

A STUDY OF THE NATURE, MANAGEMENT
AND RELATIVE EFFECTIVENESS OF PUPIL PROJECT WORK
IN C.S.E. SCIENCE

E.J. AUSTIN BSc., MIBiol.

Thesis submitted to the University of Leicester
for the degree of PhD.

October 1983

UMI Number: U346068

All rights reserved

INFORMATION TO ALL USERS

The quality of this reproduction is dependent upon the quality of the copy submitted.

In the unlikely event that the author did not send a complete manuscript and there are missing pages, these will be noted. Also, if material had to be removed, a note will indicate the deletion.



UMI U346068

Published by ProQuest LLC 2015. Copyright in the Dissertation held by the Author.
Microform Edition © ProQuest LLC.

All rights reserved. This work is protected against
unauthorized copying under Title 17, United States Code.



ProQuest LLC
789 East Eisenhower Parkway
P.O. Box 1346
Ann Arbor, MI 48106-1346



Thesis

17.4.1984

VOLUME ONE

ACKNOWLEDGEMENTS

I am indebted to Professor M.J. Galton who undertook the supervision of this thesis, to Professor G. Bernbaum and Dr. E.S. Freedman for their helpful comments and words of encouragement, to the East Midland Regional Examinations Board for providing me with much of the official information on C.S.E. examining in the region, and to Ms. V. Davidson who painstakingly prepared the typescript.

E.J.A.

C O N T E N T S

	Page
<u>CHAPTER ONE</u> <u>THE RESEARCH IN CONTEXT</u>	... 1
1. Introduction	... 2
1.1. The 'Average' Child	... 3
1.2. The Historical Perspective	... 4
1.3. The Certificate of Secondary Education	... 11
1.3.1. Modes of Examining	... 12
1.3.2. Mode III Work	... 15
1.4. The Project Approach	... 16
1.4.1. The Doubts about Project Work	... 21
1.5. The New 16-Plus Examination	... 24
1.6. The Lay-out of the Current Study	... 28
Notes	... 31
 <u>CHAPTER TWO</u> <u>THE RESEARCH DESIGN</u>	 ... 37
2.1. The Planning of the Study	... 38
2.2. The Method of Enquiry	... 41
2.3. The Questionnaire	... 48
2.4. The Interviews	... 51
2.4.1. The Interview Schedule	... 54
2.5. The Observational Study: A Pilot Scheme	... 56
2.5.1. The Observation Schedule	... 61
2.5.2. The Observation Strategy	... 67
2.6. Processing the data	... 69
Notes	... 71

CONTENTS (cont.)

		Page
<u>CHAPTER THREE</u>	<u>PUPIL PROJECTS</u>	72
3.1.	The Types of Project Work Undertaken by Pupils following C.S.E. Science Courses	73
3.2.	Topics for Project Work: Their Choice and Assignment	85
3.3.	Summary and Discussion	94
	Notes	99
 <u>CHAPTER FOUR</u>	 <u>THE ORGANISATION AND MANAGEMENT OF PUPIL PROJECT WORK</u>	 100
4.1.	Pupil Organisation: The Individual and Group Approach	101
4.2.	Guidance and the Supervision of Pupil Project Work	106
4.2.1.	Current Findings (i) Levels of Guidance	108
	(ii) The Time for Guidance	111
4.2.2.	The Question of Guidance: An Extended Discussion	114
4.3.	Working on Projects: The Time and Place for Project Work	117
4.3.1.	The Place of Project Work in Formal Class Periods	117

CONTENTS (cont.)

	Page
4.3.2. The Time Spent on Project Work by C.S.E. Science Pupils	... 127
4.3.3. Working on Projects: A Summary	... 137
Notes	... 141

<u>CHAPTER FIVE</u>	<u>THE ROLE OF PROJECT WORK IN THE</u>	
	<u>ACQUISITION OF SKILLS AND THE</u>	
	<u>DEVELOPMENT OF FAVOURABLE ATTITUDES</u>	
	<u>TOWARDS LEARNING AND SCIENCE</u>	... 142
5.1.	The Background to the Research	... 143
5.2.	The Results of the Enquiry:	
	General Findings	... 168
5.3.	The Acquisition of Cognitive Skills	... 174
5.3.1.	Research Findings	... 180
5.4.	The Development of Organisational/ Managerial Skills	... 191
5.4.1.	Research Findings	... 196
5.5.	The Acquisition of Practical/ Manipulative Skills	... 204
5.5.1.	Research Findings	... 205
5.6.	Socio-attitudinal Aspects of Project Work	... 208
5.6.1.	Research Findings	... 214
5.7.	Combined/Related Skills	... 221
5.8.	The Ability of Pupils to Benefit from Project Work	... 231

CONTENTS (cont.)

	Page
5.9. The Attitudes of Pupils of Varying Ability towards Project Work	... 241
Notes	... 255

CHAPTER SIX SUBJECTS, SCHOOLS AND TEACHER

CHARACTERISTICS: The Main Findings

relating to the Use of Project Work

in C.S.E. Science Courses ... 256

6.1. The Survey Population:	
6.1.1. Subject Area and the Use of Project Work	... 257
6.1.2. Regional Locality and the Use of Project Work	... 261
6.2. The Teachers: General Characteristics	
6.2.1. Previous Studies	... 263
6.2.2. Sex Ratios	... 276
6.2.3. Age	... 279
6.2.4. Qualifications and Training	... 282
6.2.5. Higher Degrees	... 286
6.2.6. Experience:	
(i) Years in Teaching	... 288
(ii) Previous Teaching Positions in Secondary Education	... 296
(iii) Prior Experience of C.S.E. Science Teaching	... 300
(iv) Employment Outside the Field of Education	... 304

CONTENTS (cont.)

	Page
6.2.7. Summary	... 314
6.3. The Teachers: General Attitudes	
6.3.1. Attitudes towards Teaching	... 319
6.3.2. Attitudes towards Project Work	... 322
6.4. Science Teachers: A Typology based on Cluster Analysis	... 334

CHAPTER SEVEN PROJECT WORK IN PROGRESS:

<u>THE OBSERVATIONAL STUDY</u>	... 352
7.1. Early Considerations	... 353
7.2. The Project Lessons: A Brief Description	... 360
7.2.1. The S-Band Class	... 361
7.2.2. The G-Band Class	... 364
7.3. The Findings	... 366
7.3.1. Pupil Talking	... 367
7.3.2. Pupil Reading	... 373
7.3.3. Pupil Writing	... 375
7.3.4. Pupil Practical Work	... 377
7.4. Summary and Conclusions	... 382
7.5. The Limitations of the Pilot Study	... 391
(i) The Observation Schedule	... 391
(ii) The Teachers	... 393
(iii) The Topics	... 394
(iv) The Project Strategy	... 395
Notes	... 397

CONTENTS (cont.)

	Page
<u>CHAPTER EIGHT</u> <u>MAJOR CONSTRAINTS ON THE</u> <u>IMPLEMENTATION OF PROJECT WORK</u>	... 399
8.1. Introduction	... 400
8.2. Main Reasons for Not Using Project Work in C.S.E. Science	... 401
8.3. Managerial and Organisational Aspects	... 401
8.3.1. Class Size	... 408
8.3.2. Class Composition	... 412
8.4. Applicability of Project Work to Examination Syllabus	... 420
8.5. Pupil Ability	... 423
8.6. Examination and Assessment Procedures	... 425
8.7. Resources and Facilities	... 429
8.8. Pupil Attitude	... 440
8.9. Other Factors	... 443
8.10. Summary and Discussion	... 445
Notes	... 452
 <u>CHAPTER NINE</u> <u>FINDINGS AND IMPLICATIONS</u>	... 456
9.1. The Findings: An Overview	... 457
9.2. Implications	... 470
9.3. Recommendations	... 478
9.4. Towards Further Research	... 486
Notes	... 488

LIST OF TABLES

CHAPTER TWO

Page

2.1. The Interviewees: By Subject Area and Use of Project Work	...	54
2.2 Science Pupil Observation Schedule	...	65

CHAPTER THREE

3.1. The Types of Project Work Being Undertaken by Pupils in the Four Main C.S.E. Science Subjects	...	74
3.2. The Choice and Assignment of Topics for Pupil Project Work in Each of the Main C.S.E. Science Subjects	...	87
3.3. Factors Guiding Teachers in their Decision to Assign Topics or Give Pupils Choice	...	87

CHAPTER FOUR

4.1. The Incidence of Project Work on an Individual and Group Basis: The Usual and Preferred Arrangements	...	103
4.2. Levels of Guidance for Pupils Engaged in Project Work in C.S.E. Science	...	109

LIST OF TABLES (cont.)

