teams had been disorganised over the first team phase the deadlines were shorter by the time teams were becoming effective. Similarly, staff had 'built the simulation'. Observations showed that participants did begin to 'live the simulation' and take it very seriously. It became important to them to meet the deadline. Referring back to the Yerkes-Dodson hypothesis and the relationship between anxiety and performance it is possible to draw the conclusion that these raised levels of anxiety took teams beyond optimal levels for performance. Performance, therefore, would reduce as deadlines approached. This raised anxiety may also be a factor in the observed poor levels of mathematical ability as these calculations had to be done very close to the final deadline when anxiety was maximal.

7.2.2 The use of a trial teamwork ability profile in account 5 (5.6.4) raised some interesting points. It should be noted that this is based on a limited sample within the account of seven teams (49 students) and requires further work.

When teams completed a single profile, as a team, they rated themselves higher than when individuals rated themselves on the same profile. There appeared to be a team self-supporting effect in action. The basis of this effect is impossible to illuminate through this limited sample and with only this form of data.

The profiles also indicated that this sample of students considered leadership as a less important aspect of teamwork. Other observations triangulated with this indicating a form of sub-cultural ideal for cooperative team management. When leaders did emerge through a form of social interaction these were not recognised by the team members, even though that person may have been overtly directing activity. Staff observations confirm this in that they identified several leader orientated teams, the members of which considered they were working a cooperative management system.

7.2.3 Competition. The potential value of competition had been a factor in the design of the pre-enquiry events based on earlier work (Denton 1984). Similarly the literature indicated that competition could be used positively to raise pupil

effort. The commercial context of simulated companies was the setting which was intended to generate that competition.

Observation showed that pupils were not competitive at an inter-team level even in the latter phases of the events. The sharing of ideas between members of different teams was common, especially in the early phases. Whilst this sharing diminished in the later phases it was not eliminated. The diminution appeared to be due to the fact that the teams were, by then, very busy rather than competing. Some of this sharing may have been between school friendship groups, the data cannot differentiate.

The use of limited dividing partitions between team bases was shown to have some effect in maintaining intra-team focus by partly limiting inter-team communication. This area merits further exploration as it may be a significant factor in developing team work.

As the final phase of the events was reached it was apparent that endeavour had risen. Team members encouraged each other and worked long hours and with sustained attention spans. There was evidence of pupils both feeling the pressure to succeed and wishing to do so individually. There was, effectively, a competitive atmosphere but one aimed at meeting the deadlines. Even in the final phase of the event there were few examples of overt inter-team competition.

Living in a competitive society, in which children are exposed to team games both in and out of school and on the media, this observation was surprising. The data does not allow any closer analysis of the phenomena, but this is an area that merits further enquiry. One hypothesis would be that pupils did not understand how commerce works and the effects of their aiding a competitor company. Another would be that friendship groupings from school were so strong that they transcended intra-team responsibilities within the simulation. This would probably be the case if the inter-team transfer of information and ideas were shown to be between friendship groups.

7.2.4 Staff roles. The role of staff within the planning and running of these events has been shown to be significantly different to their normal school role. Not all aspects are unique but the following merit highlighting.

Cross-curricular groups were necessary for planning. Staff report that this was difficult and time consuming. It has already been pointed out that lack of familiarity and the fact that the events were monitored by outsiders will have caused staff anxiety and possibly encouraged them to over plan. Nevertheless, staff reported positively on the secondary effects of cross-curricular planning particularly improved understanding of, and empathy with, other subject areas.

Pupil team autonomy of action was a central plank of the approach. Yet this autonomy needed discreet support to prevent teams or individuals failing to a degree that damaged self confidence. All staff recognised the principle of allowing autonomy in planning but in practice found it far harder to apply. Staff should have been able to stand back and observe, intervening only when necessary. Nevertheless, a significant proportion of staff involved themselves in team processes to a greater degree than had been intended. Staff reported an almost irresistible need to move close to pupils and directly involve themselves. Such involvement would lower pupil perceptions of autonomy.

The reasons for this probably vary. Many staff are simply conditioned to working closely with children. To do otherwise would `feel wrong`. Confidence to break contact must be developed. Staff are similarly used to gaining frequent feedback from the learning process in terms of tests, homeworks, coursework and verbal interaction. In the accounts, particularly account 2 which ran over 10 weeks in the timetable, formal feedback was reduced to a final assessment. This caused a lowering of teacher confidence and prompted more direct intervention in order to gain detailed feedback. The opportunity to observe to a higher level than had previously been possible during the event was inadequate for that teacher`s needs.

A third perspective on this phenomena was that of staff control. The teacher in account 2 was working with year 7 children. He normally adopted a teaching strategy which used highly structured work for the youngest pupils and offered more and more flexibility as they moved up the school. The event described in account 2 is more structured than those which ran with older pupils and students. Nevertheless, this teacher appeared to loose confidence as he released control. He admitted anxiety at many stages in the event. Several inputs were inserted which were not previously planned. These may have had a subconscious aim of re-establishing control over the learning situation. The

teacher also became concerned over the coverage of his normal knowledge base. Due to the `roundabout` type structure in that department this teacher was using his only exposure to the year 7 group on this particular event. As the event gave pupils greater autonomy he lost the ability to teach many of the practical skills he would normally cover in year 7.

7.3 The significance of the enquiry.

In this section the significance of the enquiry is discussed in the context of education in the final decade of this century. The following are highlighted:

a. The National Curriculum, particularly Technology and Cross-Curricular elements.
b. Pre-vocational education.
c. A general focus on levels of endeavour.

7.3.1 The National Curriculum was conceived, developed and partly implemented during the period of this enquiry. This illustrates that the pace of change in general education has accelerated since the inception of TVEI. The management of change has become an important skill required by teachers.

This enquiry has generated a number of observations relevant to the management of change. Management structures which are pyramidical from the principal down to main scale teacher may not be as effective as a group orientated structure. Staff working groups (often termed teams), involving staff of various seniorities including main scale, are becoming the norm. Many such groups span subject areas and offer staff opportunities to gain experience of management and curriculum development beyond `their` specific subject area. Staff from the accounts reported increased understanding and empathy with other subject areas as a result of working in cross-curricular planning groups.

Nevertheless this enquiry has shown that staff underestimate the difficulties of establishing effective groups. It is anticipated that further research into the management of change would establish that staff do not recognise the value of groupwork beyond that of simply being a forum for discussion and delegation. Effective staff groups can produce synergetic effects but require careful selection and nurture. Such groups should be recognised as having long term

goals and the growth of the group should be seen as an objective in addition to specific tasks set. Consideration should be also given to the working environment of staff groups. Similarly time management must be considered in relation to staff planning and meetings. These questions have implications for resources.

Work is needed on investigating senior management attitudes to, and understanding of, staff team-work if gains in performance are to be made.

7.3.2 Designing in a simulated commercial context acted as a focus for the activities of this enquiry. The National Curriculum has changed the terminology, but the significance of the enquiry for this area of the curriculum has become pronounced.

The accounts of this enquiry represent an approach to learning which has the potential to fulfil many of the requirements for National Curriculum Technology. Careful record keeping of individual pupil's contributions to the team task would be necessary as delegation means that these will not be identical. Nevertheless the approach has demonstrated the potential for staff observational opportunity, this will be particularly useful. Long term planning, including integration with more conventional teaching and learning, would enable staff to ensure that all pupils gained a rounded Technological capability.

This enquiry offers an approach which could be used to assist staff in developing their own understanding of each other's contributions to Technology. Integration is not demanded within the Statutory Orders. Specific subject areas may remain, but there is an implicit call for moves towards a process which integrates appropriate technologies including IT, commercial contexts and aesthetic sensitivity. The approach promulgated by this enquiry offers an appropriate tool to be included with others in the teaching of Technology.

7.3.3 An area of significance is that of staffing events such as those described. The enquiry has described how small numbers of staff are able to supervise far larger groups of pupils and students than would be normal in schools. Staff could look on staffing ratios more flexibly when engaged in such learning events. Clearly aspects of safety must be paramount. Nevertheless, with effective planning and appropriate working areas, it would be possible for staff

to develop a programme which offered individual members of staff more non-contact time and yet a greater quality of observation when involved. The idea of maximising staff:student ratios and staff contact time are not necessarily the most effective means of developing learning.

7.3.4 The National Curriculum also requires attention to of a number of cross-curricular elements. As worded, these could be considered within subject areas by taking cognisance of the broader context. However, the use of the type of learning event described in the accounts would be in the spirit of the cross-curricular elements. The use of suspended timetabling for such events, whilst not unique in schools, is significant as teachers search for appropriate ways in which to meet these requirements. Several of the schools within the accounts are now using the approaches developed as a means of teaching cross-curricular elements.

7.3.5 In the final stages of writing this thesis Mr Tim Eggar, Minister of State at the Department of Education and Science, speaking at the Design and Technology Educational Research and Curriculum Development Conference (DATER 91) indicated there would be new government proposals for the development of pre-vocational education within schools.

The enquiry could have significance in this area, which is at present confused. The approach illuminated is intended to help pupils recognise the broad context of the technological process, including the social, environmental and commercial. In this sense the approach is pre-vocational in that it looks towards the world of work, but is not specifically vocational. Staff could take the general principles of the approach and direct tasks in specific vocational directions such as manufacturing engineering, catering, building and others. Whilst a central feature of the approach as applied in the accounts was the use of a concrete task it would be possible to format the approach around the design of services such as a cleaning contract for specific buildings or a range of insurance options. Direct links with appropriate local companies in terms of planning and running the simulation would further enhance the pre-vocational potential.

7.3.6 The final area of significance is more general, centring on motivation. There have been voices raised to the effect that secondary schools are failing to motivate pupils sufficiently. The observations of the Science Education Project

(CASE May 1991) to this effect were discussed earlier. Similarly Jones (1984 p 35) described a syndrome she saw as: ...*teacher as slave and pupil as tyrant.* This is characterised by teachers doing most of the work and failing to make sufficient demands of pupils. Jones was providing a commentary on work by Pring, rather than reporting first hand research and so her words are opinion, but it is an opinion, backed up by CASE, that has common currency in many staff-rooms.

Jones' assertion, if proven, could have many causes which lie beyond the central aims of this enquiry. Nevertheless, it is apparent that the accounts of this enquiry show a reliable ability to raise levels of endeavour and pupil perceptions of the relevance of the work to their futures. Similarly self-confidence to operate within a team and manage commercially orientated tasks were developed. The general post-event response by pupils has been positive with calls for more time to be spent on such events.

The approach adopted within the accounts would be inappropriate for frequent use. It is not as effective for delivering knowledge and skills based learning and frequent use would reduce the motivational potential of novelty effects. However, higher level competencies such as teamwork ability, decision making and the integration of subject learning may be developed through the approach if considered in relation to long term progression.

7.4 Finally.

It was intended to maintain an open perspective on the phenomena that caused this enquiry to be launched. The methodology used has, to some extent, achieved this. In contrast the methodology has not allowed observations and conclusions to be drawn with the reliability and validity of a more focussed research design. This is accepted. The enquiry has provided a perspective on a form of learning approach which would appear to be both significant and timely. The enquiry has been able to confirm the literature on many aspects and so improve reliability. It has also been able to make original contributions to understanding in a limited manner.

8.0 Areas for future work

This enquiry has raised many areas of interest which call for clarification and expansion. These have been signalled in the body of work and will hopefully generate interest in other workers. However, at this point four general areas are identified as those which I see as the immediate logical extensions of this work. All are in keeping with the motives which began this enquiry.

8.1 A model of the relative effectiveness of elements within the approach

The approach described was intended to be flexible, enabling teachers to take ownership and adapt to their own situation. The accounts showed that this was the case in practice. What was not fully established during the enquiry was a comparison of the effectiveness and efficiency of different elements in relation to endeavour or learning. These are complex areas but a model which helped teachers decide where best to focus limited resources would be valuable.

In order to develop such a model a series of case studies would need to be built up which adopted different combinations of elements. A multidimensional measure of the effects of the different elements could be built. Observation would focus on pupil attention spans and rates of work. These could be measured by analysis of video taped sequences. Pupil attitude instruments and teacher interviews would triangulate these observations.

8.2 A model of the progressive development of elements within the approach

The enquiry was based on a series of singular case studies. It was not possible to gain a long term perspective on the development of those elements which contribute to both staff and pupils' abilities to work within the approach described. This area represents a logical progression from this enquiry.

Such an enquiry would need to clarify the elements within the basic groupings of group/teamwork, commercial simulation and time management and then relate these to Technology within the National Curriculum. It would be then necessary to establish a logical hierarchy of progression both within each group and in terms of group interaction.

8.3 An enquiry into the effects of residential aspects of the approach

There have been indications from the fieldwork that the residential aspect was a significant element in the ability to raise endeavour. This has only been illuminated through one account. In order to improve the reliability of this observation and more fully establish the manner in which residential working influenced endeavour a series of similar case studies would have to be conducted. These studies would be triangulated against studies of residential courses of different natures in order to isolate the residential effects from those of the the other elements in this enquiry.

8.4 An enquiry into pupil design work in both cooperative groupwork and teamwork settings.

It had been anticipated that synergetic effects would improve the range and quality of design ideas generated by the teams in these accounts. In practice the enquiry indicated that the anxiety generated by working to deadlines worked against such positive synergy.

This opens some interesting possibilities for the investigation of designing by pupils in both cooperative groups and teams. Such an enquiry would be of significance in illuminating the question of positive synergy in competitive situations. Similarly the enquiry would establish guidelines for teachers as to when and how to apply elements such as cooperative work and competition in Design and Technology contexts. The question of assessing such joint design work would also have to be addressed in relation to GCSE and other externally led assessment.

An aspect of such an enquiry would be an investigation into the most appropriate conditions for designing in group/teams in schools. This would focus on team bases, their equipment and organization.

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Appendix 1

Case account 1

1.0 Background

This case study was carried out to gain a rapid perspective on the use of the approach described in section 1.0 in a school. A year 12 class following an `A` level Design course was chosen and a short simulation run lasting 90 minutes used. The simulation was supported by a trial computer package intended to give a financial structure to the event. The package is not a part of this enquiry.

2.0 Key purpose (research)

To gain insight into the transfer of the the approach into a school situation.

3.0 Key developments

The transfer of the principles from 1.0 into a short timespan and within a school.

4.0 Evaluation techniques

Researcher participant observer notes.
Teacher as observer and debriefing interview immediately after the event.
Nominal group technique (NGT see 2.4.4 for method), with researcher present as facilitator.

5.0 Description

The simulation linked two elements, the Open University "Chair design" simulation from T 263,(modified by J.M.Flood to include a commercial element) and the computer programme (1986 version 1.0). A reduced copy of the pupil briefing sheet can be found on page 90 at the end of these appendices.

A class of 10 `A` level Design students worked through the simulation in 3 teams. After a random selection by the teacher the teams had 60 minutes to design a 1:10 scale chair from sheet card. The chairs had to be costed out at full scale using information supplied. After the design, make and cost stages teams had to specify a selling price based on unit cost + profit.

A market place simulation was held whereby teams broke into individuals who acted as buyers for furniture retailers. Each had 1000 units to spend as they wished.

The number of sales were entered into the computer and a final readout given in terms of `total profit`.

6.0 Observations

6.1 Nominal group technique

The final factors, in order of importance to the class, were produced using a 5 - 1 weighting factor so that 5 was the highest importance and 1 the lowest.

See over for results.

Order	Weighting	
1.	4.8	Team work was a valuable experience.
2.	4.7	The time constraints were valuable experience.
3.	4.5	Working out "real costs".
4.	4.4	The need to delegate.
5.	3.9	Good to work on an actual product.
6.	3.8	It was strenuous.
7.	3.7	Few factors in the design process were raised.
8.	3.7	The need to compromise.
9.	3.6	It was hard to plan in such a short time, experience needed.
10.	3.5	Keep it simple.
11.	3.5	More guidance needed, examples given.
12.	2.8	The other teams were too close, they negatively influenced each other.
13.	2.7	The exercise brought out many mistakes in designing by the teams but did not offer any real answers.
14.	2.2	The product was unrealistic.
15.	1.8	More time was needed.

6.2 Teacher debrief

The following notes are in the sequence they were reported.

1. Meeting deadlines was good experience. The exercise started off slowly but the teams soon came to realise the urgency of the task and work rate accelerated to a high level.

2. The way individuals worked in the teams was indicative of their personalities. The quieter individuals stayed quiet. This was noticeable when, at the end, it was necessary to call out figures. It was also noted that many were still shy of asking for clarification during the exercise. It was felt that this was due to a reluctance to admit to failings in front of peers and staff.

3. Some difficulty handling the mathematical concept of "mark up".

4. Not enough time was available for the teams to understand many features of the computer programme, particularly the forecasting facility.

5. Working to scale in terms of costings caused a little difficulty, it was suggested that the costs should be given at the 1:10 scale rather than full size.

6. The teacher noted the interest in having to work to a tight deadline. It was felt that this aided motivation.

7. The debrief raised the majority of teaching points that the staff would have wished to ensure covered. Because these factors related to the students immediate experience it is a reasonable assumption that they will have had a more meaningful impact than might have been the case in a more traditional teaching situation.

8. The level of complexity of the simulation was felt to be about right. A good level of learning "tension" was offered without having any of the students loose interest due to being over or under taxed.

9. It was felt that the time needed to get the students mentally prepared was rather short. This was primarily due to a number arriving late.

10. Giving students information on a large, A3, format was helpful in that it was easier to read and was easily available during the pressure of the event.

11. It was felt that the fact that the teams were in easy visual contact was an incentive and helped develop the work rate and competition.

12. It was felt that the exercise was particularly valuable in the way it introduced students to the costs in producing a product.

13. The very closed nature of the experience together with it's intensity, meant that it made a very meaningful learning experience. The teacher pointed out that ... *it got over as much in an afternoon as in a normal whole day.*

14. A number of suggestions were made for modifying the student instruction sheets. The `Basic manufacturing costs` needed a column to allow the total of basic costs to be put down. In `Costings preparation` the line for unit cost needed changing to `basic manufacturing cost` in order to be better understood. Finally the programme called for `available capital` but there was no mention of this on the sheet.

6.3 Researcher observation notes

For brevity there is no repetition of points raised above.

1. The rate of activity was initially very slow. Students appeared unable to set an appropriate pace. This accelerated as they realised to passage of time. Verbal reminders by staff reinforced this.

2. The time available did not allow students to make full use of the computer programme. They were unable to use the forecast facility or fully analyse the information on the derived data printout.

3. The students needed to be separated when in the individual buyer role. There was much discussion and fully independent decision making was unlikely.

4. All the teams achieved sales of over the 1000 entered into the programme as projected sales. This means that no company had stock as liabilities after the market place simulation, consequently this learning opportunity was diminished.

5. More time was needed for the Nominal Group Technique in order to make a better job of agreeing the final wording.

6. Whilst none of the teams made the initial deadline, it was possible to stop the simulation, explain lain the consequences in commercial and social terms, then give a further 5 minutes without loosing the impact of the learning situation at all. Indeed the failure to meet this deadline was a very clear experience for the students.

7.0 Discussion

A number of patterns emerged from the three sources of data, the principle components appear to be: team work, time, designing and other miscellaneous factors.

Results are referred to as Nominal Group technique (NGT), Teacher observation (TO) and researcher observation (RO).

1. The importance of the team work aspect was clearly well accepted by students with the highest NGT weighting of 4.8, very close to a perfect score of 5. As 'A' level students we might expect them to be particularly receptive to the need for team work experience. It will be necessary to compare this result with further trials on lower age ranges and mixed ability teams.

2. The need for specific methods of working within a team was grasped, with the need to delegate carrying a weighting of 4.4. Staff also reported a high level of interest in aspects such as this (TO 6) during informal interaction.

3. Whilst individuals within companies recognised and worked hard at cooperative aspects, external competitive effects were also very marked. TO 1 indicated a higher work rate than would normally be expected from the class. During NGT it was suggested by one student that the teams negatively influenced each other (12) but we can see that this did not carry a high weighting, (2.8). This can also be confirmed from TO 6, 11. In fact the teacher observation was that close proximity was of value in promoting an intense work rate. It is possible to draw the conclusion that proximity and competition between teams appears to promote work rate and intensity of experience (NGT 6).

4. Turning to an appreciation of time a weighting of 4.7 in NGT, indicated a high level of agreement amongst students as to importance of experience in working to time constraints. TO 1, 6 backed this up. An interesting aspect is that whilst staff and students alike recognised the importance of working to tight deadlines, those deadlines operating at the school tended to be fairly long, certainly students had never been placed under the same pressure as this activity.

5. Students found the work strenuous (NGT 6, weighting 3.8), but observation during the simulation indicated this to be in a positive manner. TO 6 confirmed this together with the point that the students were mentally very active, constantly asking questions which developed their understanding rather than simply questions of clarification. The need for more time was raised during the NGT but the subsequent weighting of 1.8 (the lowest) confirms that the teams recognised the importance of working within tight time constraints.

6. NGT 9, with a weighting of 3.6 on the difficulties of planning in such a short time was seen as a problem by students, but carried a far lower weighting than some of the points already discussed. RO 1 clarified the point in that students were very slow to get underway with the simulation, only after a substantial period did the realisation of the immediate deadline dawn, indeed none of the teams made the deadline for completion of the chair, costings and point of sale sheet. Nevertheless it is interesting to note that as the simulation was suspended at that point and the consequences of this failure in real life (losses, possible closure, bankruptcy and the effects of their families and those of dependent workers) pointed out, discussion revealed a very marked effect, as a learning experience. The subsequent five minute extension was used by the teams most effectively.

7. The question was raised as to whether the task itself was appropriate in the time. The consensus was that it was (N GT 14) though NGT 10 made the observation that the task needed to be simple (weighting 3.5). TO 8 pointed out that the level of complexity was "about right", though the RO 2 and TO 4 indicate that the simulation was too fast to make the most of some of the features of the computer programme. This is a valid point but one that does not necessarily distract from the general success of the simulation. It did indicate that the exercise was at the limits of practicality in linking the programme to the particular simulation under consideration.

8. TO 9 raised the point of mental preparation of the teams before the exercise began. This was felt to be inadequate, primarily due to the amount of time being limited. Consideration needs to be given to this aspect as distinct from the pre-simulation briefing. The briefing informed the teams

adequately (no negative feedback from any of the triangulated techniques) but it did not get them in the right frame of mind.

9. The clarity of the points raised in NGT was in some respects lacking (RO 5). More time needs to be spent refining this aspect, again the exercise was on the limits of practicality in the time available.

10. TO 13 valued the experience in that it exposed the teams to important factors in a very personal and intense manner. The fact that it was a "closed" event appeared to help in that students were able to experience the activity and assimilate it in one session, unlike many design experiences in schools which require weeks to complete, so removing some of the intensity of the experience. TO 7 supported this in a slightly different manner by pointing out that the debrief raised the majority of factors the staff would have wished.

11. Teams valued the point that they were working on a `product` rather than a simulation running only on paper or computer(NGT 5, weighting 3.9). Students felt they had learnt new aspects of designing via the exercise (NGT 7, weighting 3.7) and had others emphasised, for example the need to compromise (NGT 8, weighting 3.7). On the negative side NGT 13 pointed out that the exercise did not always offer answers to the problems it raised . This is a reasonable point, tied to the points on time limitations, however the weighting of only 2,7 indicates a feeling of only moderate importance. Again the exercise was seen to be operating at the edge of what was possible in the time.

12. A minor point with the computer programme was that all the companies achieved their projected sales and, therefore, did not carry any stock liabilities. It would help the general simulation if a small number of companies fell into this position, in that it would add more impact at debrief. This could be achieved by lowering the sum of money available to buyers. Having liabilities need not mean a company making a loss, so we avoid the negative feedback that this may cause.

Appendix 2

Case Account 2

1.0 Background

This trial was opportunity led. It followed the work of a teacher who had heard of my work and wanted to apply some of the lessons in his own school. The teacher set his own scheme of work, based on a number of discussions with myself.

The trial was based in a Nottinghamshire 11-18 comprehensive in a rural setting. The sample was a Design class of 19 y ear 7 pupils, mixed ability (one third had specific learning difficulties of various forms) and mixed sex. The pupils were well established in the school, but this was their first time in the Craft, Design and Technology (CDT) area as they had followed a rotational course. The trial was run within the normal curriculum, 9 weeks with one 1hour 15 minute lesson per week.

2.0 Key purpose

To observe the transfer of the principles of the pre-enquiry residential events into a 'normal' teaching situation.

3.0 Key Developments

Within normal timetable rather than saturated timetabling.
Year 7 class with no prior 'Design' experience.
A teacher's interpretation of the principles described in 1.0.

4.0 Evaluation techniques

Teacher observation notes.

Teacher debriefed on observations each week. As the lesson was the last in the day this allowed a detailed and immediate debrief.

Researcher observations over 6 of the weeks.

Informal 'interviews' with pupils as they worked, by researcher.

Student questionnaire (half class).

Student Nominal Group Technique (half class).

5.0 Description

1. The scheme was planned by the teacher over a period of 2 months.

2. The class was first given a warm up exercise based on the design of a motorway contra-flow system. This took 15 minutes.

3. The remaining 8 weeks were spent in teams of 4 or 3. The teams were teacher selected on a random basis as he had no specific data on performance at that time. The only criteria used was to mix sex in the groups. All groups were two boys and two girls with the exception of one team of two girls and one boy.

4. The topic was the design of a three-dimensional jig-saw type puzzle for the partially sighted. This was fairly tightly structured as the pupils were given materials of a specific cross-section to work from. Disability was simulated by the wearing of blacked out goggles with pin holes.

Each session ended with a debrief where progress was discussed and points raised by the teacher.

5. The exercise was evaluated by a 'market place' simulation. Other staff and governors were invited to visit and place 'orders`.

The class was split in the final week. Half completed a questionnaire set by the teacher and half did a Nominal Group Technique exercise.

6. Prior to the exercise the teacher sent information home to parents in order to inform them and so enlist their support in a discreet manner.

7. I played an active role in observation, talking to pupils and playing a part in the debriefs. The teacher was, however, left to lead the activity in every sense.

6.0 Observations

For brevity I have combined my own observation notes with those of the teacher and points raised during the post lesson debriefs. They are presented chronologically.

1. The warm-up was a 'paper' exercise to design a motorway contra-flow. All the introductory information was on the sheet given and the teacher tried to say little, but to get them going. It soon became clear that most of the class had not understood the task and were very confused but too embarrassed to say.

The exercise ended after 15 minutes and the teacher attempted to pull the experience together.

Whilst the exercise itself was a failure, the importance of teamwork was emphasised by the teacher. This was done simply and focused on the need to talk to each other. The groups used were those that they were to stay in in the whole trial.

2. The main brief was introduced and the groups left to establish themselves. No roles or specific work spaces were given. This period was marked by unease and lack of direction, it took much of the remainder of the lesson for them to complete the simple tasks of establishing a work base and company name.

3. 75% of parents contributed to homework based on the brief. Children were reluctant to talk about their parents' contributions but it was very clear that parents found the basic mathematics involved difficult. One pupil said he did not want parental help. This appeared to be personal pride.

4. There were a number of occasions where concepts such as cooperation and competition were reinforced. Nevertheless in the early weeks several groups broke down. Individuals moved about, joined other groups and worked there before rejoining their own team. The concepts of belonging to and working cooperatively in one team whilst competing against the other groups did not appear to be natural to them.

5. Progress was slower than the teacher wanted in the first 3 weeks, in comparison with his normal first year lessons. Groups found it difficult to get together and discuss work, tending to prefer working alone. Because they would not share thoughts in an organised way tasks were not delegated properly and individual work was less efficient.

After about three weeks there was a considerable improvement in communications and effectiveness, but it was difficult to ascribe this to particular factors.

6. The groups were physically close due to limited space. This appeared to facilitate inter-team communication, much of which was not work focussed. The simulation was not building and focusing attention as well as it might due to these off-the-point conversations.

7. Informal conversations with individuals and teams indicated no experience by pupils of this type of team work. They had typically worked in pairs in primary and early secondary classes, simply sharing text books.

8. Children found the mathematics difficult. The level involved was within their ability as reported by the Mathematics department. During week 3 I listened very closely to one team discussing costings. There was much active discussion but they did not find the calculations easy. The public nature of the discussion may have dampened confidence.

9. By the end of the second week the groups had to decide which of the individual initial ideas, completed for homework, would be adopted. The teacher had not given guidance as to a strategy. There was evidence of some good evaluation and open-mindedness, though perhaps half of the pupils 'fought their own corner'. In some cases strong personalities came to the fore and forced adoption of their ideas despite relative merit.

10. The computer programme was introduced in week 3. The teacher chose not to emphasise the competitive element.

11. A larger room was used from week 3. It was noticeable that the rate of activity started to rise rapidly from this week. This may be partly due to the groups being separate enough to focus internally but it could also be due to improved understanding of the task. The teacher blamed himself for the slow start, explaining it was due to inexperience and lack of confidence with the approach.

12. By week 3 groups were getting the idea of competition against the others. One team deliberately left false information around in the hope that it may mislead others. This is also an example of initiative. In contrast with this, one team left their company data on the screen, unprotected by the password. They not yet internalised the concept of competition in this context. It could have been forgetfulness, but when I talked with them it was clear that they did not understand the consequences involved.

13. There were many opportunities for micro teaching in which it was possible to develop concepts connected with the brief. It was impossible, however, to ensure that all pupils could benefit from these opportunities, even using the end of lesson class debrief. This frustrated the teacher.

14. A number of situations arose in which the teacher was unsure whether to intervene. Typically a `low ability girl` who had a strong personality was leading a team, but poorly. Cases were decided on their individual merit. The teacher tried to pull such observations into the end of lesson summary without embarrassing specific pupils.

15. There were some cases of groups where a fertile individual provided all the ideas and others simply accepted his/her ideas. The teacher was concerned on how to react to this, ie how to ensure that all pupils pulled their weight. He was reluctant to allow this to emerge at end of lesson debriefs.

16. One lesson was observed by a Mathematics teacher who was very enthusiastic and made the observation that; *This Is the total curriculum!*

17. We became concerned that some of the activity may be based on pupils assumptions which may be wrong. Due to the method of working it was not easy to check whether this was the case.

18. The computer was a log-jam when it came to entering data. A second terminal would have helped. The computer programme was popular but they were having difficulty grasping the idea of using it to experiment with 'cause and effect'. Discussion with teams revealed difficulty in separating the 'real' exercise from the simulated exercise in the computer which they could experiment with. There was a tendency for the whole team to go to the machine and put numbers in. There was little fore-thought or logical procedure. The teacher had not planned or given a specific structure for this. My own work, to date had been with older pupils who had managed this aspect far better. A clock could be inserted in the computer programme to charge teams for time in use as both a degree of realism and to encourage teams to plan for computer use.

19. By the debrief of week 3 most teams were beginning to internalise team skills such as handling several strands of the work in parallel. Initially they had all tended to work to a linear plan after the selection of direction from individual ideas.

20. In one team the two girls were forceful but 'not too bright' (teachers phrase). When one of the boys was absent in week three the effect on the other boy was most noticeable in that he withdrew to a large extent. On the return of the other boy he became more involved again.

The teacher was very concerned as to whether he should intervene to assist this team. His lack of confidence in handling the situation was apparent, thought this may be partially due to my presence. He was also constantly worried about the fact that unforeseen problems may come up. This form of teaching gave him less direct control than he was used to.

21. During week 6 the computer 'lost' the data entered so far. This caused considerable frustration amongst the teams and the teacher decided he would proceed without it. The structure of the scheme allowed this.

22. A video on industrial packaging techniques was shown during week 6. This lasted 10 minutes and was directly relevant to the task. It was

noticeable, however, that on returning to the working area from the video room, it took some time before the groups reformed and worked properly.

23. Groups were beginning to evolve better decision-making strategies. Some were simple, such as drawing lots, but others involved allowing each individual a short time to describe his or her idea followed by discussion and vote. These observations were brought out in the end of lesson debrief in week 6.

24. During week 6 the teacher introduced a short costings exercise as he was concerned about pupil ability to handle costings so far. He had prepared a handout and delivered the exercise in the room while the pupils stayed in their teams. This time they did seem to get the idea very well. This may be due to the fact that they had already been through it before; better teaching, or the more concrete nature of the task now that they all had real examples before them.

25. The teacher took the majority of week 7 out in order to give input on graphical technique. This had been planned but for a far shorter time. This appeared to divert pupils from the building of the simulation. I felt the teacher may have been wanting to 'regain' some personal control, but could not confirm this without compromising my 'advisory' role and the relationship built up.

26. Children took some weeks to realise that they were expected to use the teacher as a facilitator and not as a direct resource. Typically they would ask questions the answers of which they could have arrived at themselves with a little thought. To some degree I felt these were attempts at 'fishing' for feedback from the staff. I did not communicate this to the teacher but by week 7 he said that he had become concerned about the amount of feedback he had been able to give the class. Normally he would have had several homework and project work marks by this stage. There was the danger that the feedback he felt he could give them was that based on the easily assessable rather that the more abstract concepts involved.

27. During week 8 it was apparent that after the register was called several groups immediately met and reviewed the situation without being told to - team work was starting to come together. There were many

examples of good thinking coming out in discussions with individuals and groups.

28. The teacher introduced a short demonstration on logo design in week 8. The logo would be done individually, justified by him on skills input terms. This had not be planned originally and my discussions with him revealed again an underlying fear that he was not getting enough concrete feedback on the pupils, I feel that this was the real reason for the logo exercise. The sudden move limited continuity in building team work, but they did return to it reasonably quickly after the exercise ended.

29. By the final week it was apparent that more time was necessary but the roundabout system in the school prevented this. This meant that the products were not as well finished or evaluated as the teacher wanted. The teacher remarked on the difficulty of estimating pace when he had no experience of this form of working. All the groups, however, did meet the deadline.