	Page
4.3. The Periods during which Guidance was usually given to Pupils undertaking Project Work in C.S.E. Science Courses ...	112
4.4. The Place of Project Work in Formal Class Periods ...	121
4.5. The Total Number of School Hours Per Course Spent on Project Work in C.S.E. Science Subjects ...	131
4.6. The Total Number of Hours per Course Teachers Think Pupils Should Spend on Project Work ...	133
4.7. The Time Actually Spent on Projects Compared to the Amount of Time Pupils Should Spend on Them ...	135

CHAPTER FIVE

5.1. a. E.M.R.E.B. Mode I C.S.E. Biology Syllabuses 1980: Aims and Objectives ...	156
b. E.M.R.E.B. Mode I C.S.E. Syllabuses, Chemistry and Physics 1980: Shared Aims and Objectives ...	157
c. E.M.R.E.B. Mode I C.S.E. General Science Syllabus 1980: Main Objectives ...	158
5.2. The Main Behavioural Objectives Common to the E.M.R.E.B. Mode I C.S.E. Syllabuses for Biology, Chemistry, General Science and Physics (1980) ...	159 - 160

LIST OF TABLES (cont.)

	Page
5.3. Project Work as a Means of Developing Skills and Attitudes Appropriate to the Major Objectives of the Four Main C.S.E. Science Courses	... 171
5.4. Project Work as a Means of Developing Skills and Attitudes which may not otherwise be tapped in C.S.E. Science Courses	... 172
5.5. The Types of Skills and Attitudes Developed mainly through Project Work as identified by the Users of the Project Approach at C.S.E. Level	... 173
5.6. Project Work as an Exercise in Plagiarism	... 183
5.7. The Acquisition of Cognitive Skills Through Project Work	... 188
5.8. Project Work as a Means of Developing Skill in the Planning and Organisation of Scientific Investigations	... 200
5.9. The Development of Socio-attitudinal Skills through Project Work	... 219
5.10. The Development of Skills of Communication and Presentation through Project Work	... 224
5.11. a. Pupil Ability as a Variable affecting the Benefits to be Derived from Project Work	... 234
b. The Benefit to be gained from Project Work by Pupils of Differing Levels of Ability - Who Gains Most?	... 235
5.12. The Attitudes of Pupils of Varying Ability towards Project Work	... 244

LIST OF TABLES (cont.)

<u>CHAPTER SIX</u>	Page
6.1. The Questionnaire: Teacher Response by Subject Area and Use of Project Work ...	259
6.2. The Questionnaire: Teacher Response by Regional Locality and Use of Project Work ...	262
6.3. The Use of Project Work by Male and Female Teachers in Different Subject Areas ...	278
6.4. Teacher Age: An Analysis by Subject Area and Use of Project Work ...	281
6.5. Qualifications and Training of Teachers of C.S.E. Science: An Analysis by Subject Area and Use of Project Work ...	283
6.6. The Incidence of Higher Degrees among the Teachers of C.S.E. Science ...	287
6.7. The Teachers:	
a. Years Spent in Current Establishment ...	290
b. Years Spent in Teaching ...	292
6.8. a. The Incidence of Experience in other Full-time Secondary Teaching Posts ...	296
b. Prior Teaching Experience in Secondary Education: Types of Establishment ...	298
6.9. a. The Incidence of Prior C.S.E. Science Teaching Experience among the Users and Non-Users of Project Work ...	301
b. The Range of C.S.E. Teaching Experience Gained by Science Respondents ...	302

LIST OF TABLES (cont.)

6.10.	a.	The Incidence of Full-time Employment Outside the Field of Education Among the Teachers of C.S.E. Science	... 305
	b.	The Nature of Employment Outside Education	... 307
	c.	The Incidence of Scientific and Industrial Work Experience Among the Users and Non-Users of Project Work	... 310
	d.	The Duration of Employment Outside Education	... 311
6.11.		Teaching Commitments in Relation to Qualifications and Training	... 321
6.12.		Attitudes Towards Project Work	... 324
6.13.		The Range of Attitudes Held by the Users and Non-Users of Project Work	... 330
6.14.		The C.A.R.M. Program	... 337
6.15.		Diagnosis of Three Clusters	... 340
6.16.		Cluster Group Attitudes Towards Project Work	... 341
6.17.		The Use of Project Work by Cluster Group Members	... 342

LIST OF TABLES (cont.)

CHAPTER SEVEN

7.1.	Pupil Activity during Project Work	...	368
7.2.	The Incidence of ' <u>Talking to Peer(s)</u> ' among Pupils engaged in Project Work:		
	a. Pupils of Above-Average Ability (S-Band)	...	370
	b. Pupils of Below-Average Ability (G-Band)	...	370
7.3.	The Incidence of ' <u>Talking to Teacher</u> ' among Pupils engaged in Project Work:		
	a. Pupils of Above-Average Ability (S-Band)	...	372
	b. Pupils of Below-Average Ability (G-Band)	...	372
7.4.	The Incidence of Reading and Writing among Pupils engaged in Project Work:		
	a. Pupils of Above-Average Ability (S-Band)	...	374
	b. Pupils of Below-Average Ability (G-Band)	...	374
7.5.	The Incidence of Practical Activity among Pupils of Varying Ability engaged in Project Work	...	379

LIST OF TABLES (cont.)

CHAPTER EIGHT

- 8.1. Chief Factors influencing Teachers in
their Decision Not to Use Project Work
as part of their C.S.E. Science Teaching
Programme ... 402
- 8.2. Teachers' Ratings of the Facilities in
their Schools and Colleges, and their
Availability to Pupils engaged in
Project Work ... 433

LIST OF FIGURES

CHAPTER TWO

Page

- | | | | |
|-------|--|-----|----|
| 2(i) | Flow Chart Illustrating the Method of Enquiry and the Levels of Response | ... | 47 |
| 2(ii) | Science Pupil Observation Schedule:
Basic Structure | ... | 66 |

CHAPTER FIVE

- | | | | |
|-------|---|-----|-----|
| 5(i) | A Diagrammatic Representation Illustrating the Possible Relationship Between Pupil Ability and Effective Project Work | ... | 239 |
| 5(ii) | Bar Chart Illustrating Teacher Opinion about the Attitudes of Pupils of Varying Ability Towards Project Work | ... | 245 |

CHAPTER SIX

- | | | | |
|--------|---|-----|-----|
| 6(i) | Years Spent in Current Establishment | ... | 291 |
| 6(ii) | Years Spent in Teaching | ... | 293 |
| 6(iii) | The Duration of Employment outside Education | ... | 312 |
| 6(iv) | Agreement with Favourable Statements about Project Work | ... | 327 |

LIST OF FIGURES (Cont.)

CHAPTER SIX (Cont.)

6(v)	Agreement with Unfavourable Statements about Project Work	... 328
6(vi)	a. Favourable Attitudes Towards Project Work among Users and Non-Users	... 331
	b. Unfavourable Attitudes Towards Project Work among Users and Non-Users	... 332
6(vii)	Patterns of Group Merger	... 338
6(viii)	The Fusion Plot showing Reflexion at Cluster Stage 3.	... 339

CONTENTS (cont.)

	Page
<u>APPENDICES</u>	
I The Questionnaire ...	490
II Regional Composition: Sampling of Centres ...	505
III The Survey Population: Sampling by County/ Subject Area ...	506
IV The Survey Population: Analysis by County and Use of Project Work ...	507
V Analysis of Response to Questionnaire by Teachers of C.S.E. Science ...	508
VI The Interview Population: Sampling by County/Area ...	509
VII Interview Items:	
a. Topics frequently included on the C.S.E. Science Syllabuses ...	510
b. Teaching Strategies and Assessment Procedures ...	511
c. Possible Constraints ...	511
VIII a. Sampling in the Observational Study ...	512
b. Frequency of Use of Categories of the Science Pupil Observation Schedule ...	513
IX The 'Non-Users': Their Experience of Project Work ...	516

<u>BIBLIOGRAPHY</u> ...	523
-------------------------	-----

CHAPTER ONE

THE RESEARCH IN CONTEXT

- 1. Introduction
 - 1.1. The 'Average' Child
 - 1.2. The Historical Perspective
 - 1.3. The Certificate of Secondary Education
 - 1.3.1. Modes of Examining
 - 1.3.2. Mode III Work
 - 1.4. The Project Approach
 - 1.4.1. The Doubts about Project Work
 - 1.5. The New 16-Plus Examination
 - 1.6. The Lay-out of the Current Study
- Notes

1. Introduction

The period leading up to the study reported here coincided with a time of growing concern about the functions of education for pupils who, in a rapidly-changing technological world, were destined for new and very different types of work and leisure. Strong arguments were emerging in favour of a move away from the more traditional methods of science teaching and examining, and their reliance on factual knowledge, towards strategies which would make science more relevant to the 'real' world outside the classroom, place more responsibility on pupils for their own learning and lay emphasis on the skills and 'processes' of science rather than the memorization of facts. Indeed, it was on this set of arguments that the proponents of the project approach built their case.

In considering the case for project work in science teaching and examining, this thesis directs attention towards the 'average' pupil and explores the use of project work within the national examination scheme designed specifically for such pupils, namely the Certificate of Secondary Education (C.S.E.). In this first chapter, the development of the C.S.E. is discussed alongside the growth of Mode III examining and the subsequent expansion of project work across all areas of the school curriculum. Early views on the value and effectiveness of the project approach in a variety of settings (including the new 16-plus examination) are also considered and it is against this educational backcloth that the aims of the current enquiry are formulated.

1.1. The 'Average' Child

It has been suggested that the most neglected pupil in the State education system is the 'average child'⁽¹⁾. Within the existing comprehensive framework, a good deal of time, energy and resources has, it is argued, been spent on those pupils promising high scholastic achievement and, at the other end of the scale, children with learning difficulties have drawn due sympathy, but the 'average child', by slotting neatly in the middle, presents relatively few overt problems and has, as a result, received little direct attention.

A recent study by the National Children's Bureau (Steedman 1980), which has analysed mathematics and reading tests of sixteen year olds at comprehensive, grammar and secondary modern schools in England, alongside data from questionnaires and interviews with parents and teachers, has lent some support to this view by suggesting that the present comprehensive schools are failing to cater adequately for children of average ability. However, if one explores the historical development of secondary education and examinations in this country, one can see immediately that the neglect of the average child is not by any means a new phenomenon; it has its roots in an educational system based on elitism, private enterprise and benevolence, and governed by the universities and professional bodies.

1.2. The Historical Perspective

When in 1902, the Education Act gave Local Authorities power, under the Board of Education,

... to supply or aid the supply of education other than elementary, and to promote the general co-ordination of all forms of education ... (Part II, 2(1))

and to establish a network of new secondary schools (later to be called grammar schools), they were forced to accept an external examination system already in existence to equip pupils for entry into the universities and the professions. In one sense, these examinations were valuable in that they enabled the new schools to compete against the longer established grammar and public schools, but in another sense they were a serious constraint. The pressure of the examinations prevented schools from providing a good general education because it was in their interests to prepare pupils for the examinations which covered only a relatively narrow range of subjects. As a result, 'cramming' became popular and important areas of the curriculum not covered by the examination were neglected. The deleterious effects of this system on the general education of the average child were soon recognised although it was 1917 before the much discussed two-tier examination scheme, the School Certificate and the Higher School Certificate, was finally instituted by the Board of Education.

The School Certificate was designed for sixteen year olds to conclude a course of general education, and to gain certification a pupil had to pass in five subjects with at

least one from each of the three subject groups:
Classics, Modern Languages, and Science and Mathematics⁽²⁾.
The Higher School Certificate was introduced for eighteen
year olds who, after specializing, had reached a specified
standard in the three groups. The universities remained
the custodians of the system and although it clearly
catered primarily for the above average pupil, it was
almost twenty years before the system fell into serious
disrepute with the publication of the Spens Report in 1938
and the Norwood Report five years later.

In 1926, the Hadow Committee, reporting on 'The
Education of the Adolescent', advocated a complete break
in primary and secondary education at the age of eleven,
and prepared a charter for a different type of modern
secondary school that was meant neither to emulate nor be
inferior to the grammar school. It was proposed that all
children should be:

Transplanted to new ground, and set in a new
environment, which should be adjusted, as far as
possible, to the interests and abilities of each
range and variety ... (Hadow Report, p.xix).

and it was the hope that the study of subjects such as
English, modern languages, history, geography, mathematics
and science would be:

... related more closely to the living texture of
industrial or commercial or rural life ...
designed to stimulate interest in boys and girls
who are beginning to think of the coming years
and a career in life, and are likely to feel
the liveliest quickening of the mind when they
see the bearing of their studies on that career
(ibid, p.xx).

The two types of secondary school proposed by the Committee
were never instituted but the report did bring a new look
to education and set a precedent which, in conjunction

with the Spens Report, was made statutory in the 1944 Education Act.

The Spens Report (1938) examined the secondary school curriculum 'with special reference to grammar schools and technical high schools'. It was harshly critical of the School Certificate examination system, maintaining that it severely cramped curricular freedom by strengthening and intensifying the tendency towards uniformity. The schools, it was argued, were continuing to teach the traditional narrow curriculum with which they were familiar and which, in turn, was accepted by the users (the employers and professional bodies) even though it often had little bearing on their real requirements. The Committee reported:

... We cannot avoid the conclusion that the requirements of the examination have put a heavy premium on certain subjects to the detriment of others, and have compelled schools, in the interest of pupils desiring to obtain the Certificate, to teach certain subjects to all pupils throughout their course, even when they might be deriving greater benefit from taking alternative subjects or from taking fewer subjects to a higher level. (Spens Report, Chap. VII, 3)

and it was their belief that:

... the demands of the examination, as at present constituted, the rigour of the preparation for it and the importance attached to the certificate by employers are such, taken in conjunction, as often to cause overstrain and excessive anxiety even when children are receiving the wisest guidance at school. (ibid, Chap. VII, 4)

Hence, it was as a result of the Spens Report that a widespread demand for educational reform at all levels emerged.

In 1943, the Norwood Report published by the Secondary School Examinations Council⁽³⁾ (S.S.E.C.) supported the

Spens Report in its condemnation of the existing examination system. It recommended the end of the School Certificate (conducted by the universities) and the introduction of Examining Boards, assisted by panels of teachers, to conduct subject examinations as an interim step towards internal examinations run by the schools themselves. It proposed four quite radical concepts which, in retrospect, are especially relevant to the education of the average child, and the demand for 'effective teacher control' of the syllabus and examination, which was only finally met with the introduction of the Certificate of Secondary Education (C.S.E.) some twenty years later. The Norwood Report made the following proposals:

- i. To provide every school-leaver with a comprehensive report containing the fullest positive information about his/her abilities, in all aspects of school life.
- ii. For individual schools to carry out systematic internal examinations to suit particular pupils and their courses.
- iii. For the Ministry and the L.E.A.'s to prompt experiments and studies in the conduct and assessment of internal examinations.
- iv. To organise associations of teachers to set and mark papers and for them to be assessed by external assessors.

No immediate action was taken on these proposals but with the introduction of the tripartite system (grammar, technical and secondary modern schools) following the 1944 Education Act, it soon became clear that the new secondary modern schools would make use of the School Certificate examination despite its inappropriateness, and that changes would have to be made.

In 1946, the Minister of Education reformed the S.S.E.C. to ensure that it no longer held interested parties, namely the representatives of the School Certificate examining boards. A year later the new Council produced its first report recommending the introduction of a single examination, the General Certificate of Education (the G.C.E.), taken at two levels to replace the School and Higher School Certificate. The proposed G.C.E. would be fundamentally different from the School Certificate scheme in that it would be a single-subject examination with no restrictions on the subjects that could be taken or the entries. It was proposed that the standard of a pass at G.C.E. Ordinary level should be approximately equivalent to a credit in the School Certificate examination.

The General Certificate of Education was introduced in 1951 although in several respects it failed to fulfil its aims from the start. The grammar schools began adapting the scheme, making the new examination almost identical to the old one. The universities contributed to this by specifying entrance requirements in terms of groups of subjects and minimum qualifications. In addition, the minimum age for entering the G.C.E. had been set at sixteen years but after a good deal of negotiation on the part of the grammar schools, a clause was passed so that the minimum age of entry became practically meaningless. As a consequence, pupils were being entered en masse for the O-level as early as possible.

The G.C.E. O-level was designed for the top 20% of the ability range (i.e. for those pupils at the selective

schools) but the secondary modern schools could not fail to be interested. The advantages of single-subject individual entries were quickly realised and this, combined with post-war demands for educational qualifications, meant that increasing numbers of candidates were being entered for G.C.E. O-level outside the selective schools for which it was designed. There was also at that time a considerable increase in the number of external examinations other than the G.C.E. in operation and both these issues were a cause of concern. The Central Advisory Council for Education was consulted, and in July 1958 a special sub-committee of the S.S.E.C. was formed to study secondary school examinations other than the G.C.E. The Crowther Report was produced in December 1959 and reported in favour of external examinations organised on a regional or local basis and of formal assessments by the schools. Seven months later, the sub-committee chaired by Robert Beloe made its report.

Reiterating many of the arguments put forward by the Norwood Committee some seventeen years earlier, the Beloe Report (1960) is acknowledged as a landmark in educational development by (i) recommending that new external examinations aimed at pupils below G.C.E. O-level ability could make a valuable contribution to the educational process, (ii) emphasising the importance of the teacher in the control of those examinations, and (iii) stressing the need for research and development provision to enable teachers to improve their assessment and examining skills.

In considering the new examinations, the Beloe Report¹ also specified certain criteria that would have to be fulfilled if the examinations were to be successful and useful. The following recommendations were drawn up:

- i. The examinations should be appropriate for pupils at the end of the fifth year of a secondary education course.
- ii. They should be aimed at the 20% below the G.C.E. O-level and yet permit those up to 40% below the level to attempt them (i.e. the examinations should cater for those pupils within the 40th to 80th percentile range).
- iii. They should be specially designed to fulfill the needs and interests of the candidates in the ability range stated, and not simply be a diluted or lower version of G.C.E. O-level.
- iv. The examinations should adopt a different approach, provide for practical work wherever possible, and aim to encourage candidates to show 'involvement' in their subjects. Credit should be given for freshness of approach, intelligence and ability to write good English, as well as for remembered facts and textbook learning.
- v. The examinations should be arranged on a single subject not group basis, with the majority of entrants attaining four or more subjects.
- vi. They should be largely under the control of the teachers serving in the schools, their task being overseen by the Regional Examining Bodies.