30. The market place exhibition was put up early in the final week and the pupils assessed each team by placing 'orders'. Other teachers came around during the next few days and gave feedback in a similar manner. During the final session the team were split , half completed a questionnaire designed by the teacher, half completed a Nominal Group Technique exercise (7.00).

A general discussion/feedback session was held in the last 10 minutes. Feedback on the 'commercial' success of the products was given one week later, but this had to be very brief as they had moved to a new area.

7.00 Nominal Group Technique

The technique was explained to the half class and it was decided that I would remain with them to help guide it. As I was not a teacher and had never adopted a teacher like stance during the project it was hoped that they would feel relatively free to comment.

7.1 Results

Statement	Mean	StDev
Good project	4.75	0.707
Confusing at times	3.875	1.125
Needed more time	5	0
Not everybody worked equally hard	4.25	1.164
Prefer to work with friends	4.875	0.353
Voted for prototype	3	1.927
Parents help was good	4.625	1.060
Good to work in groups	4	0.925
Some aspects were difficult	2.875	0.991
Good practice for when leave school compared with normal school work	4.625	0.774
Useful to help each other in the team	4	1.069
Agreeing is sometimes difficult	4.75	0.707
Peer criticism of project tends to be negative	4	0.925
Marking can be unfair	4.5	0.534
Would like to do it again	4.75	0.707
We understand why the groups are mixed	4.571	0.786

During the NGT exercise pupils were also asked what they felt the ideal team size would be for this type of work:

Ideal team size (response with size)	4.571	0.786

Note. - individual responses- 2 - from 3 Individuals
3 - from 3 ''
4 - from 1 ''
6 - from 1 ''
9 - from 1 ''

8.0 Questionnaire

This questionnaire was developed by the teacher and was intended to evaluate both the project itself and the way of working. No attempt was made at piloting. The group consisted of 8 pupils. The questions which are relevant to this enquiry were:

How much did you enjoy this project?

Which part in the designing and making of this project did you enjoy most and least?

What unforeseen problems did your project pose during the making phase?

The majority of answers focussed on the practical aspects which are common to all design and make projects, whatever their organisation. Nevertheless the following observations did emerge, no attempt has been make to quantify responses as the numbers are small:

1. The variety of work offered interest compared with the narrower focus they were used to in normal teaching.

"I enjoyed the project a lot because I'd never done anything like this before".

2. Problems in "doing totally different packaging from each other" (ie lack of coordination within the team).

3. Problems with "people not doing what they were supposed to do".

4. Choosing own team members rather than teacher imposition was frequently mentioned.

5. "----it's horrible when people criticise your work".

9.0 Discussion

This trial raised a great many points which shall be discussed under three main headings: teacher aspects; structural aspects; pupil aspects. Whilst it was necessary to categorise in order to manage the data much did not fit neatly into one category.

10.0 Teacher aspects

This trial was the first in which a teacher generated and ran the scheme. My role, whilst participant observer, was played as subservient to the teacher. Whilst this relationship 'worked' the teacher felt uncomfortable. This was due to an interplay of factors:

The approach was unfamiliar, different from the normal teaching approach adopted with such a team.

He was unaccustomed to being shadowed so closely.

He was putting into practice concepts I had developed, in my presence. I would have felt uncomfortable had the roles been reversed.

1. As the work progressed the teacher gained confidence and our final debriefs indicated that he had gained a great deal from the experience and was ready to attempt another trial. The final result was positive but it is interesting to chart the development of the teacher's reaction.

2. The poor result of the warm up exercise (6.0/1) followed by the slow progress over the first three weeks clearly caused the teacher concern. Discussion and observation point to his concern of not being totally 'in control'.

3. The teacher was used to lessons with this age range where the work was largely prescriptive and design projects were structured in such a way that his experience enabled him to predict and control directions with inputs of knowledge and skills. The approach in this enquiry was relatively open-ended and there were fewer opportunities to give inputs. Such inputs, whilst normally seen by teachers as being about the transfer of knowledge

and skills, were also very much to do with control of the learning situation, direction, pace and the reinforcement of the teacher's own role within it.

4. Related to the above was concern over what knowledge and skills the pupils were able to take with them into subsequent years in the school. The teacher became concerned that the normal foundations were not being laid and that this would have ramifications for his work with the pupils subsequently. This raises the issue of content versus process in Design and Technology education. This trial preceded the National Curriculum Technology which has a process led approach.

5. We should not underestimate the stress innovation in teaching methodology can cause individual teachers. Whilst my presence was a source of concern I was also able to give support in the debrief sessions, this would not have been the case if the teacher had only written guidance.

11.0 Structural aspects

The warm-up exercise failed to work as the teacher had hoped and this meant that the pupils started the main phase without the positive feedback that it should have generated. The next three weeks were difficult as the pupils came to terms with the approach adopted. Had the warm-up succeeded it is presumed that this period would have been shortened.

1. The teacher had attempted to adopt virtually all the factors of the pre-enquiry work with the exception of the suspended timetable. It had been assumed that as the pupils were used to group work in the primary phase they would have little difficulty adapting to the approach described. This proved not to be the case until well into the scheme.

2. Whilst pupils were used to working in groups they were not necessarily working as groups prior to this experience. Discussion with pupils (6.0/6,7) showed this to be the case.

Children were placed in random teams, this meant that their usual friends were not necessarily in their team and they tended to look outside the team for advice and social contact. This depressed the establishment of a team unity and purpose. It may have been more appropriate to allow peer group

choice of teams to minimise this problem. Nominal group technique (7.1) showed "prefer to work with friends" as the second highest factors with a mean of 4.875/5. Possibly methods of team selection such as social engineering or random selection should be used only after pupils have gained some experience of teamwork via peer group teams. NGT showed a positive attitude to teamwork in "we understand why groups are mixed" 4.571/5 and "good to work in groups" 4.0/5. (They used the term `group`).

3. There was some evidence for social loafing in observations (6.0/15) and in NGT (7.1) ("not everybody worked equally hard" 4.25/5). To some extent this was observed in relation to strong personalities who were pushing forward their own ideas. In these cases there appeared to be a tendency for some members to take an easier line. We might differentiate this from social loafing by recognising the reaction to a more dominant personality rather than a simple wish to let others do the work.

Careful team selection and inputs on decision making techniques may help. Similarly it may help to raise the problem in debrief sessions (no names mentioned) to sensitize pupils to the problem and encourage participation.

4. Observations indicated that as teams had not been allocated a work space (6.0/2) there was a considerable amount of movement in the early weeks while 'territories' were established. This movement meant that there were increased opportunities for conversation with friends in other groups. These conversations were usually social and so limited team formation. It would have been better to allocate areas to teams from the start so that movement was limited in the team formation phase. The work necessarily calls for pupils to move about in a practical area and so could not eliminate inter-team contact.

5. The class started work in a rather cramped room (6.0/6) and the physical closeness of teams allowed easy communications. In week 3 the class moved to a larger room. There was an improvement in intra-team focus which could be due to outside contact being less easy, but we cannot discount simple maturation of team to task. Assuming that space is a factor we could hypothesise that in future events the teams should have a degree of privacy - perhaps low screens or simple barriers which may help to focus inter-team attention.

6. Pupils found the mathematics difficult (6.0/8), despite liaison with the mathematics staff. This appeared to show a lack of transfer of mathematical skills and knowledge into a new context. This may be the case but the reasons could be complex. The public nature of the work may have caused a lack of confidence. It was impossible to draw any firm conclusions at this point other than to note that this phenomenon had been observed whenever I have tried to use similar techniques with pupils, undergraduates or teachers. It is an area of concern that merits further investigation.

7. 6.0/9 noted that teams had to devise their own decision making strategies. Whilst many of these proved useful there were cases of poor strategies, usually force of personality. Nominal Group Technique (7.1) showed "agreeing is difficult" as being the second highest factor with a mean of 4.75/5. It may be beneficial to include decision making as an input topic. Doing this pro-actively rather than within debriefings, however, will increase the number of inputs and detract from the growth of focus on team and task.

8. The computer programme, intended to offer structure and relieve the teacher to some extent, was a mixed blessing. This has been discussed in 6.0/18 and 6.0/21. Future work with young pupils would need to show them how to make good use of the programme. Additional computers would relieve the log jam.

9. Time management within such a structure is difficult. Nominal Group Technique showed (7.1) "needed more time" as the highest factor with a mean of 5/5 - perfect agreement. Having said this the children's reaction was not negative, the statements "good project" and "would like to do it again" score highly at 4.75/5 each. The feeling amongst the class was more of exhausted satisfaction with a little frustration. More time would have helped complete the task fully but would have lowered the urgency which became an obvious feature.

12.0 Pupil aspects

1. The reaction to groupwork was positive as discussed above. One interesting factor to emerge, however, was a unease about what pupils saw as 'cheating'. The homeworks which were intended to actively involve

parents were reported in a slightly embarrassed manner, the pupils appearing to feel it was not correct as the parents had 'done their homework'. Discussion revealed attitudes whereby work was a private thing and that discussion with others was 'cheating'. This attitude would limit the effectiveness of team work where pupils should share ideas. This case study did not generate enough data to go further than this but it is a factor that could be considered when planning long term development of team work skills in schools.

2. Despite prior group work experience in primary schools, pupils did not find team work easy at first. Some structural aspects have been discussed in 11.0/2. Here we look at aspects centred around pupils. At first groups easily broke down, members moved around and joined others before returning. The idea of competition was not strong and the teacher chose not to emphasise it. It appeared that pupils did not see teams as having boundaries.

By week 3 the concept of competition was beginning to be internalised. In 6.0/12 of one team deliberately left false information out for another to see. Nevertheless this was only one team, others were failing to grasp the idea that they were competing. The issues were raised at debriefing sessions, but the teacher was reluctant to develop competition as far with this year 7 class as I had done with the years 10 and 12 in the pre-enquiry events.

3. The interpersonal effects were most obvious. Force of personality was the factor which tended to have the greatest effect. 6.0/20 gives an example of forceful girls causing a boy to withdraw when the other boy was away for a week. This is a complex area and one which we cannot totally manage in a real classroom situation, but improved knowledge of the pupils can help. Turning to the question of progression rather than one-off experiences, careful consideration is needed of how to bring out the inter-personal skills necessary. In the long term we can expose pupils, with support, to a wide range of situations which will develop their ability to work with others.

4. Relationships between teacher and class were very different to those this teacher was used to (6.0/26). Both parties found `teacher as facilitator` to be difficult. The need for immediate feedback for both parties was evident. This led to inefficient use of the teacher, answering questions that the

pupils could easily have thought out and the teacher giving certain inputs which it appeared were subconsciously designed more to give him feedback than put over knowledge. This needs to be considered amongst factors for progression.

13.0 General conclusions

1. Feedback from both teacher and pupils was generally positive and all hoped to repeat the type of exercise. It was clear that if repeated with a fresh first year group it would need re-structuring.

2. Team size could be reduced to two, but there was no evidence to indicate that this would be beneficial though it would make initial team bonding and subsequent communications easier. Possibly of more benefit would be to use teams of four, two boys , two girls but allow friendship choice for pairs (presuming, at this age range, they will tend to be single sex pairs).

3. The warm up phase could be extended to include a series of inputs to get over a wider range of knowledge and skills such as decision making strategies. Similarly, further necessary inputs could be programmed into the scheme, possibly being done immediately at the start of a lesson so that it does not break down the team identification with the task once the main work has started.

4. A teacher working on his or her own in this manner should be encouraged to keep the event simple and possibly include more 'content ' based inputs than in this example so that they maintain a higher level of personal confidence. Progression of experience is as important for teachers as it is for pupils.

5. Defined team bases should be used together with space to help intra-team and task focus and cut down on unnecessary inter-team communication. This may mean employing subtle space delineating devices such as use of coloured sugar paper on the wall by each team as well as more obvious techniques such as partial barriers. Privacy needs to be given without the teacher loosing command of the situation by creating blind areas.

6. Inputs could be given by specialist staff, for example mathematics to help bridge the 'boxes' of the curriculum. This would need careful observation and research in itself as it may perpetuate the idea that maths is only done in certain settings - in this case with certain teachers. Nevertheless this may be a useful bridge into team teaching such experiences (see account 3).

7. If computers are used there need to be enough of them. Pupils need helping to think about what they are going to put into the computer so reducing the amount of 'on machine' time. Time could be 'booked', so helping focus attention on what it is to be used for and this may also limit the problem of the pupil who uses the computer to escape from personal contact within the team as had been observed in the pre-enquiry residential events.

8. A suitable resource base needs to be very obvious in order to encourage use. This may go some way to establishing the teacher as a facilitator rather than as a simple database of facts.

9. There needs to be careful thought to progression rather than treating such exercises as one-offs.

Appendix 3

Case account 3

1.0 Background

In 1987 I was contacted by the Head of Personnel Development for Nestlé (UK) after he had read one of the articles based on the pre-enquiry work in this area (Transition March 1987). He had approached the Chief Education Officer (CEO) of an LEA local to the Nestlé (UK) headquarters with the aim of introducing similar approaches/events into schools. A link was set up where myself, Nestlé (UK) and the LEA were to design and run an INSET course for teachers. The INSET would cover the principles outlined in the article and start the process of helping teachers to develop the approach in their own schools.

The INSET was designed and run, over four days, at the Nestlé Training Centre in early 1988. Four teachers from each of six schools attended, each school providing a `senior manager` and teachers from a spread of curriculum areas as it was intended that the approach would be cross-curricular in nature.

The `contract` with the schools was that each group of teachers would develop an appropriate learning event in their own school and report back to the group as a whole at the Nestlé headquarters in July of that year.

This account focuses on the results of that reporting back rather than the INSET event.

2.0 Key purposes (research)

To give a group of teachers INSET on the approach under enquiry and observe application in schools.

3.0 Key developments

The teachers would design and run events in their own schools without direct contact from me.

There were 24 teachers operating from 6 schools, representing the largest sample I had been able to work with.

4.0 Evaluation techniques

The schools evaluated their events by a variety of means including: teacher observation (a minimum of 4 per school, triangulating these observations); pupil feedback by questionnaire and/or discussion post-event; outside observer, for example a vice principal not directly connected to the event.

At the Nestlé headquarters meeting each school gave a 30 minute presentation. This was followed by 20 minutes of discussion per school where I or any other observer could ask for clarification. These proceedings were recorded on audio tape and notes made on essential points, backed up by reference to the tapes.

An independent evaluator was appointed by the LEA at the start of the planning process. He was commissioned to observe the whole process and write a report. Aspects of this report have been included in the notes below.

5.0 Schools` reports - Nestlé headquarters 5 July 1988

The format for this section will be to record the general approach of each school and the observations they made. Finally these observations are discussed as a whole.

5.10 School 1

Class: year 7, single class

Time: suspended timetable for one day

Method: The rationale was to use a "difficult" (sic) class in order to demonstrate to other staff that the approach was possible with more difficult classes. The class teacher was one of those from the original course. Support was available from 2 advisory teachers who observed the day.

It was felt that this exercise would make a good bridge between junior and secondary school practice. It was decided to capitalise on the recent change of school name by using the design of a school bag incorporating a school logo as the brief.

A number of inputs were planned: mathematics for pattern and tessellation of fabrics; fabric department for assembly and fastenings; IT for graphics; English for communications.

The pupils were given one week warning of the event in order to research the area. Once the day had started the 'time out' concept was used on several occasions, the staff feeling this was very useful. The pupils were expected to organise their day fully , including breaks etc.

Staff reported that many relevant teaching points arose unplanned and that these were valuable.

The level of activity caused some problems in that staff had difficulty 'winding down' pupils before the lunch break. It was reported that the debrief was also used to help pupils `wind down`.

Evaluation was carried out by observation during the day and informal discussion in the following day's registration

Observations

1. Staff remarked on the amount of planning time required. They had used their planning time on the INSET course effectively, quickly putting together the general concept, nevertheless they felt a great deal of extra time was spent in school prior to the event. They were unable to quantify how much time they used for planning.

2. Staff found the concept of 'time out', introduced on the course, to be useful. This was particularly the case for 'micro teaching' opportunities and for control in terms of settling down an often hectic pace. Children seemed well able to switch in and out of the simulation in relation to the fairly short time out sessions. How long such a session can be before it is difficult for pupils to switch back in is a question for further investigation.

3. Staff were interested in the number of micro teaching opportunities that arose and appeared very pleased with the use they made of them.

4. Children quickly adopted roles within the simulation and demonstrated initiatives which staff had not introduced. Such initiatives were taken from the children's experience of the world such as working on market stalls. It would be interesting to find out whether the use of personal initiative in these situations helps raise children's own self confidence and self esteem by virtue of demonstrating an independence of staff.

5. As indicated earlier the experimental class were classified by staff as 'difficult'. Staff observed that 'bullies' did not act in their usual manner, but cooperated in the teams far more than they would in a normal teaching situation.

6. Children quickly learnt that they had to get around to find information out. To what extent this is due to the experience itself or to their 'normal' education is a point that requires further investigation.