It was these recommendations that formed the basis for the setting up of the Certificate of Secondary Education (C.S.E.) examinations over the five years that followed.

1.3. The Certificate of Secondary Education

The C.S.E. became operational in 1965 and its emergence was important for several reasons.

It was the first national scheme designed specifically to cater for the majority (i.e. the 'average') of secondary pupils. Prior to this, public examinations had been aimed mainly at the grammar schools for those seeking entry to university or professional life. The C.S.E. moved away from this; it sought to examine a wider range of ability than had ever been examined before.

In 1963, the Standing Committee of the S.S.E.C. proposed that the performance of pupils in C.S.E. examinations should be graded on a five-point scale with reference grades 1 and 4 defined thus⁽⁴⁾:

Grade 1 - This grade reflects the overlaps, in terms of the calibre of the candidates, between those entering a C.S.E. examination and those entering a G.C.E. examination. An award of Grade 1 indicates that the candidates, had they followed a G.C.E. course, could have reasonably expected to gain a pass at Ordinary level⁽⁵⁾.

Grade 4 - This grade reflects the standard of performance to be expected from a sixteen year old of average ability in the subject, having applied himself to an appropriate course of study with regard to his age, aptitude and ability⁽⁶⁾.

By defining the scope of the examination in terms of a band of ability rather than an expected standard of performance, it was hoped that the teachers would teach according to their own 'collective judgement' of 'average' and not according to some pre-defined standard which may have been set too high or too low. This system of grading was adopted and is still in use today.

1.3.1. Modes of Examining

The C.S.E. was also important in being the first system to put into practice the radical principle of 'effective teacher control' of the syllabus and examinations, a concept that was first introduced in the Norwood Report some twenty years earlier. It made provision for three distinct modes of examining,⁽⁷⁾ a facility which rapidly gained support following the raising of the school leaving age to sixteen in 1973⁽⁸⁾, and which continues to be a much valued aspect of the C.S.E.

In Mode I examinations, the examining board⁽⁹⁾ defines the syllabus and examination scheme; under Mode II the school (or, in some regions, a group of schools) compiles

its own syllabus on which the board then examines candidates, while under Mode III the school (or group) compiles the syllabus and devises the assessment, the standards and conduct of which are overseen by the board through its moderation procedures.

Over the years, a number of adaptations have been made to these original schemes and as a result the absolute distinction between the three modes does not exist to anything like the extent first envisaged. For instance, within the Mode I framework there has been a growing tendency to include an element of teacher assessment of some aspect of the pupils' work undertaken during the course. Similarly, a variation has emerged in the form of 'mixed mode' examinations where a school takes part of the Mode I examination while making its own assessment, under moderation, of other aspects of the pupils' work. However, despite these modifications, the major aims of the C.S.E. have remained intact. By extending the role of the teacher and using his/her expertise in the assessment of course work, practical work, projects and the like, the examination has aimed to provide a more complete picture of pupil attainment in all areas of school work. Moreover, by placing increased responsibility on schools 'to decide which of the available facilities will best meet the needs of their pupils',⁽¹⁰⁾ it has been the hope that the examination will serve to 'reflect and not inhibit the originality of the work being done in the schools',⁽¹¹⁾.

Although it has long been accepted that an examination should not dictate the subject matter of the syllabus nor how it is taught within the schools⁽¹²⁾, it was not until

the introduction of the C.S.E. that any real progress was made in reducing the damaging backwash effects of examinations. By the principle of teacher control (brought about by the establishment of regional examinations boards functioning through subject panels and sub-committees with teachers in the majority) and the provision of alternative modes of examining (Mode II, Mode III and mixed-mode) the C.S.E. increased the range of curricular options open to teachers and went some way towards ensuring that what was examined was what they (the teachers) actually wanted to teach. It urged them to become more responsive to the needs of their pupils and, in this light, to consider critically the content and methodology of their courses, and their assessment strategies.

The C.S.E. therefore marks the turning point in the history of examinations in this country; it moved the balance of power away from the universities and examining boards towards the teacher in the classroom, and as a consequence, it promised a better deal for average pupils: the chance of certification on an examination that was more relevant to their real needs, interests and aptitudes.

When the C.S.E. was first instituted there was only very limited experience of examining pupils of this age and ability range but now, as a result of research and development through the teacher in the classroom, there exists a wealth of expertise among teaching staff and board officials and a wide variety of proven examining techniques⁽¹³⁾. C.S.E. courses have become more imaginative and less academic; some have developed an interdisciplinary approach (e.g. Integrated Science, Environmental Studies;

Materials Chemistry) others have become vocational (e.g. Audio Typing, Accounts, Office Practice). Hence, it is now generally agreed that the examination board/teacher partnership has paid off; it has led to improvements in course design and assessment procedures and has resulted in a richer learning experience for many pupils⁽¹⁴⁾.

1.3.2. Mode III Work

All C.S.E. boards have examined under all modes since 1965 and now, following the pioneer work carried out in the C.S.E. field, many G.C.E. boards feature different modes of examining and include an element of teacher assessment at both O- and A-level.

Mode III work, in particular, has expanded across the secondary school curriculum⁽¹⁵⁾. It carries a number of distinct advantages, the most important being that of flexibility. Mode III courses are especially valuable in that they can be tailor-made to meet the needs of particular groups of pupils, with respect to subject content, teaching methods and assessment techniques. Through the Mode III scheme, courses can be developed that help to relate school work to the real life of the pupils and by making school study more relevant, Mode III courses can increase interest and motivation, and improve behaviour and discipline. It follows that such improvements help to make the teacher's job more rewarding too.

Mode III schemes are also useful in the handling of mixed-ability classes composed of pupils destined for

different examinations (notably G.C.E. and C.S.E.). In these situations, a C.S.E. Mode III syllabus can be constructed that is compatible with the G.C.E. course whilst taking full advantage of existing resources and facilities (e.g. where Nuffield Science O-level courses have been offered, Mode III schemes based on Nuffield Science have, in many cases, satisfactorily fulfilled the requirements)⁽¹⁶⁾. Hence, a C.S.E. syllabus can be designed so that a teacher is able to pursue a common course but still enter pupils for the examination most appropriate to their ability level. In practice, this has the added advantage of allowing teachers to delay decisions about G.C.E./C.S.E. entries until the last possible time and, under certain circumstances, it gives them the option of double-entry.

Thus, it can be seen that the introduction of the C.S.E. and, more especially, the Mode III examination has given teachers unprecedented freedom in their choice of course material, teaching strategies and assessment procedures. Moreover, as doubts have surfaced that wholly external examinations might fail to tap important areas of pupil attainment, arguments supporting the use of teacher assessments have grown in strength.

1.4. The Project Approach

In attempts to complete the picture of pupil attainment, a wide variety of approaches have emerged so that all kinds of school (and out of school) work are now included in the assessment of pupils for examination purposes. One approach that has increased in popularity across all areas

of the school curriculum is pupil project work⁽¹⁷⁾, and it is the use of project work as a teaching/learning strategy and as an assessment procedure in the context of C.S.E. science examinations that forms the basis of the research documented here.

Although the project approach itself was not new, the Mode III examination alongside the influence of O-level Nuffield Science gave it renewed impetus so that from 1965 to the present day more and more examination courses have incorporated some type of project work in their syllabuses as part of a teacher assessment scheme.

Project work has over the years acquired a wide range of interpretations and its format has as a consequence varied greatly from course to course. Pupil age, ability and attitude have clearly set certain limits as to what kind of project approach can be most successfully implemented. However, despite these variations, a review of earlier studies reveals certain key features which help to characterize the different types of project approach.