7. A video was produced and backed staff claims of a very high level of endeavour from the pupils. In a similar vein the reporter and photographer from the local newspaper also stayed far longer than intended, as they also got very involved. Certainly a very infectious atmosphere was developed during the day which carried pupils, staff and visitors along.

8. An interesting observation was that staff felt the pupils showed a new type of respect for the staff in this situation. Following the exercise the pupils got together and produced a thank-you card for the teacher, an unusual event from a class considered 'difficult'.

9. Staff concluded by saying they saw the experiment very positively. They pointed out that they saw it as a pilot for future events and also as a bridge between good primary school practice and upper school work.

5.20 School 2

This school found it very difficult to re-engineer the timetable for a consolidated experience. Instead they opted to work with normal classes within the timetable.

Classes

a. Art - year 10, mixed ability. Two classes were used.
b. Home economics year 9, textile class. Low ability generally and with considerable motivational problems.
c. Science - year 8, mixed ability.

Time

Within the normal timetable. Art, 8 weeks of 35 minute lessons; home economics, not a fixed length of 1hour, 10minutes per week; science 4 weeks, 1hour 10 per week.

Method

Art. The topic was to design and promote a board game, the aim being to use the approach to broaden the traditional methodology used. The teams were left to decide which areas of the market they were aiming at. Both classes had previous experience of group work within that school but a more precise statement of this was unavailable.

The teams were assessed by the teacher on the basis of their designs, the practicality of that design and their economic awareness. The teacher specifically stressed that she did not want "over emphasis" on the money/profit element.

Home economics. Here the topic was to design and market a hot water bottle cover. The teams were peer chosen, though the teacher allowed some to work individually and one larger team of 6 to form.

Science. This member of staff was the most reluctant to involve himself in the approach. The topic was "The great egg fall", packaging to protect an egg when dropped. In presentation information was thin.

Observations

1. There was a distinct difference in the approach of each class due to factors in the formation of those classes rather than the teacher or material. Class A was motivated, well organised and made democratic decisions after discussion. There were some "flat periods" which needed inputs and redirection but on the whole the class responded well.

Class B was more diverse in it's response, some of the teams were negative at times, though not consistently so. The teacher felt this may be because they had not done group/team work for some time and they had lost some of the necessary skills. She pointed out, as an illustration, that work sharing within these teams was poor. The other teams had, however, had a similar break since last doing group/team work. The reasons for the diversity cannot be hypothesized without considerable first hand analysis which was not possible in this case.

2. The teacher reported that parental involvement was high in this project. This was a subjective observation but valid in comparison with other work she did. The project and approach may well have increased parental interest.

3. It was observed that pupils were very sensitive to curriculum areas, sometimes resenting "doing maths in an art lesson".

4. At year 10 level the teacher expressed concern at the need to be generating personal coursework for GCSE, he saw this work as not fulfilling this need.

5. In the home economics class the teacher showed a low level of confidence in operating in this manner. The work sheet produced was not to the high standard produced in all the other trial teams and this, together with her obvious reluctance to socially engineer the teams may well have combined to mean that the project started without building the motivation necessary.

6. The teacher did recognise and point out many cross curricula opportunities within the project, despite the fact that it was operated within one area only. In this respect she had understood the concepts involved but lacked the confidence to operate the approach with such a `difficult` class.

7. There were operational problems in terms of pupils needing to learn practical skills and knowledge which the teacher felt her system had not surmounted. Similarly the teams were unwilling or unable to plan their approach. She also pointed out that some pupils opted out.

8. Within the science class the teacher felt that the debrief was the most valuable aspect, especially when discussing team work. He felt this class were quite used to group work and hypothesized that it was due to their relative proximity to primary schools and the use of groups there. The teacher pointed out that the class saw great relevance in using team work.

General points

9. The staff felt GCSE practical assessments considerably limited their options and that it will be easier to operate in the autumn term. They recognised that blocking time would help and that cross-curricular staff links were needed in order to supply all the necessary skills.

10. It was felt that extra staffing was needed to operate the approach. Whilst they had operated within single areas they were interested in expansion and school working parties on technology and business studies were expressing an interest in the concepts involved.

5.30 School 3

This school started by pointing out that they saw their main aim as being to absorb the concepts of the approach into the curriculum as a whole, so making it redundant as a separate exercise.

Classes

Three different approaches were attempted:

Within normal classes and timetable; team taught classes within the timetable and a specific exercise using the approach intended as an opportunity to show other staff the concepts and methods. In these cases teams were formed both by peer choice and socially engineered.

Observations

1. Within maths and English, projects were attempted. Within English pupils were used to group work but staff reported variable response to the work. Staff admitted that motivating this third year mixed ability class with a project on poetry was a problem. There was no commercial factor in this project, the `teams` (groups?) finally gave verbal presentations to the other teams.

2. The maths staff attempted two exercises, one to design and make a 1 litre container and market it and another for a credit card holder. Groups were self chosen.

The maths staff remarked on the number of `extension` teaching points that the projects raised, they were felt to be of particular benefit. They also pointed out that whilst operating in the normal timetable time limits need to be firmly applied.

The `staff team` taught teams (within timetable) progressed reasonably well, thought staff remarked on the following:

3. Some teams splintered over the project, one had a very dominant individual.

4. In the main exercise, to design and market a form of school specific filo-fax, the response was generally very good, teams were selected on a random basis. Staff reported that some frustrations were experienced in shortage of materials and that some pupils were too interested in getting on with the job to plan properly.

5. An interesting point was the use of pupils as independent evaluators. In addition one member of staff acted as an evaluator, reporting she felt the exercise went very well. Further work is planned.

6. Staff who had not been on the INSET course responded very favourably, particularly pointing out the team work - resolving problems due to individualism and the commercial environment.

7. There were worries amongst staff as to when and where to intervene and how to assess. Evaluation was primarily by questionnaire and staff reported they felt the vast majority of pupils responded accurately and responsibly. There were a few cases were pupils did not respond sensibly but staff soon became aware of these.

8. The staff who had attended the INSET were very positive about the concepts involved but felt it difficult to communicate them to the rest of the school. The official staff INSET days were already booked up for the year, however, good use was made of the cascade model by involving other staff in the exercises. Response was reported as good.

5.40 School 4

Classes

A pilot class (year 8, top set home economics) operated in normal timetable slots, after this the normal timetable was suspended for the whole year 9 to do the same exercise over one day. Groups were formed of pupils who did not normally work together. This was an all girls school.

Time

Initially within normal timetable and then culminating in a full day.

Method

To design and market puppets and a theatre. Groups worked for a number of weeks in several subjects in the normal timetable where work was orientated in the project direction. Four areas were involved, drama, CDT, home economics and R.E. A deputy head acted as an evaluator. Within drama inputs were given to the whole class on research, similarly other staff gave various inputs on aspects such as evaluation. The class was given this information as a whole, the technique of individual "representatives" feeding information back to colleagues was not used. Evaluation was by observer (deputy head) and pupil questionnaires.

Observations

1. The topic was chosen as one suited to the age and interests of the pupils. Staff recognised that a trip to a primary school to establish context would have helped.

2. This school was reluctant to enter fully into the commercial environment and used a points system for peer evaluation rather than a commercial environment.

3. There was evidence of poor planning in some of the teams. Staff commented that they felt that more experience of this form of work earlier in the school could minimise this problem.

4. Both pilot and whole day exercise were based on staff expertise within the school. Staff reported that involving outside agencies would have advantages but was difficult in the timescale available.

5. The Deputy Head acting as an evaluator summed the one day exercise up as a "resounding success", pointing out that virtually all the pupils were very enthusiastic about the approach. The staff were very committed to the approach and intend to experiment further in the next school year. In addition the school was entering the TVEI scheme in September of that year and was looking forward to using the approach within that scheme.

5.50 School 5

Classes

Year 12 CPVE students, repeated with 'A' level students. Arranged in teams of 4 by staff on a random basis.

Time

2 days, suspended timetable.

Method

The design and production of a book for slow learning pupils in the local special school.

The staff attempted to get outside agencies such as a publisher involved but failed in the time available. Staff provided all inputs an support.

Flexible breaks etc were allowed, more easily achieved with year 12 students.

Observations

1. There were several contrasts between the CPVE and 'A' level students. Staff felt the 'A' level groups were more resourceful and democratic in the way they approached the project. Both sets of students exhibited a very high work rate, including a marked reluctance to have breaks or leave at the end of the day. Staff felt that they would have to talk to students about pacing their work if they were to operating on longer term project work. The sense of pressure was very noticeable, but in a positive manner.

2. A variety of team work styles were adopted. It was noted, particularly with the `A` level teams, that when individual work rates varied the team

tended to accept the member with a current low work load on the basis of their increased load and contribution earlier.

3. One team did disintegrate when it suddenly came across a problem, one student was left to tackle it.

4. With the 'A' level students the technique of only one "representative" attending inputs was adopted.

5. Senior management within the school was positive and it was on this basis that the second cohort was run, nevertheless staff commented on the need for planning time.

6. Staff used a record of achievement with the CPVE group, looking at initiative, perseverance, imagination etc.

7. It was pointed out that students saw staff in a different, and more positive light due to the different working practices. Staff felt that working together as a team helped their relationships and working practices.

8. Both cohorts ended with a Nominal Group Technique evaluation which staff described as very positive. Points raised included an appreciation of the need to compromise both in terms of the project itself and when working in a team. Students appreciated the none-interference of staff. They also commented on the infectious effect of the approach on students who, at first were reluctant to enter fully in to the exercise.

9. Finally the staff, as with several of the schools, registered unease as to the commercial and competitive concepts.

5.60 School 6

Classes

Year 7, whole year group of 5 classes, mixed ability.

Time

2 days, suspended timetable.

Method

Badgemaking companies were set up, following the concepts described in the INSET. Staff saw senior management support as essential for further development, they initially planned `in secret`, making a point of building suspense amongst other staff. One week before the event a display was put up in the staff room to explain the project. Staff we asked to tick a staff list to show who had read it. Such was the interest generated that all staff asked to be allowed to attend when they could.

A video was made of the event both to record for evaluation purposes and to act as a way of promoting further events.

One floor of the building was taken over in order to facilitate the logistics and control of the exercise.

Inputs were organised in parallel, ensuring delegation and the need for reporting back to teams.

Senior management was used to evaluate the exercise. This achieved the aims of a good standard of observation and feedback to the organising group of staff and also informing senior management of progress and potential.

Observations

1. The video showed a most successful event, demonstrating staff commitment and enthusiasm together with a similar enthusiasm in the pupils.

2. There were some problems with team work aspects. One team required a great deal of counselling to smooth over antagonistic feelings to each other. Similarly it was found that the standard of reporting back to the teams from inputs was poor. This particularly affected the costing part of the exercise, staff having to intervene to ensure this was done correctly.

Staff pointed out that they felt they learned a great deal more about their pupils working in this way, more so than conventional teaching methods. There was more opportunity to observe and intervene on an individual level than in conventional lessons.

Staff were so pleased with the results that they intend to develop the exercise for next years first year and also to carry a further exercise forward into the second year.

6.00 Observations on the school exercises

The following points are based on the experiences of the 6 schools in their follow up to the initial course. Data is triangulated by notes and recordings from presentations, notes from the external evaluator, notes from the visiting advisers and notes from the follow up meeting with LEA advisers, most of the schools` staff, Nestlé managers and myself - September 1988.

6.10 Teacher aspects

6.11 Planning

1. Planning for the school based events had commenced during the INSET course with the intention of ensuring inertia had been overcome. The short deadline in the remainder of the school year was also intended to keep the teachers` momentum.

2. Teachers reported that planning required a lot of time, though none were able to quantify it. Planning, in most cases, was done in cross-curricular groups which reported spin-off effects such as a better understanding of different curriculum area aims and working methods and a sharing of ideas which could be applied generally. This was not normally the case as staff tended to work in curriculum area groups.

3. Planning time had been aided by the use of several hours supply teacher cover in most cases, however it was pointed out and understood that the eventual aim was for planning to be carried out within the normal time available. Whilst initial planning time may have been high it was unlikely to have been much higher than any other new work in a single curriculum area, though increased by the coordination needed by the cross-curricular aspects. Like any new work, initial planning takes a great ideal of time but once it has been implemented it could be used again, even when modified. It was seen as important that the schools built a `library` of experiences which they could all tap into to save much work in planning events. This library would consist of a case study of each experience together with examples of all materials produced.

4. Some teachers saw importance in using the approach in year 7, when primary practice was fresh in childrens` minds. To introduce the approach in later years was seen as inefficient, though some schools had to do this for their initial experience. Several schools pointed out that they saw an expansion in their planning to cover each year group as they move up through the school.

6.12 Teacher confidence

1. Teachers were worried about their ability to communicate the concepts of the approach from INSET back to colleagues. The 'contract' between teachers, principals and the LEA called for developments within the schools and whilst a part of the INSET had rehearsed the difficulties of innovation in schools, even those schools which had had particularly successful exercises still lacked confidence. This was most noticeable amongst those schools where the in-school exercises had not fully used the concepts introduced in the INSET.

2. Most schools had put some form of presentation to colleagues on their return from the INSET. Some had used staff who had not attended the course in the planning and execution of the course in order to introduce them to the concepts. In these cases it was reported that staff entered fully into the spirit and both learnt and contributed fully.

3. What emerged was that some teachers were less confident than others. This also became clear at the presentations in respect of their introducing the approach in their schools. Some schools had entered fully, utilising most of the concepts discussed, whereas others (for example, school 2) would only introduce some concepts, resisting those more difficult to engineer or more dissonant to their own concepts of teaching such as competition.

6.13 Support

The support available to teachers in the planning and execution of their experiences was limited to some supply teacher cover. Advisory staff who had attended the INSET visited several times to discuss and also to observe. Teachers felt exposed in planning and running the first event. Whilst it is recognised that they must be able to work with the normal resources of the school, it was decided by the LEA to offer further support in a similar manner into a second year. This would have the effect of supporting teachers both directly and psychologically in that it would legitimate the activity in the eyes of colleagues.

6.14 Support/liaison from industry

Non of the schools were able to use industry or outside agencies as a part of their exercises. This is a source of concern as it is an important plank of the approach. In a similar vein few embraced the commercial or competitive elements. This was partly due to the difficulty of getting industry to agree to support in the timescale available. However, it is possible that teachers were reluctant to approach industry effectively and use the concept of commerce. There is evidence of this in both NGT results

from the INSET course and subsequently the teacher presentations (5.20; 5.50/9).

Gaining access to industry and establishing working relationships is far from simple. Teachers will need specialist assistance in this respect from colleagues and/or advisory staff.

6.15 The relationship with GCSE coursework requirements

The point was made by several teacher that events using teamwork approaches could not count towards GCSE. This is not strictly true (see section 4.0) but the essential point is that teachers were concerned. The effects are likely to be that teachers will avoid using the approach in years 11 and 13.

7.00 The approach in action

1. The results point to a high rate of pupil endeavour (the word infectious was used by one school) and high pupil perceptions of relevance of the approach generally. More work needs to be carried out in order to analyse pupil perceptions in detail and directly rather than through their teachers.

2. There was a clear relationship between the number of concepts from the INSET used and the overall success of the exercise across the six schools. The schools which entered fully into the exercise reported very high rates of commitment from the pupils and high levels of satisfaction from staff as to the educational merit of the exercise. Those schools which did not suspend the time table and resisted concepts such as competition or commerce had proportionately less positive results. It It difficult to quantify these factors but the relationship appears to be positive, in that the most benefit accrues when the most concepts are included. Confidence in this finding is improved by the fact that the LEA adviser liaising between the LEA and myself visited all the schools during their events and her observations tied closely with the teacher reports.

3. This opens the question as to which concepts within the general approach offer the most return, a question for further enquiry.

7.10 Parental Interest

Teachers reported a high level of parental interest in the exercises. This was without any direct communication . It would appear that pupils reported their experiences to their parents who then showed interest via questions to staff via the pupils and also at parents evenings. Teachers report that this interest was completely positive and whilst this represents only a small percentage of the total numbers involved it does give an indication of positive parental support. In turn we may hypothesise that this increased parental interest may generate increased pupil effort.

7.20 Cross curricula aspects

One particularly valuable observation from teachers in planning and executing the exercises was a stronger awareness of cross curicula aspects in all of their teaching and planning, even when operating within their normal role. This will help build bridges in pupil understanding that teachers often fail to make.

7.30 Evaluation/assessment

1. There were concerns voiced during the presentations in these areas. Most schools evaluated using the techniques used during the INSET: triangulating observation by teacher observation notes, questionnaires, other observers such as senior management and in one case, NGT. None of the schools had used industrial links and therefore, could not use this as a further perspective. One school did innovate in using pupils as evaluators, putting them in an observational role. This was reported as being successful, though it was not reported how these pupils were selected for the role. This aspect merits further development, possibly offering pupils some form of observation schedule to aid focus on various aspects.

2. Teachers reported that pupil response via questionnaires and NGT was mature and honest with only a very small minority not reaching this standard.