All projects require pupils to use their initiative and to assume some degree of personal responsibility for their own work. Wilmut (1971) has acknowledged this in his own definition of project work in Nuffield A-level Physical Science:

A project is a piece of work organised principally on the initiative of a pupil, involving a substantial element of personal enquiry, and the structuring of ideas and/or experiments in order to pursue the enquiry to a logical conclusion.(Wilmut 1971, p.7)

Deere (in Macintosh 1978) in a discussion of the assessment of project work has identified similar elements:

(Project work) ... a teaching/learning activity which requires the student to determine one or more of the following, his strategy, his resources, his target; which presents a task which is not artificially compartmented nor idealized; which allows a range of solutions rather than a unique answer. ... (Deere in 'Techniques and Problems of Assessment' edit. by H.G. Macintosh 1978)

Several writers have stressed the importance of problem-solving in their definitions of project work. Browning (1967), for instance, has indicated that,

In its widest context it (project work) consists of the presentation of a problem, theoretical or practical, which is new to the student and which requires a measure of thought and care to find the solution. (Browning 1967, p.68)

Others, whilst accepting the role of problem-solving, have emphasised the practical aspects of project work. For example, the National Examinations Board in Supervisory Studies (N.E.B.S.S.)⁽¹⁸⁾ have drawn up the following aims:

It will be an investigation of a problem or situation and involve collecting appropriate information followed by its analysis in order to arrive at logical conclusions and make suitable recommendations ... The principle purposes of the project are to provide the student with practical experience in problem identification and solution, together with an opportunity to apply the knowledge he has gained from the specialist tutors. (N.E.B.S.S. 'Notes for Guidance on Projects' 1981)

Harper (1972) in a discussion paper on project work at degree level has set out the aims of project work in terms of the intellectual phases of science to be experienced by the student: defining a problem, reviewing the literature, preparing the material, selecting appropriate techniques, analysing the data, presenting the data and discussing the results. Support for this type of experimental/investigative approach to project work has been widespread although several studies have shown that such work is probably

beyond the scope of all but the very able pupils (Cronbach and Snow 1969; Hewitt 1970; Reid and Booth 1970, 1971; Wells 1972). Surprisingly few studies have placed value on totally theoretical approaches although Halliday (1972) and Harper (1972) have acknowledged that there may be areas in science where projects involving bibliographic or critical review treatments might provide comparable worthwhile 'practical' experience.

The importance of pupil interest in project work has received much attention. In the A-level biology course studied by Eggleston and Kelly (1970) the definition of project work that was finally accepted includes the element of pupil interest:

... a biological study carried out by the student, largely on his own initiative, involving experimental enquiry into some aspect of biology which has interested him. (Eggleston and Kelly 1970, p.225)

while the guidelines on project work given by the N.E.B.S.S. (cited earlier) state that:

The project should, wherever possible, be concerned with matters at the student's place of work. (N.E.B.S.S. 'Notes for Guidance on Projects' 1981)

Head (in Sutton et al 1974) has suggested that learning can be made more relevant and interesting not by the study of the formal logical structure of the subject but by teaching around real-life situations or topics, with the centre of interest arising from pupils' own suggestions, and Carin and Sund (1970), commenting on science teaching through discovery, have indicated that efficiency in problem-solving occurs most rapidly when the problems are related to the interests of the students and are appropriate to their maturity level.

Hence, by placing demands on the pupils' own initiative, by requiring pupils to demonstrate some personal responsibility for their own work, by incorporating the elements of practical enquiry and problem-solving, and by tapping the pupils' own special interests, the project approach would seem to have much to offer both as a teaching/learning strategy and as an assessment procedure. Its advocates have viewed it as a valuable component of science courses, contributing an important element to the teaching/learning process at all levels. Project work has been especially valued for its role in the acquisition of skills which by more conventional teaching methods might fail to be secured. In addition, it has been suggested that the independent nature of project work makes it more suitable for girls who, according to recent studies, lack confidence in their ability to succeed in more traditional science classes (Kelly 1978, 1981). Indeed research has shown that girls fare less well than boys in classroom questioning (Samual in Kelly 1981), pupil/teacher interactions (Spender 1982) and multiple choice/single answer testing (Kelly 1982) - that is, activities requiring a measure of self-confidence - but better on structured, essay-type exercises which allow for qualifications and hesitations, without the fear of ridicule from male contemporaries (Elliot 1974). Viewed in this light, the project approach has gained additional support from those opposed to sexism in education, who believe that by allowing pupils to work independently on topics that interest them, and to proceed at their own pace, in a co-operative rather than competitive atmosphere, project work has enabled girls to escape the

dominant male attitude that intervenes conventional science lessons and has given them a greater chance of success.

1.4.1. The Doubts about Project Work

The project approach has not, however, been left unchallenged. In recent years, practising teachers and examiners have expressed growing concern about the project method, and its usefulness and relevance for the 'average' pupil. Serious doubts have been cast on the lasting value of the project approach.

In 1975, the London/Middlesex 16-plus feasibility studies concluded that project work was beset by so many pedagogical and practical difficulties as to be dispensed with⁽¹⁹⁾. Some have suggested, like Eggleston (1980), that the open organisation of projects and the detailed structuring of the activities demanded of the pupils are difficult for even the most able and that, as a result, there may be many pupils who undertake a succession of projects but reach only minimal achievement in each one, and attain no more than a vague grasp of the concepts involved. Furthermore, it has been argued that because of the time limits imposed on project work, there is seldom time to fill in the gaps in understanding so that project work for many turns out to be ^αfrustrating, negative experience.

Similar defects in the project system have been observed in C.S.E. history although many of the arguments put forward by Brown and Daniels (1979) on this issue may

be applied equally well to science:

Most teachers see the project as a personal study in depth into a specific subject. To be of any real value this necessitates, among other things, the use of quite sophisticated reference skills for locating information, skills of discrimination and selection in checking the information and choosing or discarding it, skills of asking questions of material and finally communication skills in producing a synthesis from the chosen information. The good pupil should be able to display initiative and originality. It seems something of a paradox that teachers expect all this sophistication from pupils of average and less than average ability (the C.S.E. pupil), rather than from pupils with greater ability. (Brown and Daniels 1979)(20)

Others have opposed the use of project work on the grounds that it tends to emerge as an exercise in plagiarism rather than problem-solving. Sweetman (1980), discussing the increasing use of course work in C.S.E. assessments, made this point:

Immediately, the "project" approach must be radically and critically questioned. The slavish copying from books and the emphasis on presentation rather than on information, has consistently done a disservice to course-work. It is possible for projects to be original, to draw together and synthesize information from a variety of sources, but in too many cases this approach is neither practised nor encouraged. (Sweetman 1980)(21)

A number of questions have been raised about the use of project work as an assessment procedure. Some have suggested that by placing too much emphasis on presentation and content, and too little on skill processes, project assessments have failed to test fully the level of pupil understanding. Moreover, it has been argued that there has been too much confusion between the value of project work as a teaching strategy and its use as a method of assessment(22).

A variety of factors would seem to make project assessments difficult. The choice of topic, the type of approach, the time allocations, the degree of teacher/parent involvement and the level of guidance and supervision given to pupils are just some of the factors that can affect the project outcome and influence the final assessment. Additional problems arise when a good C.S.E. candidate has perhaps as many as five projects to do in different subjects at one time - a workload that could clearly have an adverse effect on his/her overall performance - and when a pupil with little or no previous experience of the project approach finds project work much more difficult than one accustomed to this type of working.

The difficulty of standardizing these aspects of project work has not escaped the attention of its critics and has, in some instances, led to its transfer from the core to the optional sections of examination syllabuses. However, despite these problems, the project approach has grown in popularity across all areas of the school curriculum although much of the evidence relating to the use of project work with 'average' secondary school pupils remains speculative or anecdotal.

In other contexts, a variety of research studies investigating the operation of project work has been undertaken (see, for example, Armstead 1975; Cowan 1969; Hiles and Heywood 1972; Kelly and Dowdeswell 1970; Reid and Booth 1971; Small 1973). These and similar studies have been valuable in highlighting some of the negative as well as positive features of project work and, as a result, a range of publications, drawn up specifically to

provide guidelines for those intending to implement a project approach, has arisen (see, for example, Browning 1967; Deere in Macintosh 1978; Green 1976; Handy and Johnstone 1974; Jones 1970; Wilson 1976). Hence, for those teachers concerned with non-science or non-vocational, non-examination or highly advanced courses, a wealth of prescriptive information is available. But for the user of project work in C.S.E. science, little of direct relevance has as yet been produced.

Lack of any substantial data on the operation of project work within the context of C.S.E. science examinations without doubt constitutes a serious omission if any realistic policy is to be formulated concerning the use of project work as a teaching/learning strategy and as a form of assessment for pupils of 'average' ability.

1.5. The New 16-plus Examination

Work in this area is of increased importance in view of the decision to replace the dual system of examining (i.e. the G.C.E. O-level and the C.S.E.) by a single examining system, the new 16-plus examination (i.e. the General Certificate of Secondary Education - G.C.S.E.), in the late 'eighties. Over the last decade⁽²³⁾, dissatisfaction with the existing system has grown and a number of powerful arguments in favour of its abolition have emerged.

Firstly, the division between the G.C.E. O-level (intended for the top 20% of the ability range) and the C.S.E. (intended for the next 40%) is seen as artificial, failing to correspond to any natural division in terms of pupil ability, subject matter to be examined, job opportunities for successful candidates or suitability for further or higher education.

Secondly, under the dual system, schools not only have to handle two sets of administrative tasks for the different examination boards, they are also forced to pre-judge pupils' development and separate them, at an undesirably early stage, in order to prepare them for two different examinations. Such procedures are notoriously unsatisfactory and are clearly wasteful in respect of school resources and teacher time. Moreover, it is argued that the differing nature of the syllabuses make it hard in many cases for pupils to transfer between courses should the initial decisions about pupils' capabilities prove incorrect. In attempts to reconcile the different curricula required in a dual system, the G.C.E. syllabuses (as discussed earlier) have, in some instances, been adapted to become C.S.E. Mode III schemes. Although useful administratively, such strategies are seen as makeshift measures which fail to consider fully the needs of the pupils and which are far removed from the original terms of reference for the C.S.E. (see Beloe Report 1960).

Thirdly, the existence of the dual system encourages double entries for border-line candidates. This practice substantially increases the financial burden of the examinations and imposes additional stress on those pupils

already struggling with a G.C.E. course.

And fourthly, although the grading schemes for the C.S.E. and O-level are linked (i.e. C.S.E. Grade I \equiv G.C.E. O-level Grade C or above), the former certificate, even Grade I, is often regarded as 'second rate'. In addition, the multiplicity of examining boards⁽²⁴⁾, the wide variety of examination subjects and the dual form of certification leaves many parents and employers anxious and confused about the meaning and value of individual certificates.

It is on the basis of these arguments that the pressure for change has increased and although the feasibility studies of the new 16-plus examination have in many instances been fraught with difficulty⁽²⁵⁾ - leading to delays in its introduction - the case for the abolition of the dual system remains sound.

Official statements focussing on the new system have called for the retention of effective teacher involvement (if not control), the availability of all modes of examining through a choice of examining boards, and a much wider variety of assessment techniques. It is hoped that the new examination, by sharing responsibility for syllabus construction and assessment procedures in varying proportions between the boards and the schools, will reflect the needs of all the candidates and show a much more sensitive recognition of their interests, capabilities and aptitudes.

In science, many are anxious that the new examination should concentrate more upon methods and ways of thinking than on factual content, and teacher assessments - by allowing flexibility in teaching methods across the ability

range - are seen as an important means of encouraging this perspective. In a similar vein, the Waddell Report (1978), commenting on the feasibility of the single system, has recognised that terminal practical examinations are of only limited value and are better replaced by school-based assessments of practical skills, and has suggested that:

It also seems necessary to continue the investigation of the value of alternative approaches to science. The studies (i.e. the feasibility studies) concentrated on the sciences as three separate subjects, and little attention has been paid to the potential of more broad-based approaches (e.g. integrated science), which might be more relevant to some pupils at all levels of ability ... The development and design of a range of new syllabuses reflecting conjoint and unified approaches to science could make an important contribution to the place of science in a common 16-plus examination system. (Waddell Report 1978, Pt.II, para.101)

Hence, the proposals for the new 16-plus examination scheme have brought with them not only a clear recognition of the potential value of courses that promote a broader view of science but also an urgent demand for further investigation into:

- i. teaching methods that might encourage pupils to become more actively involved in the 'processes' of science;
- ii. assessment techniques that might reflect more accurately the interests and aptitudes of pupils, and so give a fuller picture of their real capabilities; and
- iii. strategies that might help in the discrimination of pupils across 60% of the ability range whilst still attending to the needs of individual candidates.

On all of these accounts the project approach, by taking science education out of its conventional setting, by placing new demands on both pupils and teachers and by opening up new areas for assessment, would seem to have much to contribute to the new system. Thus, at the start of this enquiry, an in-depth study of the nature, management and relative effectiveness of pupil project work as a teaching/learning strategy and as an assessment procedure was seen as a pressing area of research, particularly relevant at this time of reappraisal.

1.6. The Lay-out of the Current Study

The study reported here - which forms part of a larger research programme⁽²⁶⁾ sponsored by the East Midland Regional Examinations Board (E.M.R.E.B.) with the additional support of the Social Science Research Council (S.S.R.C.) - represents an attempt to fill some of the gaps in our knowledge and understanding of project work for the 'average' pupil.

The chief areas of interest and the major aims of the study are set out in Chapter Two where the planning and the method of the enquiry are also described in detail.

Chapter Three focusses on the variation that exists in the nature of project work being undertaken by C.S.E. science pupils throughout the region, and discusses the teachers' decision to assign project topics or give pupils choice.

Chapter Four concentrates on the organisation and management of pupils' projects, the grouping of pupils, time allocations and the question of guidance and supervision.

Chapter Five, perhaps the most interesting of the chapters, assesses the role of project work in the acquisition of skills and the development of favourable attitudes towards learning and science. This chapter also discusses the apparent disjunction between some of the desired outcomes of project work and the actual outcomes as perceived by the respondents, and considers the important issue of whether or not project work benefits all pupils to the same extent.

Chapter Six takes the reader away from the operation of project work and directs attention towards the teachers themselves. Their age, sex, qualifications, training and experience are examined, in turn, in relation to their use of project work and their thoughts about it as a teaching/learning strategy and as a form of assessment. The technique of cluster analysis is introduced and a teacher typology is formulated based on the respondents' stated perspectives of project work in C.S.E. science.

Chapter Seven explores project work in progress, drawing evidence from a pilot observational study carried out in an East Midland school, while Chapter Eight - the penultimate chapter - considers the arguments for and against the use of project work with C.S.E. pupils and discusses the major constraints on the implementation of project work experienced by the C.S.E. respondents.

(The reader is advised that in an attempt to bring the individual topics of each section into context, each chapter commences, where appropriate, with a review of the existing literature in the field. It is hoped that by dividing the areas of study in this way, the arguments and issues under discussion will be clarified.)

Chapter Nine, the final chapter, summarizes the main findings to emerge from the enquiry, examines both the positive and negative aspects of project work and assesses how it succeeds and where it fails. The potential value of the project approach with respect to new developments in teaching and examining (e.g. the new 16-plus examination, the Assessment of Performance Unit and the more recent youth education programmes) is also considered. The study concludes by acknowledging the weaknesses of the current research and identifies new areas of interest and fields of further study.

NOTES

1. This suggestion was put forward by Mr. Peter Dawson, general secretary of the Professional Association of Teachers, at a conference organised by the National Council for Educational Standards in March 1981. See 'The plight of the "average" child', Times Educational Supplement, 13 March, 1981.
2. The fourth subject group, Arts and Crafts, did not contribute to the award of pass.
3. In October 1964, the work of the Secondary School Examinations Council (S.S.E.C.) and of the Curriculum Study Group (formed two years earlier to offer advice and information to schools, and technical assistance to the S.S.E.C.) was taken over by the Schools Council for the Curriculum and Examinations, now generally referred to as the Schools Council.
4. Seventh Report of the Secondary School Examinations Council, Scope and Standards of the Certificate of Secondary Education, H.M.S.O., 1963.
5. It is stressed that the overlap or equivalence of the two examinations (G.C.E. and C.S.E.) refers only to the ability of the candidate after having applied himself to a course of study appropriate to his age, aptitude and ability. The two examinations, should not be equated in any other way; equivalence is not one of course content or methodology.

The main advantage of the Grade 1 as a reference grade lies in the assistance it gave in the early years to the recognition of C.S.E. as a worthwhile and valid

qualification. Its correspondence with a pass at G.C.E. 0-level gave it credibility in the eyes of employers and professional bodies.

Another advantage of the overlap between C.S.E. and G.C.E. concerns the border-line candidates (those around the 80th percentile). In theory at least, pupils at this level of ability can be entered for either examination and be guaranteed success.

6. It is stressed that 'average' is used here with respect to the whole ability range and not simply the C.S.E. (40th-80th percentile) band.

7. Secondary School Examinations Council (S.S.E.C.): Examinations Bulletin No.1, The Certificate of Secondary Education, H.M.S.O., 1963.

8. In fact, a major change to arise from R.o.S.L.A. was the extension of C.S.E. examining to the lower end of the school population for which it was not originally intended. This was accomplished through the development of special Mode III syllabuses, often with limited grade range, to cater for those pupils staying on until the end of their fifth year who would, before R.o.S.L.A., have left. This expansion of Mode III schemes, to some extent, undermined confidence in standards. All examination boards examined a greater number of Mode III schemes in 1974 than in 1973.

9. The C.S.E. operates through examination boards which are teacher-controlled with local authority participation, and serve defined areas (regions). In 1978, the number of C.S.E. regional examination boards stood at fourteen:

Associated Lancashire, East Anglian, East Midland, Metropolitan, Middlesex, North, North-West, Southern,

South-East, South Western, West Midlands, West Yorkshire and Lindsey, Yorkshire, and the Welsh Joint Education Committee.

10. S.S.E.C. Examinations Bulletin No. 1 (1963), op.cit., para.17.

11. Ibid. para.8.

12. For example, in the Spens Report (1938) and later in the Norwood Report (1943, p.31) it was acknowledged that the School Certificate examination in existence at that time adversely affected the curriculum by confining experiment, limiting free choice of subjects, hampering their treatment and encouraging wrong values in the classroom.

13. This has been acknowledged in more recent discussions on the proposals for a single system of examining at 16-plus (the General Certificate of Secondary Education) in which many have advocated the retention of 'teacher control' and coursework assessment.

14. The reader is referred to an article on the proposed 16-plus examination (G.C.S.E.) scheme 'Disturbing power shift' by P. Whittaker, Times Educational Supplement, 20th November, 1981.