3. During the exercises teachers reported some concerns as to when to intervene in aspect such as team work or the general direction of the exercise. This reflects some lack of confidence which is to be expected. These are complex, dynamic and individual situations in which hard and fast rules cannot be drawn. During INSET it had been suggested that teams and individuals should be allowed to come close to failure and helped, through debriefing, to recognise consequences. However, it becomes counterproductive if failure occurs, is very public and has negative effects on personal self confidence. Staff have a very delicate, professional tightrope walking act.

8.00 Pupil/team aspects

8.10 Generation of ideas

There was no evidence reported by teachers to support the hypothesis that team work develops a synergistic approach in the generation of ideas. The simulations used and the shortage of time meant that teams could not spend overlong developing a breadth of ideas if they were to complete a prototype to deadline. This mirrors commercial design practice where the emphasis lies on the honing of good initial ideas rather than a continual search for the 'perfect' initial idea before moving on.

8.20 Demonstrating initiative

1. Teachers reported that pupils quickly learnt that they had to get their own information rather than have it supplied directly, there were many anecdotal examples of initiative shown. Whilst the teachers did not quantify these effects they were convinced that the pattern was far higher than in a normal framework of learning.

2. Two immediate questions arise. To what degree was this initiative latent or at least learnt in their normal lessons? To what degree was this behaviour learnt outside school and transferred to the new setting. An

example repeated in most of the situations was the use of business/market place practice such as sales "patter" and techniques such as price cuts to attract custom.

This may well be a fine distinction to draw; was it transferred behaviour or a completely new behaviour pattern? Both result in an improved learning environment and, possibly an improved self esteem in the pupils concerned. They will have demonstrated an independence of thought and action which was rewarded in terms of the simulation. They will become to realise that the 'rules' that staff impose upon them or they themselves seek in any learning situation do not always apply and are in-fact often restrictive.

8.30 Staff/pupil relationships

Teachers felt pupils modified their views towards staff in a positive manner. They considered this was due to their role changing towards that of `facilitator`. Many pupils remarked on preferring the teachers willingness to 'give space'. Teachers reported that they felt the experience gave them time to observe pupils in action and discuss aspects on a one to one or team basis. It was generally agreed that this was beneficial, giving a better perspective. It would merit further investigation to see whether these improved relationships continue in the normal curriculum and whether teachers apply the technique of drawing away from the team in order to observe in their normal teaching.

8.40 Cross-curricular work

Initially many pupils found the cross-curricular aspects difficult, a typical comment being that they resented "doing maths in an art lesson".
Nevertheless teachers felt pupils quickly understood the relevance of the overall approach and eventually were able to leave behind the restrictions of the timetable.

8.50 Reaction to team work

1. The reaction to team work varied from school to school and within the schools as one might expect with such a diverse sample. In some schools staff allowed peer group selection, in others random allocation or active social engineering was employed. If the variety in interaction effects is added it was apparent that no two teams were the same. However, within the sample of schools it was possible to see that teachers felt that the most diverse, particularly negative, reactions occurred in those schools where peer teams were allowed. When teams were staff allocated they reported better pupils responses in respect of intra-team cooperation and team identification with the aims of the exercise. There is a complication here as there was a strong correlation between the schools which allowed peer team selection and those which were reluctant to fully embrace the concepts within the approach. This means it is difficult to apportion the observed effects of poor intra-team cooperation to the means of selection.

2. Teachers reported that pupils did recognise the importance of team work when staff explained this and they felt this did improve motivation, at least in the short term. It may be possible to hypothesise that some of the less successful teams were self chosen and of pupils who had less identification with education generally. This needs confirmation by further work.

3. Teachers felt that disruptive pupils were more cooperative within teams. This has reliability as several schools included 'difficult' classes in order to test the motivational powers of the approach. Again it is difficult to know how long this motivation could be maintained and under what circumstances.

4. In many cases members of a team came to the defence of a member who had been reprimanded by staff for lack of involvement. This was usually defended on the grounds that the individual had contributed in another aspect. This demonstrates a developing 'team spirit' in terms of mutual support but also a poor understanding of the management of the task by continual review and delegation of tasks. In some teams there were cases of individuals or sub-elements of the teams breaking away or becoming non productive, often with acrimony, from the rest of the team. Tolerance in interpersonal relationships is clearly a highly complex matter, however

these observations teach us something as to how these teams tend to gel and operate.

5. The 'time out' concept was used effectively by many teachers to intervene in aspects such as team dynamics. Pupils appeared to be able to quickly re-enter role after such a 'time out', but staff were not explicit as to how long these sessions were. It may be reasonable to hypothesise that longer periods will increase the difficulty in re-entering role, though more work needs to be done before clearer conclusions can be made.

6. It was observed that many pupils had difficulty `winding down` at the end of a working session. Whilst de-briefing sessions are primarily designed to analyse the period and promote learning they also have a role in lowering such tension.

8.60 Planning

Pupils were generally reluctant to plan effectively, there was a tendency to rush forward without thinking. This is a complex point, to some degree it may simply be due to enthusiasm built by the learning environment. It may be that the pupils were not capable of efficient planning due to lack of experience and/or poor briefing on this exercise. This is a factor requiring more investigation and action.

8.70 Communications

It was observed generally that pupils were poor at reporting back to team members. This may be partly due to impatience as above, but limited skills in communication must also be considered. Other aspects of communication appear to have been satisfactory, though data was thin.

Appendix 4

Case account 4

1.0 Background

This case emerged when I was approached by a Leicestershire Upper school for advice on generating a bid for support from the 'Six Counties' Joint Support Activity (JSA). The bid centred on the approach described in section 1.0. The school was successful and I conducted a one day INSET event for a group of 8 staff. The teachers aim was to plan a 5 day suspended timetable event within their own school. Financial support was available from the JSA to cover some planning time. The teachers designed and ran this event without subsequent assistance. This perspective was gained by interviewing two of the teachers involved.

2.0 Key Purpose (research)

To illuminate the transfer of the approach described in section 1.0 into an event designed and run by teachers.

3.0 Key Developments

Teacher designed event run following 1 day INSET.

68, Year 10 pupils, comprehensive school.

Suspended timetable, 5 days, - based in school.

4.0 Evaluation technique.

Post event interview with two staff from the planning and teaching group, an unstructured pair interview lasting approximately 90 minutes.

5.0 Description

This account looks at the design and running of the school based event rather than the INSET.

A staff group of 5 planned the event, with some supply cover over a period of 2 months.

68 pupils of mixed ability and gender were organized in teams of 4 or 5. The staff allowed pupils to choose a friend and then friendship pairs were put together by staff on the basis of a balance in gender and ability. This was only possible to a certain extent.

The event was run over 5 school days, within normal start and finish times. Day 1 was dedicated to a warm-up exercise based on the design and production of 'Star Wars' costumes for fancy dress. The warm-up was more substantial than any used in previous events, The aims were broader, staff wished to run through a 'mini event' in addition to establishing teams.

The main event was based on teams setting up businesses producing and marketing biscuits. These were to be aimed at the quality end of the market and packaged appropriately. One of the town's main employers was a biscuit manufacturer who contributed to the event.

The financial simulation was based on the Enterprise Allowance Scheme whereby each person was paid £40 per week but another £1000 had to be put into the company. Teams had to raise this and other necessary cash by a bank loan. Three banks contributed local managers for interviews held in the school.

The structure of the 5 days were as follows:

Day 1

08.45 - 0915	Initial briefing
09.15 - 11.15	Production/costing of warm up exercise
11.15 - 11.35	Break
11.35 - 12.00	Set up market simulation displays
12.00 - 12.45	Market simulation / report on results
14.00 - 15.15	Whole group debrief

Day 2

10.15 - 11.15	Input 1 (three in parallel)
	food production and design- Bakery company
	packaging and presentation-a teacher
	business plan-Midland Bank
14.00 - 14.45	Input 2 (four in parallel)
	practical cookery-a teacher
	computers in business-a teacher
	market research trip-a teacher + bus
	food hygiene- environmental health officer

Day 3

08.45 - 09.15	whole group briefing
09.15 - 14.45	kitchens available
09.15 - 10.00	Input 3 (two in parallel)
	costings/business plan-a teacher
	packaging workshop-a teacher

Day 4

08.45 - 09.15	whole group briefing
09.15 - 14.15	kitchens available
09.15 - 14.45	bank interviews- Midland,
	Barclays and National Westminster
09.15 - 10.30	presenting finished product- a teacher

Day 5

08.45 - 09.15	whole group briefing
10.15 - 11.15	market simulation
11.45 - 12.45	feedback of results / debriefing
14.00 - 15.15	individual group evaluation and debriefing

6.0 Observations

6.10 Planning

1. The planning group consisted of teachers with expertise in: business studies, information technology (IT), food, graphics, science.

2. Staff remarked on the effort required to plan the event. Some extra planning time was generated by JSA support, but this was small in relation to the overall task, amounting to 1.5 days for the planning group as a whole. Other meetings were held during lunch times and after school.

3. The JSA support had the effect of concentrating staff motivation, they had gained the money in order to put a plan into effect, therefore they had to achieve.

4. Staff described the planning as 'intensive'. They decided to keep very much to the structures outlined during the INSET and the topic was very similar to that used during the INSET for case account 3. Staff explained this as deliberate policy in that they felt more confident in an area covered by case account in the INSET.

5. Staff planned as a cross-curricular group but felt more and more able to understand and overlap specialisms as planning progressed. They felt this would have positive effects for normal curriculum work.

6. In future staff felt they would appoint a specific leader for planning rather than operate cooperatively. It was felt that this would lead to more rapid decision making and less time under general discussion.

7. Staff were optimistic that they could use these events for GCSE coursework as boards were willing to allow group/team project work where the work of the individual could be recognised. They were concerned, however, for how they might identify and assess the individual contribution.

6.20 The event

6.21 Warm up

1. Staff decided that the warm up had been too long. Teams knew it was not the 'real thing' and did not respond as positively. They had worked 'well' up to lunch but staff felt they were 'too analytical', constantly asking staff how this would fit into the main event. Pupils were being diverted from the warm up by the knowledge of the main event and the deliberate secrecy that surrounded it. This secrecy was staff policy in order to build an element of mystery and interest.

2. Staff considered that pupils needed more experience and information on how to operate in teams. The only other team / enterprise type activity in the school had been a car wash scheme. This included a minority of pupils, discussion and decision making had been minimal.

6.22 Main event

1. Staff were divided as to whether the briefing offered enough structure and detail. Inputs started soon after the end of the briefing, giving teams little time to get organised. This was deliberate in order to force the pace.

2. Teams had been told that it was not necessary to send a delegate to every input, but 90% attended. Staff were satisfied that inputs had appropriate depth and quality, especially those from industry and banks. Similarly pupils responded positively, respecting the information given by outside agencies.

3. The market research trip into the town by mini bus was felt to have been less successful. Pupils were not given enough information on what to do and did not gain enough from the trip.

4. Staff described the rest of the working period of day 2 as 'OK' but observed that the pupils were getting tired by the end. Pupil response at the debrief was limited.

5. Day 3 was described as satisfactory but staff observed that as the deadline came closer towards the end of the day pupils accelerated their activity and attention. It was noted that by the end of day 3 there were concrete results in the form of the first biscuit trial runs. This appeared to be one factor in giving positive feedback and boosting motivation.

6. The pace during day 4 was noticeably higher, as was pupil attention and motivation. The biscuits had to be finished during the day and the bank interviews were held. These lasted between 30-45 minutes with one of the bank managers available. Pupil responses to the bank interviews was uniformly very positive, seeing this as relevant to their futures.

6. Day 5 was marked by intense activity to the final display and market simulation. There was a period of 30 minutes while the results were tabulated which was 'free'. The task was over and the pressure removed. Staff noted a rise in less responsible behaviour such as name calling and some 'fun' with displays. This was minor and noticeable due to the contrast to behaviour within the working period.

7. It had been planned to include work on records of achievement in the afternoon together with the individual team feedback sessions. Staff decided pupils appeared too tired to concentrate and yet at the same time noted that the majority were still over-excited at the end of the day. Staff remarked that a large number of pupils stayed around the displays, talking to staff, long after school ended. Staff received a great deal of positive feedback on the event. Staff felt this was 'exceptional'.

6.3 General points

6.31 Teams and teamwork

1. On the whole the teams worked very well. Four pupils (out of 68) were moved to different teams after the warm up day in response to requests from the pupils. Staff did not allow this unless they felt there were serious differences.

2. One team broke up at a late stage of the main event. In this case the two girls were observed to be 'carrying' the boys, described by staff as 'disaffected'. The girls reacted in a mature manner by going round and negotiating to join an existing team. The response of the two boys was interesting. Staff expected the group to fold and these boys to do nothing, on the basis of their knowledge of them. In fact they asked staff whether they could carry on and started to apply themselves very seriously as a pair.

3. One team had a member who would not cooperate and contributed nothing. Eventually the other three turned on him and had 'firm words'. He appears to have appreciated the fact that he was failing team members in that he admitted to staff that he had been uncooperative.

4. Staff reported that in talking to teams there was a widespread positive response to working in teams and the approach as a whole. Pupils were aware of the need for specialist skills in the team and there was some envy of those with 'talented' members in mathematics, to control finances, and art, to design the packaging.

5. There was a general response from pupils that the event should be longer. This centred on a wish to do more work of this type and a wish to have more time before the deadline. The day spent on warming up was generally felt to be useful for team building but of limited value otherwise. Pupils felt the warm-up should be shorter.

6. Pressure was evident in a general feeling that larger teams would have helped by being able to spread the load. Pupils remarked that aspects of the week were `lonely`, as delegation meant that some individuals were working on their own much of the time in order to get all tasks achieved on time. Generally pupils preferred to work with a friend, but recognised the value of exercises which encouraged delegation and independent work contributing to the whole.

7. Staff remarked on the general level of maturity and application demonstrated by pupils, particularly the lower ability and normally disaffected. This point was repeated a number of times during the interview in different ways.

8. The general response of staff was very positive. They reported that they intend to build on the event for larger pupil numbers in the next academic year. The best period of time for such events caused debate. Either side of Christmas being favoured as pupils tend to have a lower focus on school work. Staff appeared to feel either that this period was less important or that the event could make the most positive use of such a `down` period.

Appendix 5

Case account 5

1.0 Background

1. This case study was opportunity led. It followed a similar pattern to the pre-enquiry residential events held at Loughborough, in that it ran over 5 days and the sample was a group of 83 TVEI year 12 students from a total of 10 schools and 2 Further Education colleges. The ability range varied from BTEC to `A` level students. There was a slightly higher proportion of males. Very few had experienced any form of enterprise type activity within a suspended timetable even though they had followed a TVEI course.

There were three significant developments:

2. Course planning was by a group of teachers, advisers and industrialists. I took part as a member of the team but for the first time I did not plan and execute the course myself. This approach was adopted as a part of a plan to extrapolate the principles of the event into schools of this LEA, a principle agreed with the TVEI unit but which they were unwilling to tackle directly.

3. Teachers accompanying students were given a two day INSET course, at Loughborough, two weeks before the main even. This INSET had two aims: to familiarise teachers with the campus and the structure of the course and to give an input on the philosophy of the course. It was intended that this would both increase the effectiveness of the course and also help teachers to attempt this type of work in their own schools. The INSET was primarily designed to improve the effectiveness of the course, teachers transferring work in their own schools was seen as secondary.

4. Six industrial sponsors were involved, to some degree, in the planning of the course. The course task was to design and prototype desk-top promotional materials for these sponsors. Teams worked to a particular sponsor in that a company representative was present on the Tuesday and Friday to answer questions and to evaluate the work. Up to this course industry had only been involved in terms of final evaluation, with the

exception of Lloyds bank which had been involved in previous residential events.

2.0 Key Purposes (research)

To further illuminate this type of working.
To improve effectiveness via the use of a pre-course INSET for teachers.

3.0 Key developments

Teacher rather than researcher led course planning.
Teacher INSET prior to course.
Industry support in finance, planning and representatives with whom student teams were able to liaise.

4.0 Evaluation Techniques and instruments

Teacher questionnaire on INSET
Nominal Group Technique (NGT) with students.
Observations from participating teachers
Observations from Banking Information Service (BIS) researchers.
Own observation based on log.
Profiles of teamwork ability used by individuals and then by teams, conducted by a research student.

The above techniques were applied in what was a very intense experience in which all involved were very busy. Nevertheless as data were gathered by individuals who were immersed in the activity the quality of that data is very immediate and personal.

Triangulation was achieved within method (questionnaire, NGT, observations and profiles) and within observers (students, teachers and myself). Triangulation was also achieved in time in that these observations can also be compared with previous courses of this type.

5.0 Description of the two day INSET

1. The INSET was planned by myself in liaison with the TVEI unit. The course lasted two days.

2. The first phase of the course was intended to familiarise teachers with the basic concepts of the work to be done on the main course. This consisted of the same warm up exercise the students would receive immediately at the start of the main course. In this way teachers would have a concrete experience upon which to base discussion and also be familiarised with the exercise.

The warm up exercise was basically the same as used in account 1, but without the computer programme. The teachers were put into teams of four and used paper and thin card to design and make a chair to a 1:10 scale which could be costed and sold in a simulated commercial environment. The exercise lasted 90 minutes. Debriefing focussed on performance in the simulation and on the general teaching opportunities which might follow.

3. The second phase attempted to develop teachers` understanding of the basic concepts behind the main course by reference to case accounts of previous courses. Following these it was possible to open a more general forum where teachers participated in deciding many of the details of the main course and their roles within it. In this way it was intended to boost `ownership` of the course and promote ability to contribute positively to a form of working which the majority admitted was beyond their experience.

4. Whilst a case could be made for carrying out this INSET months previously so that those teachers could have carried out all the planning, it had already been decided that the basic planning should be done by a group who had experience of previous events.

5. The third phase of the INSET was to familiarise teachers with the layout of facilities on the campus.

6. The course was evaluated by an open questionnaire. I do not propose to go into depth on the results other than to say that the teachers were pleased to be given a clear picture as to what the main course would consist of and felt that they could now contribute strongly.

6.0 Description of main course

1. The course was planned by a group of TVEI staff, teachers with experience of previous events and representatives from the 6 supporting companies. I joined in the later planning meetings as adviser and to coordinate logistics. In the previous 4 residential courses I had planned, and then led, with teachers acting only in pastoral support. I wanted the TVEI unit to move away from the idea of events each year which had no direct links with schools.

2. The format of the course was much as in previous events. Students from the 12 schools/colleges were divided by staff into mixed teams to achieve a good balance on sex, ability, subject background and ensuring, as much as possible, that they were made up of students from different institutions. The team size was generally seven rather than the smaller 4/5 used in previous events. It was the industrialists who proposed this larger team as they felt it represented their own working situations more closely. It suited my purposes as I wanted to observe the effects of a larger team.

3. The task was chosen by the teachers in conjunction with industrialists and was to design desk top promotional materials. Teams were to be paired to specific sponsoring companies and it was intended that they work to those companies, personalizing the basic product. The companies also were to have a representative on the course for day two and the final day for discussion with the teams.

This brief was more open than previous courses of this series and posed problems in potential material and equipment requirements. This was recognised.

4. Task briefing was given to students only on arrival. It was intended to avoid students getting sidetracked or spending too much time researching.

5. On arrival students were briefed for the warm-up activity and put into teams. Specific workplaces had been arranged consisting of two tables and two screens per team. These places were designed to offer good inter-personal communications and a degree of privacy from other teams, yet by standing up it was possible to see virtually all the teams.

6. As a warm up exercise the `chair design` simulation was used (see 5.2). This was intended to enable students to experience working together and discuss it before the main event. It also acted as an example of the main exercise in microcosm.

7. The brief for the main exercise was introduced and final deadlines for the presentations and `trade display` were given. Internal deadlines were not given as such but all inputs were timetabled for specific times in order to offer a hidden structure to the week whilst letting the teams feel they had control. Inputs were given on various techniques that may have been necessary, financial planning and use of the various information technology facilities available which included word processing, spreadsheets, databases and computer aided design (CAD).

8. 20 minute appointments were available with the commercial manager of Lloyds Bank, Loughborough to discuss financial plans. Students had to book a time which would fit in with their other commitments.

9. Teams were given sports passes and a list of facilities available on campus. It was made clear that the building would be open from 08.30 to 22.00 each day, they were to plan their time accordingly, but given freedom on how to do it.

10. A `market launch` with presentations by each team, was given on the evening of the 4th day. This had an up-market flavour, with industrialists present.

11. A market place simulation was held on the morning of day 5. This was followed by a team self-evaluation exercise using a set of trial profiles on teamwork ability. After a central feedback session a Nominal Group Technique exercise was conducted to evaluate the course as a whole.

7.0 Nominal Group Technique

1. During the final morning the students were assigned to three random groups for NGT. The task posed was simply `To evaluate the week`. This specific wording was chosen in an attempt to be as open ended as possible.

In fact the task should have been more focussed as some of the responses were concerned with basic matters on food etc in the hall of residence. The full NGT responses are in available at the end of this account. Here, I have selected out those responses directly concerned with the course itself and grouped them under basic headings. As the responses came from 3 separate groups some responses are similar and have been juxtaposed.

2. NGT methodology has been described in section 2.0. The responses generated were weighted from 5 = strongly agree to 1 = strongly disagree. The mean and standard deviation only are recorded here. The three groups numbered 23, 13 and 21 as some students were needed by staff for other tasks.

3. It should be noted that evaluation in this form was not popular with the students. After the intense activity of the week, students saw this as an anti-climax. Nevertheless they produced the following results without any staff input.

7.4 Results

		mean	StDev
Warm up			
1	Chair exercise relieved tension (warm up)	3.846	1.143
2	Chair design useful introduction to teamwork	3.435	1.342
3	Teamwork/communication was a useful exercise	3.870	1.179
4	Getting to know people took time	1.846	1.344
Teamwork aspects			
5	Team work was easy	3.333	1.110
6	Working in teams was easy	4.385	0.869
7	Teams required leadership	3.048	1.465
8	Group members absent too often	3.857	1.152
9	Group communications poor	3.619	1.430
10	Planning was important	4.385	0.869
11	Rules had to be defined in the groups	2.846	1.143
12	Learned not to judge people by their appearances	3.609	1.499
13	Useful for developing personalities/communication	3.826	1.302
14	Good making new friends	4.462	0.967

Commerce/Industry		
15 Good that industries take an interest	4.304	0.702
16 Inputs from sponsors often vague	3.130	1.486
17 All company representatives should be around	3.905	1.261
Course structure		
18 Not enough information given beforehand	3.478	1.377
19 Objectives not explained clearly at the start	3.231	1.091
20 Too much financial work	2.538	1.198
21 Good working under pressure	3.923	0.862
22 Good working to deadlines	4.385	0.767
23 More incentives	4.714	0.560
24 Should have been more competitive	3.095	1.338
25 Touched aspects of production	3.462	0.967
26 Inputs don`t go deep enough	3.154	0.898
27 Not too many rules	3.692	1.548
28 Time assigned to presentations limited	4.143	1.152
29 Evaluation is boring but feedback necessary	3.571	1.502
Staff		
30 Good personal staff relations	3.000	1.303
31 Some negative teachers	3.043	1.147
32 Teachers treated us like adults	3.391	0.988
General		
33 Similar to real life work	3.692	1.109
34 Exercise useful for similar situations	3.652	1.465
35 Learned how to use new equipment - good	3.609	1.117
36 BBC computers were not adequate	3.261	1.136
37 CAD system too long	3.000	1.581
38 Staff should wear labels and skills	2.870	1.140
39 Supply of products not constant, delayed production	3.783	1.085

8.0 Discussion of NGT results

8.1 Warm up

1. The warm up exercise was a new development for these residential courses. Previously students had been introduced to the main task and work begun as briskly as possible. Students valued the exercise In terms of relieving tension (1) and as an introduction to teamwork(2,3) the means indicated were reasonably high but the StDev`s indicated that whilst some saw the exercise as valuable, some did not. This requires further investigation in future events. It may be possible that some students saw it as an obstacle to the main event or the competitive nature of the task and deadlines caused too much pressure. There was a strong staff response to the warm-up (9.2).

2. It would be interesting to experiment with a less complex and less competitive warm up in future events.

3. `Getting to know people took time` (4) drew a mean of 1.846, indicating that students disagreed with the statement. As an essential early phase of team building this is interesting if we contrast the points in 8.4 and 12.3.

8.4 Teamwork aspects

4. Student confidence in their ability to work in teams was high (5,6) as indicated by high means and low StDevs. This contrasted with teacher and researcher observations (12.3) which indicated that students had more difficulty than they felt.

5. No formal `management` structure had been suggested to teams. Most claimed to be using a `cooperative` model (R0) and (7) supported this as leadership is not seen as a strong requirement, but with a mean of 3.048 and a StDev of 1.465 there was no unanimity. It would appear that a sizable minority would have appreciated a more formal leadership within teams. Students were confident of their team management(11) in that a relatively low mean was given to `rules had to defined in groups`.

6. Communications within the groups were not strong (9) and this is backed up by staff observations (9.5). One aspect of this was students who went off without telling colleagues (8). A part of the structure of the course was that students may use their time flexibly and the University sports facilities as they wished. This was seen as an important part of establishing a mature approach to teamwork. The students, on the whole, respected this but failed in some cases to inform colleagues. In future courses it may be better to have times when teams meet formally to check their overall position. Even year 12 students found it difficult to manage the freedom they had been given. Very few indicated any previous experience with this type of work and we can only hypothesise how they would react if they had followed a structured series of experiences at school.

7. Planning was identified as one of the aspects students recognised as being most important for this type of work (10): both a high mean and low StDev support this. This is a fairly obvious response. Staff observations (9.5, 9.13) showed that practice did not match up to ideals. Nevertheless all groups did reach the deadline with appropriate work done, though staff observation indicated that this was often done by a great deal of hard work close to the deadline.

8. Statements 2,13 and 14 were all very positive on general interpersonal relations development from teamwork. The point `learned not to judge people by their appearances` is a mature comment, though a cliche, and typifies the level of response to the course and is backed up by staff observations (9.27). Statement 14 was a very strong response on `good for making new friends` and shows the way in which students see such work very much as an extension and development of friendship groups which extend beyond the classroom.

8.9 Commerce/Industry

9. Rather than simply using managers from industry to evaluate products, in this event they were present during the course and teams worked to the brief as envisaged by companies. This aspect was appreciated by students as can be seen by the very high mean and low StDev (15). This was backed up by researcher observations and discussion with teachers (9.19) It is interesting to note that in neither students nor teachers were there any negative attitudes to industry on the basis of this course. Contrast this with

some of the responses in account 3 when some teachers wanted to keep industry at arms length seeing its role only in a more limited vocational manner. The data cannot quantify these attitudes but in dealings with teachers over the last 5 years I would estimate a minority of perhaps 5% may hold attitudes negative to industry. It is a question which merits further illumination.

10. One of the 6 companies involved did not supply a representative and so the two teams working to that company were disadvantaged. This is perhaps the reason for 17, `all company representatives should be around` which gained strong support. In some respects this disadvantage was not as strong as one might expect as 16, `inputs from sponsors were often vague` shows that many students had difficulties in their communications. This is a good illustration of the typical client/designer situation, that is the client is not really sure on requirements and the designer has to focus down to a tighter specification. Students tend to have a simplistic idea that clients know precisely what they want and so this aspect was an example of a point for debriefs. Despite this having been done the resentment obviously remained in some students at the end of the course. Direct contacts with business `clients` needs to be built into long term planning.

8.11 Course structure

11. There was some feeling that information on the task should have been given out in the school beforehand (18). The policy had been to prevent students from over researching the area. Despite this one school obviously had been briefed about the task. The teacher with this school had been on the planning group and had decided to tell his students despite the decision reached in the planning group. In itself this was not a disaster, but it did fuel some resentment amongst other students.

12. This form of resentment can be contrasted with situations where groups varied in size and make up. Identical size groups were impossible, but students were happy to accept this form of disadvantage (staff observations). There was some resentment where groups had talented individuals in areas such as graphics or computing skills which appeared to advantage their team. Again these points were raised at debriefs as being part of the `real world`.

13. There was some feeling that the course objectives were not clear enough (19, at 3.231). This was supported by staff observations during the first day (9.22). There were ambiguities in the brief, and the objectives were complex but simplified for the first briefing. There are similarities with (point 10 above) where students found that client companies had not fully developed or crystalised requirements. The objectives were confused by the ambiguities in the brief and this did lead to confusion in some student minds. It is interesting to note from my own observations as well as staff that some teams did appear to be able to get on with the task without asking clarification. At this stage it is impossible to say whether this was because they could accept the ambiguities and work with them or whether they had not identified them. Whilst there can be no excuse for the ambiguities which were not identified at the planning stage, by either the staff or myself, it was possible to turn this to a positive point by discussing the question of ambiguity at debrief, in context.

14. `Too much financial work` (20) carried a mean of 2.538, not strongly felt. It was clear from staff observation (9.24) that this aspect of the course needed strengthening in future. The problem was compounded by the failure of the specialist on financial planning to give the input due to a car breakdown. These events to date had been planned by myself and on this occasion by teachers, but it became clear that we had all worked from a Craft, Design and Technology (CDT) base and only had limited understanding of financial aspects. Future courses need a business studies specialist during the planning stage.

15. Statements 21,22 and 23 all refer to aspects of working to deadlines and under pressure. All three: `good working under pressure`, `good working to deadlines` and `more incentives`, carry high means and low StDevs. This indicated that students were ready to recognise these aspects as important. Staff observations confirmed that work rate was high, particularly as the week progressed and the deadlines neared. Whilst it is interesting that students will willingly work very hard when the conditions are right it is necessary to be sensitive to the fact that this was a one-off event from their point of view and so novelty effects must have contributed.

16. The statement on incentives was interesting (23). It was impossible to follow this up for clarification. However it had the highest mean and lowest StDev of all responses. One can speculate that students were put in a very

competitive, commercial environment and yet their only incentives were personal, other than knowing, eventually, how their team performed against the others in terms of `sales`. Incentives could take the form of qualifications, perhaps based on records of achievement (RoA`s). Financial, or other concrete incentives such as would be found in a commercial context, lie beyond the possible in an educational context.

17. `Inputs don`t go deep enough` (26) generated a mean of 3.154 and StDev of 0.898, indicating it was generally agreed but at a low level of importance. A decision was made during planning to keep these inputs down in terms of number and content to prevent destroying the flow of the simulation. Enough information was put over to enable the simulation to run effectively. This may have been an indication of student perceptions of what represents learning. Students appear to be valuing a knowledge base even when it goes beyond that necessary for the task.

18. `Not too many rules` (27) had a mean of 3.692 but the StDev was 1.548, indicating a fairly broad spread of feeling. The point is ambiguous and students may have interpreted it in different ways. One aspect that emerged strongly in a previous event was that students felt there were too many rules set by accompanying teachers in the late evening. The `rules` during the day were few. This is a warning of the limitations of NGT when factors are generated by students without any staff guidance. Freedom to respond means that response may be ambiguous.

19. The final morning was given to presentations by the teams and the evaluation by NGT. Staff observations showed that the presentations did not go as well as staff hoped. Students pointed out (28) that `time assigned to presentations limited`, indicating the pressure they were under to summarise their work in the time given. In future events the time should be the same but an input on presentations given and rehearsal. Statement 29 `evaluation is boring but feedback necessary` illustrates the dichotomy at the end of a course when evaluation and feedback fit into their `natural` place and yet form an anti-climax after the intensity of the week.

8.20 Staff

20. Statement 30, `good personal staff relations`, illustrated student perceptions of staff in their changing role. There was no data on how students reacted to staff in their school environments.

21. Pre-enquiry events of this series had indicated that students often see a distinction between the University staff and teachers. In these cases University staff ran the events, teachers were passive. In the evening teachers took over supervision. In these cases students certainly resented the teachers whilst having a good relationship with the University staff. On this occasion the teachers had a full role during days as well as later and this raised the standard of relationship.

22. The role for teachers, as facilitators, was strange to many of them and not all were comfortable away from more traditional learning environments. Statement 31, `some negative teachers`, may illustrate this, though it was not a strong response with a mean of 3.043 and StDev of 1.147. It may also refer to teachers pastoral role at night. The method of working which the course demanded of teachers is not straightforward. In considering long term progression of this type of work in schools the changing role of the teacher must be considered and their development assisted.

8.23 General

23. Several general points were raised. Most (33,34,35) referred in a positive manner to the usefulness of this form of working. Little can be gained from further discussion; they simply signaled a recognition of the value of the course.

24. The CAD package the TVEI unit brought to use on BBC computers was limited. In planning it had not been intended to let the students use the University IBM machines but several members of the University staff, not connected to the event, showed students how to operate CAD on them when students asked. This led to a dissatisfaction with the simpler BBC machines (36,37). It is possible that had students not seen the IBM machines this situation may not have arisen.

9.0 Teacher observations and discussion

1. During the course teachers were asked to keep a log of observations. Not all did: they were busy from morning to beyond midnight, again one of the difficulties of gathering data in a live educational setting. Nevertheless they did actively discuss the work with each other and the responses given represent a comprehensive perspective. The responses were not guided by any imposed structure. Teacher responses were organized into the same general headings that were used for the student NGT responses. Responses are not quantified, it would have little value as there was no specific observation schedule used. The responses are discussed immediately after each group of observations. Teachers words are printed in italics.

9.2 Warm up

The warm up exercise went very well, though some isolates (sic) *were obvious.* Out of a total group of 83 there were 5 students who were obviously having difficulty integrating during this exercise. The explanations varied, some found the suddenness and intensity of the exercise difficult to manage. One group of three from one of the F.E. Colleges were inseparable and despite having being spit up by their staff into different teams during the week, they would not contribute to teams but drifted together. Their lecturer reported that while they tried to present an air of superiority, resenting mixing with students from schools, they were, in fact rather insecure.