15. See Note (8).

16. Interestingly, in some regions, Mode III Nuffield-based syllabuses, because of their appropriateness and success, have been adopted with minor modifications under the Mode I scheme and offered as an alternative Mode I syllabuses; for example, East Midland Regional Examinations Board C.S.E. Biology Mode I, Syllabus 2 (Personal communication, Regional Subject Panel Member, November, 1978).

17. For example, many C.S.E. Boards use project work as part of their assessment procedures, and at G.C.E. A-level, Engineering Science, Nuffield Physical Science and Biological Science have also included project work as an integral part of the course.

Project work has also been incorporated into Sixth Year Studies Level in Scotland and, at degree level, projects are carried out as part of the course work leading to Graduate Membership of the Royal Society of Chemistry (Grad.R.S.C.), and at the University of Sussex, research projects in Chemistry have formed part of the alternative B.Sc. degree by thesis.

18. N.E.B.S.S. is concerned with providing examinations and national qualifications in the field of formanship and supervisory studies.

19. As cited in 'The Myth Exposed' by R. Brown and C. Daniels, Times Educational Supplement, 30th November, 1979.

20. Ibid.

21. See 'More than a million words' by J. Sweetman, Times Educational Supplement, 21st November, 1980.

22. See Note (19).

23. By 1970, the pressure for changes in the pattern of examining culminated in proposals for a single system of examining at 16-plus. The difficulties involved in a single system were the subject of a report published in the Schools Council Examinations Bulletin No.23 (1971), A Common System of Examining at 16-plus, which recommended that a range of research studies should be carried out to investigate the feasibility of a single system. In 1975, the Joint Examinations Sub-Committee of the Council

reviewed the evidence and in July 1976 the Governing Council submitted recommendations for a common system of examining at 16-plus to the Secretary of State for Education and Science. The Secretary of State called for a period of further study and in March 1977 a steering group, chaired by Sir James Waddell, was appointed to study the major uncertainties surrounding a common system. The findings were published in School Examinations Parts I and II, H.M.S.O., July, 1978.

24. Under the dual system, in addition to the fourteen C.S.E. regional examining boards (see Note (9)), eight G.C.E. boards also exist.

25. Key problems in the implementation of the new 16-plus examination have centred on the national and subject criteria for syllabuses and assessment procedures drawn up by the Joint Council of G.C.E. and C.S.E. boards, to ensure that all syllabuses carrying the same title have sufficient content in common to give assurance to the users. Doubts have been expressed about the flexibility of such a system and its value in the current climate of economic recession and unemployment. Concern has also focussed on the format of examinations to cater for the top 60% of the ability range. The use of alternative papers designed for the less able and more able candidates has been proposed but others suggest that a single examination paper composed of questions allowing for different 'depths' of answer would be preferable. In addition, there has been strong feeling that many of the proposed syllabuses have failed to take into account all the imaginative curriculum development that has emerged within the C.S.E. framework

and instead, have appeared as 'watered down' versions of 0-level courses. Further controversy has arisen over the proposed 7-point grading system. Many feel that an examination which places the average pupil on Grade 6 has misleading connotations of failure rather than success.

Debate on these and other issues continues and serious delays in the proposed time-scale for the 16-plus examination have developed. As a result, the plans for the introduction of the new system in 1987 have been temporarily frozen.

26. Other studies in the C.S.E. research programme undertaken at the University of Leicester School of Education include:

- C.S.E. and the Employer
- Exploring the Format: the 1978 History C.S.E. Examination Paper
- Improving the Reliability of Essay-Marking in English Language
- A Pilot E.M.R.E.B. Basic Numeracy Examination
- An Evaluation of the E.M.R.E.B. Graded Assessment Reliability Study
- An Enquiry into the Marking Characteristics of Differently Constituted Schemes.

CHAPTER TWO

THE RESEARCH DESIGN

- 2.1. The Planning of the Study
 - 2.2. The Method of Enquiry
 - 2.3. The Questionnaire
 - 2.4. The Interviews
 - 2.4.1. The Interview Schedule
 - 2.5. The Observational Study: A Pilot Scheme
 - 2.5.1. The Observation Schedule
 - 2.5.2. The Observation Strategy
 - 2.6. Processing the Data
- Notes

2.1. The Planning of the Study

In the preparatory stages of this study, during the period October 1978 to January 1979, a number of visits were made to Science Departments in schools and colleges in the East Midland region. These visits were valuable and informative for several reasons. Firstly, they provided the opportunity to observe informally the teaching of science subjects at both C.S.E. and G.C.E. level throughout the region. Secondly, the visits permitted the resources and facilities of each establishment to be viewed, and the conditions and constraints under which staff and pupils worked to be assessed. Thirdly, during the course of these visits, it was possible to interview some of the science teachers in private and to discuss their views on a number of important issues including:

1. Assessment procedures and the criteria for assessment in C.S.E. science subjects;
2. Alternative teaching methods with particular emphasis on pupil project work in C.S.E. science subjects;
3. Mixed ability teaching versus setting, banding and streaming;
4. The proposed common system of examining at 16-plus as a replacement for the dual C.S.E./G.C.E. system (see Chapter 1).

In addition, there was some opportunity to talk to the pupils themselves and this, in turn, provided a degree of insight into the range of attitudes held by C.S.E. candidates with respect to the content and methods of their

science courses.

As a consequence of these discussions, some interesting points were raised about C.S.E. policy and practice, and the need for further communications of this kind became apparent. Several interviews were subsequently arranged with C.S.E. examination officials both past and present. These proved to be extremely useful sources of information about the development of the C.S.E., its management and those aspects of it not always so clearly stated in the formal documents. (Extracts from some of these interviews are included in later sections of this thesis.)

At this time too other important issues were highlighted which would require careful consideration in the planning and execution of the enquiry. The research project was to be based in the East Midland region, a large area, incorporating the counties of Derbyshire, Leicestershire, Lincolnshire, Northamptonshire, Nottinghamshire and South Humberside. Considerable variation in educational arrangements existed within this region, the 3-tier system of Leicestershire with its large community colleges contrasting sharply with the residues of the selective, bipartite system still apparent in other areas. The size and complexity of the region had important implications for both the method of enquiry and the sampling techniques to be employed, and it was clear that if the findings of this research programme were to be valid and relevant to the region as a whole, great care would have to be exercised in these early stages of the enquiry.

Concurrent with the programme of visits and interviews, a survey of the literature was started. This encompassed many aspects of the C.S.E., its history, its development and its aims both generally and more specifically with respect to the teaching of science. The literature survey was extended with the assistance of the East Midland Regional Examinations Board who provided copies of C.S.E. science syllabuses for the period 1965 - 1980. These were studied in relation to examination and teaching techniques. Particular attention was paid to the emphasis placed on the assessment of project work in the C.S.E. over the period since its inception.

The review of the literature and the sample of interviews and visits, although obviously not fully comprehensive, indicated that considerable variation existed in:

- i. the nature and management of project work undertaken by C.S.E. science pupils throughout the region, and
- ii. the teachers' perspectives of the types of skills and attitudes acquired by pupils through project work.

Thus, a framework of knowledge was established and a number of interesting questions were raised that could eventually be incorporated into a questionnaire which, it was hoped, would be both realistic and relevant to its recipients (see Section 2.3.).

2.2. The Method of Enquiry

Following the visits to the schools and colleges in the East Midland region and the discussions about various aspects of the C.S.E. examination with secondary science teachers and examiners, a questionnaire (see Appendix I) on Pupil Project Work in C.S.E. Science was designed. The questionnaire aimed to investigate more fully some of the major issues which had arisen in order to gain a greater understanding of the perspectives of science teachers on their work at C.S.E. level.

Every attempt was made to keep the form and content of the questionnaire as succinct as possible but the final product remained undesirably long and seemingly complicated at first glance. This being the case, it became apparent that at every level of communication a good deal of planning and sensitivity would be necessary to avoid any possibility of intimidating the potential respondents. It was essential that the teachers should view this piece of research in a favourable light and not regard it as any criticism of their current beliefs and practices. Furthermore, if the response to the questionnaire was to be good, then the teachers would have to be convinced of its value and relevance to their own teaching, otherwise it would be seen as yet another unnecessary demand on their time and attention.

During this period of the enquiry, anxieties among the teaching profession were increased by a number of external factors. The future fate of the C.S.E. examina-

tion was causing particular concern. The Waddell Report (July 1978), which presented evidence and observations largely in favour of the abolition of the existing dual system of examining at 16-plus (i.e. the G.C.E. and the C.S.E.) and the introduction of a single common system of certification (the G.C.S.E.) to be taken by all pupils across the ability range, was given a cautious but positive response by the then Secretary of State for Education and Science, Mrs. Shirley Williams. The teachers' responses to these proposals were mixed; many were anxious about possible changes in the curriculum and the assessment of pupils across the entire ability spectrum and others were totally weary of the examinations debate. As one Headmaster commented:

Examinations are a growing industry, it seems. There are already far more exams. than pupils actually need. Examinations are a drag to both pupil and teacher, and school. Let's go Swedish - that's what I say! We ought to abolish exams. (Personal communication, Leicestershire, January 1979)

In addition, the pay negotiations and the constant threats of Union action were causing both tension and anger among the teaching profession⁽¹⁾. It was also clear that the adoption of any work-to-rule policy at that time might adversely affect the response rate to the questionnaire. Thus, it was recognised that the outset of this investigation was a period of stress and difficulty for those in education.