3. Linking this to 8.0/1,2 and 3 this reinforces the principle of the warm up as a valuable exercise but also supports the point in 8.0/2 that it might be more valuable if it were to be a less intense and competitive exercise.

9.4 Teamwork aspects

Team bases good - well set up. The specific bases had been an innovation during this event, rather than simply letting teams find suitable work areas. The bases offered a sense of security and a central meeting place during a busy week. The partial screening meant that when students were

sitting there was a degree of isolation from other teams. This offered some privacy and yet it was possible to be aware of the general level of activity simply by standing up or looking around a screen. By specifically assigning a base one uncertainty was removed at the beginning of the event. Having display space meant teams were able to provide a focus for team identification. Originally it had been intended to give each team a computer in the base, but this had been impossible due to limited power points. Whether access to computers in base rather than having to use communal computer rooms would have further enhanced team identification and efficiency can only remain as a question at this point.

5. *Some students avoiding involvement. Not all groups together at first, they are making arrangements and not keeping them.`*

Not enough planning in the teams.

Some duplication of tasks - examples of poor coordination - eg feedback from inputs.

Evidence in early parts of poor team organisation - eg meeting, agreeing jobs and deadlines, failing to meet at agreed times etc.

Tuesday PM, team 1 worried by lack of progress. Complex and highly individual dynamics in every group.

6. The ability to work in teams was not easy for the majority. They had to deal with new personalities, a new environment and a way of working which was foreign to most of them. These statements referred to the first two days. After this, statements are far more positive:

By Tuesday evening teams were more at ease and more integrated.

By Wednesday AM students were discussing financial plan over breakfast.

The difficult students now contributing by Wednesday. (Day 3)

Wednesday - evidence of better delegation - marked improvement. Good general atmosphere after some poorer organisation earlier.

Most teams gelled - one did not, they tended to work individually.

7. Discussion with teams during the week showed that very few had ever worked as teams, despite the fact that they were TVEI students. This was reflected in their initial performance though this was clouded by the `culture shock` of the course. There were several factors why they found the work difficult at first.

8. Personal integration took time, most students quickly established working relations but there was a minority which avoided involvement. Typically these students reformed their friendship groups from their own schools as often as they could. Those occasions where there were formal jobs to be done were the most successful at keeping teams together, but the structure offered few of these.

9. The number of students who experienced integration problems of a nature that was obvious to observers was small, perhaps 6/83. In one case a student moved herself to another group, containing one of her friends, claiming she did not fit in with the first group. Accompanying teachers decided to allow her to remain, based on their knowledge of her at college.

10. A similar problem in personal integration arose from a small number who *over used computers seemingly to avoid the rest of the team.* This is an interesting observation but is complex, were these students using the computers to avoid integration or were they absorbed by them? In each case these were male `computer experts` who wanted to use the IBM computers which were very much more sophisticated than they used at school.

11. Whilst perhaps 6/83 had integration problems which staff observed it is difficult to know how many experienced problems which were less easily observed but which limited integration. Small disputes would arise, but generally staff felt that teams quickly integrated at a personal level.

12. By Tuesday evening and Wednesday morning integration was more advanced. Even those students who had been `difficult` were participating in their teams more, though their attention span was more limited and they still met friends for coffee etc. In the majority of cases it was obvious that during the day teams started having coffee and meals together. Observation

of evening groupings was more difficult, the students preferring to put space between themselves and staff as much as possible. It would be interesting to follow this aspect up via interviews in future courses.

13. The second factor was the development of team organisation and planning. The observations above show that like personal integration, but to a greater extent, this started poorly but made a marked improvement after two days. Perhaps this illustrated little experience in team work in the schools. Typical problems were inefficient planning, duplicating tasks and poor coordination. There was no imposed team structure - deliberately. Teams had difficulty putting a structure down to help plan and organise. Individuals displayed poor timekeeping when meetings were organised and feedback from inputs tended to be done poorly.

14. Statements from teachers later in the week spoke of better delegation, teams being more at ease, integrated and a general building of the `atmosphere` of the simulation. To some extent the improvement in organisation followed improved personal integration but how quickly would teams have developed had there been more specific organisational and planning models given to them immediately? It had been a decision made at the planning meetings that teams should be able to establish their own systems and appreciate how important they are to success. If teams had been given systems the work may have been better, but would they have learned as much from the experience?

15. This question could only be answered by a form of experiment. This has not been possible due to the opportunity led nature of this enquiry. As the results were positive staff would be unlikely to be prepared to experiment on any future course. One teacher did feel that *Everybody should have a specialist job,* but this was discussed amongst staff and felt to be inappropriate for this particular event. This raised the question of long term progression of this form of work in schools which is discussed in section 6.0.

16. Within teams teachers observed varied approaches *Groups* (sic)*varied a great deal. In some groups `organisers` feed ideas and draw out others.* Here there is the emergence of leaders or organisers operating in a fairly sophisticated manner. Other emerging leaders were less advanced, often

using force of personality. Which approaches were the more successful is difficult to appraise, but this is a question beyond a single case study.

17. *Students need to be more sensitively critical of each other* was a point raised a number of times and not simply in a leadership context. Students were often critical of colleagues within team meetings but they lacked the skills to do this in a constructive manner.

18. During the week the level of activity increased markedly. There was a purposeful atmosphere to the course but there were the occasional individuals, who whilst contributing, showed *Signs of demarcation - `That`s nothing to do with me.`* These were few but another statement illustrates the danger -*By Thursday PM the group 7 person doing the presentation was playing tennis. The rest of the group said it was his fault if there was no display.* This person did eventually arrive and set up the display, but damage had been done to team integration. These isolated incidents may signal some of the pressure teams were working under. This had been one of the aims of the course, to generate pressure and to discuss, at debriefs, whether such pressure could be maintained in a long term work situation.

9.19 Commerce/Industry

The degree to which sponsoring companies were involved during the course rather than simply in the final evaluation was a development in this event. From student perspectives it was highly successful (NGT 7.4/15). Teachers were also positive, though their written observations were limited. *British Telecom representative spent time with each group on Tuesday and the teams benefited* was an example of the value of the support. Students gave high levels of credibility to such contacts in comparison with teacher contact. Teachers observed *Nerves over having to see the bank manager* however to some extent this may have been due to lack of confidence in financial preparation.

20. When teams did not have a company representative to work with they felt disadvantaged - *Missing company representative disappointed the teams who were working to that company.* This was beyond the control of the staff but was a factor to be avoided in future as the resentment it caused was not

beneficial to the course as a whole. These two teams, did, however, make progress and produced good results in the end.

9.21 Course structure

Generally teacher statements on the course structure were highly positive eg *Organisation and facilities excellent* - similar comments were generated by nearly all teachers.

22. Students did have difficulty interpreting the brief and this was clearly observed by teachers *Confusion over brief for first few days, vagueness, open-endedness. This caused concern amongst teams and staff had to spend time clarifying on an individual team basis.* The exact wording of the brief had been the focus of much discussion during the planning stage. There had been a clear decision that it should be capable of interpretation rather than presenting a rigid set of criteria. Industrial representatives on the planning team agreed that this was more realistic. This approach did cause concern amongst students. The industrial representatives themselves, in discussing work with teams on day 2 had, in some respects, not cleared up the brief to the satisfaction of students. It required a great deal of extra work by staff to settle some teams down with a reasonable degree of identification to the task. Nevertheless half the teams took the brief and were able to act on it without further clarification.

23. Some students were happier handling open-ended briefs and ambiguity (also 8.0/13), whereas others needed far greater clarity and structure before they could apply themselves to the task. Both staff and industrialists are firm that by the sixth form students should be able to handle briefs such as this.

24. A number of teachers made points similar to *Possibly too much emphasis on production, business studies role limited.* To some degree this was exacerbated by the failure of the representative from the local Small Business Advice Centre (SBAC)to give his input. This was done at very short notice by a teacher who did not have any direct experience in this area, using paperwork from the SBAC.

25. Despite the point above I have come to realise the degree to which my own background had influenced the form of this and previous courses. They were cast in the 'CDT' tradition and whilst I had developed financial planning in previous courses it was at a simplistic level. There had been no Business Studies teachers on the planning team and none of the industrialists were financial experts. In future such planning teams must have strong representation in this area producing an approach with more balance.

26. Looking at long term planning it may be desirable to focus on specific aspects eg, design and make, business studies, IT etc in more depth. At year 12 level the planning group wished to achieve a good balance, with hindsight this had not been done.

27. The structure did build an intensive atmosphere during the week. Teachers offered statements such as *Enthusiasm and pressure, students working hard, stretched, motivated, sense of achievement.* Several visitors to the course made very positive comments about this atmosphere and the work rate and attitude of students. Detail as to why the structure was able to achieve such a constructive atmosphere is discussed in section 6.0. It is worth noting that such an intensity is not achievable for long. Some teachers pointed out that *Sluggish start on Thursday, - many had been drinking in the town the night before, also tiredness due to intensity of work?* Living away from home and entering into the spirit of the course students worked and played very hard and by the end of the week the effects were obvious. Students were very tired but also very positive about the experience.

28. Teachers reported *Inputs fine*- though one teacher did feel that all students should be present at all inputs. That only one student could attend an input was one of the basic principles of the approach. The student then had a responsibility to the team to understand, process and communicate the relevant points to members.

29. Whilst teachers generally were pleased with the inputs there were two points that were raised. Firstly *Students needed input on word processing and basic layouts, not just how to use software.* Students were not as adept at word processing as staff had expected and required help in designing page layouts. The second point was *Need input on oral presentation, they did not*

sell themselves well. This linked to *Thinking on presentation left late.* This point has been partially covered above, the final presentations were disappointing in that they were not well thought out or presented. This exercise was important from an educational point of view. Students needed to be helped to plan for this and helped with the techniques required.

9.30 Staff

Staff comments in this area simplified to:

Teachers find it difficult to sit back and observe.

Some staff felt superfluous - could not observe for long periods. Avoided imposing on groups.

31. The difficulties teachers faced here should not be underestimated. Discussion during the course underlined how they found it difficult to *sit back and observe*, some admitted to intervening when it was not necessary. Some teachers appear to be conditioned to constant interaction with students, there may be complex feelings of guilt and frustration when they attempt to stand back and observe.

32. Teachers needed to be helped to realise the value and detail of observation. In this case there was no formal schedule, only the guidelines discussed during the INSET. Developments in National Curriculum assessment and the probable rise of profiling/records of achievement in this area will require teachers to develop observational skills and techniques. These can then only be applied if teachers develop learning strategies which allow them the time to observe. There is much potential for further research here.

33. In this case study teachers did recognise the value of breaking away as can be seen from *Did we do right to play such a low profile? I think we did, as students are beginning to get the idea of responsibility and accountability in the teams.* Here they recognised the fact that as they broke away they allowed students greater responsibility and the positive feedback that generated. Sensitive management of the learning situation appeared to have generated more learning with less direct teacher contact.

10.0 Banking Information Service (BIS) researcher observations

1. BIS requested that they may use the event as a case study for the BIS Financial Planning and Management software and video, using two of their own researchers who were also experienced teachers. This was agreed providing the observation logs were made available. These logs have not been included in this document for the sake of brevity. They consisted of observational data on a specific team with no analysis or conclusions. I have taken this data and drawn from it my own conclusions. Here only those factors which have not been explored at any depth elsewhere are included to minimise repetition.

2. BIS observed, in depth, a team which started with great difficulties and yet developed an effective structure and working strategy which led to them `winning` the event as evaluated by the industrial sponsors. The BIS observations were typical of the majority of the teams and were useful as a detailed focus on the workings of a team with only a task and deadline to guide them. The following factors have been drawn together from the chronologically ordered observations of BIS.

3. Previous experience appeared to play an important role in ability to come to terms with the experience. Two girls had completed an enterprise type activity with TVEI and showed the greatest self confidence from the start. It was difficult to be sure whether other factors such as maturity influenced this but it would be a reasonable supposition that previous experience raises self confidence in a given area. There are lessons here for progression of experience in schools.

4. On the whole, girls in the team tended to be positive, putting forward ideas, especially in the early days. Their criticism of others' ideas tended to be positive. The boys tended to be negatively critical of ideas without offering much in return. This effect may be due to relative maturity of boys and girls at this age and also to role models. Possibly the boys responded in this way to protect their self image against what appeared to be a girl-dominated flow of ideas.

5. As the week progressed the team became more and more effective. It was evident that one of the girls emerged as a leader despite the fact that the team felt that it was adopting a cooperative structure at first. This leadership role became accepted by all the team and valued. There were numerous statements from members as to the positive effects of her leadership. The males learned to accept her as a leader, though this may have clashed with their cultural conditioning.

6. The early part of the exercise was difficult for the team, it was only at the end that they could be described as having developed an effective structure. BIS reported at the end of day 1 that *doing had tended to come before thinking* --- and that ---*the task was not yet clear in students minds.* This was illustrated by a lack of recording or feedback. Early attempts at organisation led by the more experienced members tended to be not accepted by others who would fail to respond to positive suggestions on organisation or simply be critical of them.

7. The `inputs` imposed a form of structure as intended. The team had to decide on delegates for these and all were attended. Feedback was poor due to a lack of cohesiveness in the group at that time.

8. Some members were aggrieved when they felt their suggestions were not being given due weight. This caused bad feeling and the danger of that member reducing effort. Individual members were not, on the whole, good at being supportive of each other by giving encouragement or letting an individual down gently if rejecting an idea. This can be contrasted with the very positive effect the feedback from the bank manager had on teams as observed by BIS. This feedback came at the end of the second day, a time when it was very noticeable that teams started becoming much more effective. Positive feedback may have played a significant role in developing this effectiveness.

9. Competition was not recognised as a factor in the early stages, team members would move freely around and discuss work with members of other teams. It was only later in the week, as pressure built, that teams became more careful with ideas. It would be interesting to have a detailed analysis of the school experiences of these students to see what degree of competition they had experienced and what form it had taken.

10. One member of the team quickly volunteered to do necessary computing work, but it soon became evident that he was becoming over interested in the computers and not using them as a tool for a purpose. It was felt by the BIS researcher and by teachers who knew the student that he was insecure and using computers as an escape route from the more painful social interaction within the team. In addition to this he had a deep interest in computers and the more sophisticated machines and software available on the course appeared to play a part in drawing him into computing and away from the task and the team. This has been discussed above. A possible development may be a way of logging computer time and using this as a charge against teams to encourage them to use computer time effectively.

11. BIS reported that as the week progressed the pressure built up on students. This was not due to direct encouragement by staff but by a recognition of the approaching deadline. It was also reported by BIS that student response to this pressure was positive, everybody worked extremely hard and started pulling together. BIS reported long periods of intense concentration (not quantified) which counter the commonly held view of short attention spans. Teams were seen meeting before breakfast and late into the evening as the week progressed. The atmosphere was positive. They could take time off to play games etc, but they appeared to be working hard at the task out of a collective team responsibility.

11.0 Researcher observations

Confined to points not raised elsewhere.

1. This was the first course run with teams of mainly seven, all previous courses used 4/5. During the warm up exercise it was clear that the larger number made this simple task difficult to approach. Teams did eventually work together reasonably well but the opportunities for off-subject talk and movement were greater. A number did rejoin friendship groups, but were a small proportion. The relationship of the task and team size needs consideration for future events.

2. The market place simulation showed indecision and difficulties working out basic accounts from the sales figures. This is a phenomenon which arises whenever this simulation is used, whether with pupils, students or

teachers. The pressure of the situation and the setting of the task appear to be major factors in producing a mathematics `block`. This is an area of interest for future enquiry.

3. During the early stages there were a great number of `can we -?` questions while teams attempted to delineate the `rules` of the event. Eventually they began to impose their own structures. This coincided with various acts of initiative such as using telephones for enquiries. They had not been told they could, but they had not been told they could not. These were brought up during debriefs to underline the point that there were few explicit rules and that initiative was rewarded. Similarly the open - endedness of the brief caused anxiety and many questions were designed to find what teams would feel as safe ground.

4. In hand with the freedom offered by the structure came responsibility. Problems in team organisation due to individuals not communicating were frequent in the early stages (10.0/7). It was clear that the point was being learned when one student at a debrief pointed out that he had not understood there would be so much responsibility.

5. There were some design difficulties due to students not understanding the technologies available. This often lead to impractical ideas. This was a problem but also raised the question of to what degree it is necessary to front load students with information before meaningful discussion or activity can take place. Students, and to some degree teachers, had an expectation that they would be fed all relevant information before being expected to use it. Real life is not like this, students were being helped to realise the first question is `What do I need to know?` and then, `Where can I find it`.

6. There was some confusion from the original briefing as to whether the teams were meant to be manufacturing companies or simply designers. This is a valid point. Clarity is essential, materials generated by teachers can easily be misunderstood and requires thorough piloting.

12.0 Teamwork profile

1. The assessment of teamwork skills is dealt with separately. However it would be useful at this point to make a few observations based on the work of a research student, Andrea Taylor. Taylor was engaged in developing assessment profiles for teamwork. This event was used as a trial run. Whilst simply a trial these results offer another perspective on the event.

2. The profile used called for a response to 5 areas of teamwork each on a 1 - 6 scale where 1=extremely high` and 6= `extremely low`. The areas were: task management, cooperation, initiative, leadership and communication. Each student filled in one of these profiles individually on the final morning of the week. Following this a team version was agreed. Teachers who had been observing specific teams were asked to complete a profile on these teams. This was done for 7 teams, that is 43 students. I have not taken the statistics as far as working standard deviation as the sample size is so small there is the danger of giving spurious credibility to numbers extracted from data which is not highly reliable.

Area	mean indiv	team response	staff response
Team management	3.02	2.96	3.39
Cooperation	2.38	2.00	2.85
Initiative	2.52	2.64	2.78
Leadership	3.15	2.92	2.78
Communications	2.80	2.67	3.14
Means down	2.77	2.63	2.98

3. Taking the totals down, staff rated teams lower than did teams themselves (the rating operates with 1= highest and 6= lowest). The difference of 2.98 to 2.63 is clear but not great. This indicates a

congruence of rating between staff and students which supports the use of such student self evaluation work.

4. With the exception of leadership the above pattern is repeated in individual, team and staff figures. Student responses to BIS and staff indicate that there was a general feeling that they were all operating a cooperative structure and that there was a feeling of resentment against the idea of leaders even though leaders did emerge. This may explain the reversal of the trend in this area for staff observations.

5. The differences between the mean individual and agreed team responses indicate that teams looked more positively at their performance than the mean of the individual members of the team (2.63 - 2.77 ie 0.14 difference). The difference is small but indicates that there may be a team support effect operating. When together they support each other and feel more positive than when they must respond individually. The difference is so small that such a hypothesis would require a great deal more investigation with a large population.

6. With a far larger sample it would be interesting to discuss the vertical differences between the areas, ie whether teams felt their performance to be more positive in any one of the 5 areas listed above.

7. Taylor noted that staff felt the use of the profiles had a motivating influence on the students. They also felt that it was helpful to focus in on aspects of performance in this way. After being mentioned briefly at the start of the exercise the students did not see the profiles until the exercise was over and the evaluation was in progress. The profiles themselves, therefore, were unlikely to have been an influence on motivation during the exercise but they may have generated further motivation in the evaluation phase.

13.0 General conclusion

1. As data was discussed in situ above the objective of this section is to highlight only key points and to look forward.

2. The teacher must become a facilitator in this form of working. Teachers in this study found this difficult despite the fact that all were volunteers and had attended the INSET. The most common difficulty was 'letting go' and allowing teams to progress under their own direction. Properly planned such exercises allow teams to move with little teacher control, so allowing far greater observation and recording of the event. Discussions with teachers involved indicated that they recognised this and the advantages it offered within the National Curriculum requirements for assessment.

3. One limitation of the residential events was that they were one-offs. Students never got another opportunity to develop the concepts they experienced. Similarly teachers were not developing their new role. Whilst the LEA intend to develop the 'Loughborough Experience' (title of the promotional video shot during the event) into a European event in 1991, taking place in France and England (+Spain in 1992) with mixed staff planning groups and student teams, they are still seeing one-off events. Whether individual teachers incorporate the ideas within their own curriculum is left to chance. This can be contrasted with the account 3 events where such exercises were seen as taking place within schools and progression was being developed.

4. Progression needs to be seen in terms of staff development, student experience and context. It needs to be thought through from the early years of education to 16+. Factors would include time usage, team size and composition, teacher experience, industry involvement, context of the brief. This is discussed in more depth in section 6.0.

5. There was evidence of changing and improving staff/student relationships. This could be partly attributed to closer staff involvement with designing and running the exercise. Other factors may have included the INSET sensitization to their new role.

6. The expanded role of the sponsoring company representatives had positive effects, for example adding to student perceptions of relevance. The teachers involved were volunteers and this may have influenced them in such a way that there were no negative feelings towards industry as was observed amongst a small minority of staff in account 3. The involvement of

industry, its scale and detail should be considered within an overall progression.

7. The team size used in this case study varied between five and seven, larger than previous events. Observations indicated that teams found integrating all members difficult at first but that all teams ended the week with workable structures. The tasks set need to be amenable to management by larger teams in that delegation should be possible though this is not to imply that work should always be tackled by delegated individuals. Students should be encouraged to operate in sub-groups when appropriate.

8. The deliberately open structure of the event left teams to develop their own team structure, interpretation of the brief, communications etc. This was not easy, and yet there are clear indications that lessons learned in this manner were appreciated (8.0/8; 12; 15). In other events it may be desirable to plan in exercises to make individuals communicate and to do this as a part of planned progression.

Raw Nominal Group Technique data from three separate groups

Bedfordshire T&FI 1989

Group 'A'

																					mean	Stdev
Staff presence limited session	5	2	3	5	3	4	4	4	4	4	4	4	5		4	4	4	3	3	5	3.667	1.0645813
More orange juice	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	3	5	5	4.524	1.0779166
Video camera a nuisance	3	5	4	3	5	3	4	3	3	4	3	5	4	4	4	4	4	3	2	5	3.714	0.9561829
All company reps should be around	3	5	5	4	4	3	4	4	4	5	4	3	5	3	4	5	5	5	5	3	3.905	1.2611408
Group members absent too often	4	5	2	5	2	4	4	5	4	3	3	4	5	4	5	3	5	4	3	3	3.667	1.1526367
Team work was easy	3	5	3	3	1	4	3	3	3	4	4	5	4	4	1	4	5	3	3	3	3.333	1.1105554
Teams required leadership	3	2	4	1	4	3	5	4	4	4	4	4	4	4	4	4	5	1	4	5	3.348	1.4654757
Time assigned to presentations limited	4	5	1	4	1	4	4	5	5	4	5	4	4	4	5	4	5	5	5	4	4.143	1.1526367
Terrible problem with aphids	3	1	4	4	1	1	5	4	5	5	4	1	1	4	1	3	2	2	2	3	2.657	1.5259657
No badminton	2	3	4	5	1	3	4	3	3	4	3	5	3	3	4	4	1	3	2	5	3	1.3033405
Good personal staff relationships	2	3	4	5	1	3	4	3	3	4	3	5	3	3	4	4	1	3	2	5	3	1.3033405
Should have been more competative	5	4	3	4	1	3	3	4	4	4	3	4	3	3	1	1	1	2	4	5	3.095	1.3380266
More incentives	5	4	5	4	5	5	5	4	4	5	5	5	5	5	5	5	5	5	5	3	4.714	0.5606119
Excellent facilities	5	5	5	5	5	5	4	4	4	5	5	5	4	5	5	5	5	3	5	3	4.619	0.6690434
Technicians a good laugh	5	5	5	5	3	4	4	3	3	4	5	4	3	5	5	5	5	5	5	5	4.476	0.8135753
Group communications poor	2	3	4	1	5	5	5	3	4	4	4	5	5	4	4	5	5	4	5	4	3.619	1.4309504
Evaluation is boring - but feedback necessary	5	5	5	2	4	5	5	5	5	3	2	5	4	4	1	3	5	4	2	3	3.571	1.5023791
Electricity representative was 'drunk'	5	5	3	5	1	3	5	4	4	5	5	3	3		1	5	2	3	5	5	4	1.5165751
Time restrictions out of order	5	5	5	5	5	5	5	4	4	5	5	5	5	5	5	5	5	5	3	5	4.81	0.5117663

Raw Nominal Group Technique data from group B

Hertfordshire H.E. Prog

Group 'B'

														Mean	Stdev
Food and room bad	5	2	1	4	5	2	2	3	5	1	1	5	1	2.846	1.772633
Too much financial work	4	4	1	3	4	3	3	3	2	1	1	3	1	2.615	1.1962694
Good working under pressure	3	4	5	4	5	4	3	3	3	3	5	5	4	3.923	0.9623.65
Working in teams was easy	2	4	5	5	5	5	4	5	4	4	5	4	5	4.385	0.6697.85
Touched aspects of production	1	5	4	4	3	4	4	4	4	3	3	3	3	3.462	0.9574179
Good working to deadlines	5	4	5	5	5	4	4	3	3	5	5	4	5	4.385	0.7879476
Too many cameramen	4	4	2	1	5	3	2	5	5	1	5	5	2	3.538	1.4096268
Planning was important	3	3	5	5	5	5	5	4	4	5	5	3	5	4.385	0.6667165
Chair exercise relieved tension	2	3	5	4	3	3	5	5	2	4	5	4	5	3.923	1.1435437
Objectives not explained clearly at start	1	5	3	4	2	4	4	2	3	4	4	3	3	3.385	1.0919284
Inputs don't go deep enough	5	3	4	4	2	3	3	2	4	3	3	3	2	3.154	0.8566717
Good making new friends	4	5	5	5	5	5	3	5	2	5	5	4	5	4.462	0.9674179
University life isn't good	3	1	1	2	5	2	2	2	3	1	1	5	1	2.231	1.4232502
Not too many rules	2	5	5	1	5	1	3	4	3	5	4	5	5	3.846	1.5403656
C&D system too long	1	5	5	4	1	4	2	1	4	2	3	5	2	3	1.5811388
Getting to know people in the real work view	5	1	1	1	1	2	2	1	4	1	1	1	1	1.462	1.3445045
Rules had to be defined in the groups	4	1	1	1	3	3	4	2	3	3	2	3	5	2.846	1.1435437
Similar to real life work	3	4	5	5	2	4	5	3	3	5	4	2	3	3.692	1.1044004

Raw Nominal Group Technique data from group C

Questionnaire 7/5/89

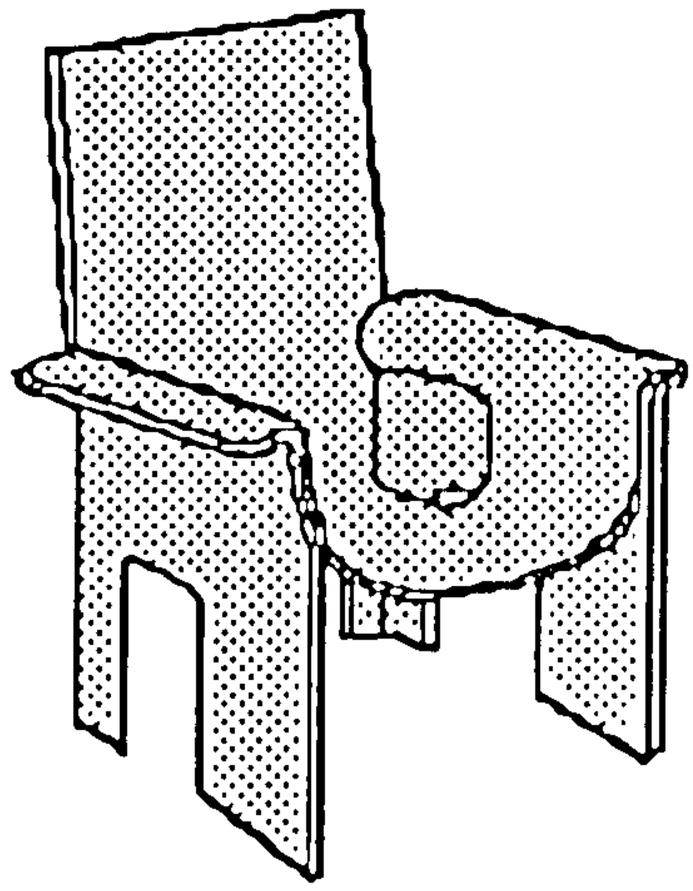
Group 1:

																						Mean	Stdev
Too much time wasted walking	1	2	4	1	3	2	2	4	1	3	3	3	4	4	5	3	5	1	3	2	5	5	5	3.087	1.4114159
Exercise useful for similar situations	5	5	3	4	4	4	5	3	5	3	3	3	3	5	.	5	4	5	5	4	.	5	.	3.652	1.4650068
Chair design was a useful intro to teamwork	2	5	3	3	2	5	2	1	5	2	2	2	3	3	3	3	4	5	5	5	5	5	4	3.435	1.3425243
Staff should wear labels with name and skill	1	4	3	3	2	4	1	2	1	2	3	3	2	5	4	3	5	3	3	3	3	4	3	2.87	1.1403487
Not enough info given at school beforehand	1	4	2	4	4	4	4	4	5	2	2	2	4	2	5	5	3	3	5	5	5	3	5	3.478	1.3774009
Inputs from sponsors often vague	4	5	5	4	5	1	4	1	2	1	1	1	4	4	4	4	5	3	3	1	4	3	3	3.13	1.486434
Supply of products not constant . delayed produc	3	4	1	4	4	3	3	5	3	3	4	4	5	5	5	4	5	3	5	4	2	3	5	3.783	1.0852952
BBC computers not adequate	5	4	4	4	3	5	5	5	3	3	3	3	2	1	4	2	2	4	2	3	3	2	3	3.261	1.1368774
Better organisation of unit (misc) equipment	3	4	3	3	2	5	3	4	3	2	3	3	1	3	4	3	5	5	5	4	5	4	3	3.478	1.0816471
Teamwork/communication was a successful exercise	4	5	3	2	3	4	4	3	5	1	2	4	5	5	5	5	5	3	3	4	5	5	4	3.87	1.1795356
Food was good	3	4	3	4	2	3	3	4	5	4	4	2	3	5	2	3	3	4	2	5	5	4	4	3.478	1.038774
Price of the course was excellent	2	5	3	4	2	5	2	5	5	2	2	1	2	5	2	4	3	5	4	5	5	5	5	3.609	1.4377739
Useful for developing personalities/communicatio	2	5	4	4	5	3	2	2	5	2	1	4	5	5	3	5	3	5	5	4	5	5	4	3.826	1.3021721
Teachers treated us like adults	4	4	3	3	4	3	4	5	3	2	3	3	1	4	4	3	4	5	4	4	2	4	4	3.391	0.9880711
Shoot the camera man	5	5	3	5	5	5	5	5	1	3	3	2	4	5	4	5	5	2	2	1	5	5	1	3.826	1.4350221
Learned how to use new equipment - good	3	4	3	4	3	4	4	3	5	4	4	4	2	5	3	4	.	5	2	5	5	4	4	3.609	1.117592
Good that industries take an interest	3	4	5	4	4	5	3	4	5	4	4	4	3	4	5	5	5	5	5	4	5	5	4	4.304	0.7029019
Learned not to judge people by their appearances	1	5	3	5	2	4	1	1	5	4	4	3	1	5	5	5	5	5	3	3	5	4	4	3.609	1.4996706
Accommodation comfortable	1	4	3	4	3	3	3	1	5	2	3	3	2	3	1	4	3.	5	2	3	3	4	3	2.957	1.1069311
Some negative teachers	1	5	3	3	1	2	3	1	2	3	3	3	4	3	3	4	4	4	4	3	2	5	4		1.14726

This exercise was used as the main simulation in account 1 and as a warm-up exercise in account 5. The image has been reduced from A4.

The Chair:

a design and marketing simulation



This chair was made from a sheet of plywood which was cut, folded, rolled and glued to achieve the form you can see on the right. It was made up from the `net` you can see below (not to scale).

Your task is to design and make a chair of your own using the same techniques.

Work to a scale of 1:10 (100mm=1metre full size.

1. Working in your teams, make up your design in card by the deadline given.

2. Work out the cost per chair using the information below, remember to include waste.

3. Set your selling price, that is cost per chair + the profit you wish to make per chair.

4. You will be briefed on the market simulation. You have £1000 per team to spend.

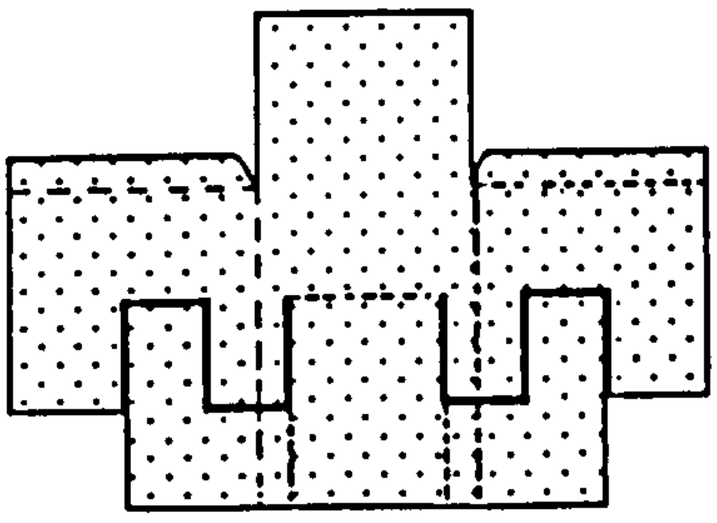
5. After the market place work out how many chairs you sold. If you multiply this by the profit per chair you will have a total income.

number sold * **profit per chair** = **income**

£ £

Manufacturing costs:

material	£1.00p per square metre (full size)
cutting	10p per length of cut
folding / rolling	10p per fold or roll up to 90o
glueing	10p per separate glued area
colour	50p per colour applied



The net before folding

Design and Technology
Loughborough University