Faced with these uncertainties about the willingness of teachers to participate in the study, it was felt unwise to approach them directly with the questionnaire. The research findings of Johnson (1966) had shown that the attitudes of

teachers towards research frequently reflect those shown by the Head Teacher. It seemed important therefore to seek the approval and co-operation of the Heads of Science in the first instance. If this was successful, then hopefully the responsiveness of the science teachers might be more favourable.

Data were collected on the schools and colleges in the region and a stratified sample was drawn up. A letter was subsequently prepared and sent to the Heads of Science in one hundred and fifty one secondary establishments throughout the East Midland region. The target population was randomly selected (using random number tables) but the inter- and intra-county ratios were kept consistent with those of the region as a whole in an attempt to tap the differing educational features of the individual localities (see Appendix II). Independent schools and the few remaining selective schools were retained in the sampling pool, together with the community colleges and residential establishments. Colleges of Further Education and Technology were omitted; so too were the Special Schools on the understanding that teachers' perceptions in these establishments may not be representative of C.S.E. Centres due to the numerous other 'special' factors and constraints which might operate therein and possibly distort the view of science teaching in the region.

The initial letter, addressed to the Heads of Science, had a three-fold purpose:

- i. It was intended to act as an introduction, serving to inform teachers about the C.S.E. research project and to explain, in brief, the aims and objectives of the

enquiry.

- ii. It was a request for information. The list of registered C.S.E. Centres produced by the East Midland Regional Examinations Board for 1979, although apparently comprehensive in the numerical sense, provided no information about the specific science subjects, if any, offered at C.S.E. level at each of the Centres. (Earlier contact with the listed Centres had, in fact, indicated that some of the named schools and colleges were not actually undertaking any C.S.E. science teaching or examining at that time.) Also, little information had been gained about the teaching staff in these Centres. The lack of knowledge with respect to both the science subjects and the staff responsible for them was recognised as a serious shortcoming in the research programme, especially in connection with any future follow-up studies. Thus, it was considered essential to obtain this information so that any further correspondence could be addressed to each teacher personally and with reference to his or her particular teaching commitments. A simple reply form together with a stamped addressed envelope was included in each mailing to facilitate prompt and easy returns of the staff names and their C.S.E. responsibilities.
- iii. Finally, the letter was intended to give assurance and confidence to its recipients. In it, the need for teacher involvement and participation in the study was stressed and the proposed sequence of the

research programme was explained. Anonymity and confidentiality for teacher, department and establishment were guaranteed.

Within six weeks, one hundred and thirty-nine replies had been received - a 92% response. Such readiness to co-operate was very encouraging although it was immediately apparent that some areas were not responding with as much enthusiasm as others. For instance, Leicestershire and Nottinghamshire - counties with close connections with the University of Leicester School of Education and the East Midland Regional Examinations Board - responded promptly to the communication whereas Lincolnshire - a county more geographically remote - made a slower and less complete return.

On the whole, the Science Heads were very helpful; many offered additional information and comments such as the notification of impending retirements and resignations, the history and development of C.S.E. science in their particular establishment and their personal involvement, if any, with its management. A substantial number of respondents also expressed their interest in the research programme and their willingness to assist with any subsequent enquiries.

Using the information obtained from the Heads of Science in response to the preliminary letter, six hundred and nine teachers were sent a copy of the questionnaire. These teachers were drawn from ninety-eight of the original one hundred and fifty-one schools and colleges used in the first sample and all of them had responsibilities which included the teaching of one or more of the main C.S.E.

science subjects (as measured by the examination entries for previous years, see Section 2.3.) namely Biology, Chemistry, General Science or Physics. The number of establishments was such as to ensure that the inter- and intra-county ratios remained consistent with the region as a whole (see Appendix II).

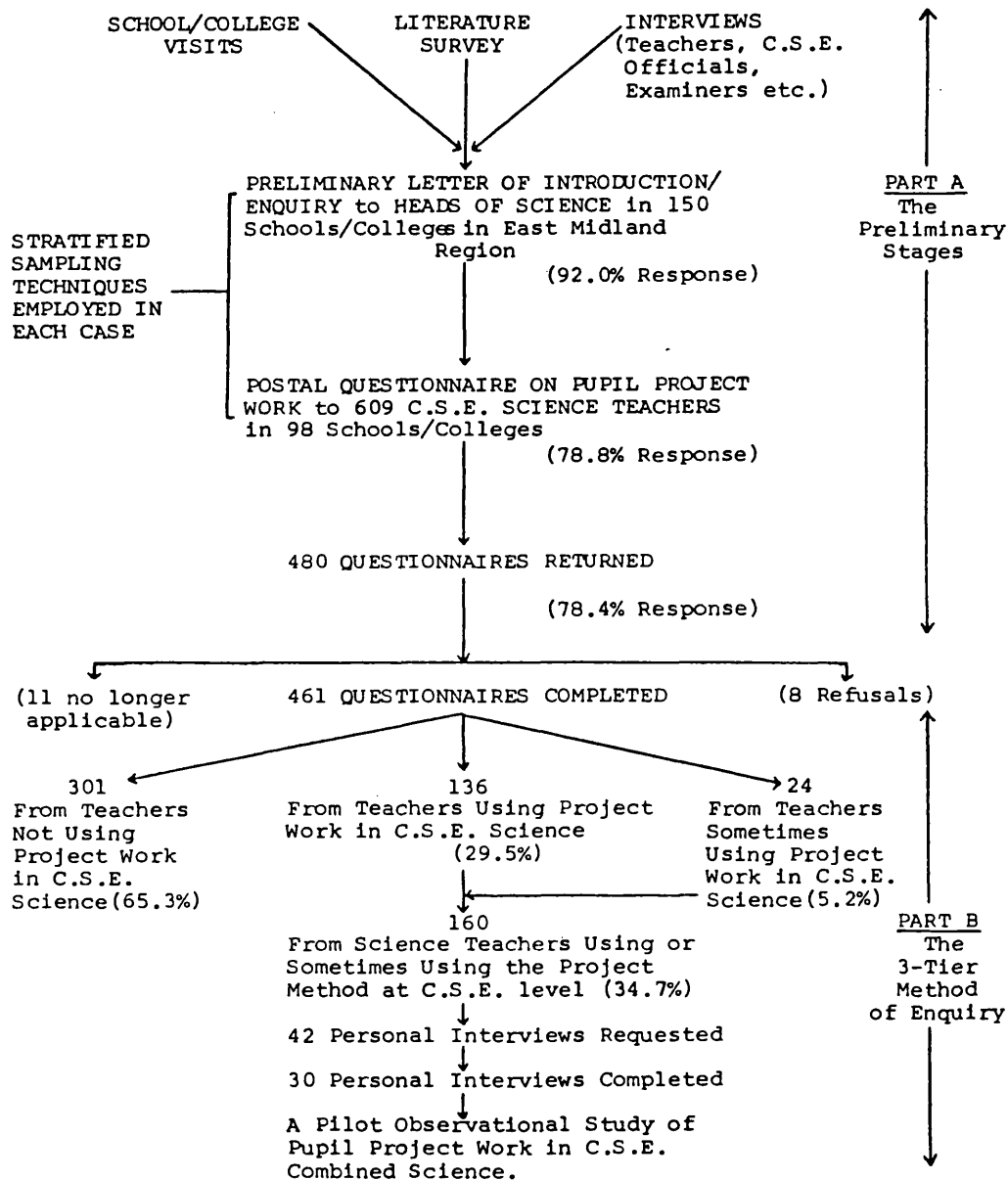
A slight variation was necessary in Leicestershire North where, due to lack of applicable centres arising from the first survey, the number of centres contacted in this sub-sample was one fewer than that required if the ratios were to be representative of the region. However, this minor discrepancy was not considered important since the actual number of teachers approached in Leicestershire North was little different from other areas of comparable size.

A summary of these preliminary stages of the enquiry is shown in part A of Figure 2(i).

Of the six hundred and nine science teachers approached, 190 were Biology teachers, 151 were Chemistry, 103 were General Science and 165 were teachers of Physics (see Appendix III). A letter of introduction addressed to each teacher personally, together with a sheet containing preliminary information, accompanied each questionnaire and a stamped addressed envelope was again included in each mailing since the postage charge for the return of the questionnaire exceeded the standard letter rate.

FIGURE 2(i)

FLOW CHART ILLUSTRATING THE METHOD OF ENQUIRY
AND THE LEVEL OF RESPONSE



2.3. The Questionnaire (see Appendix I)

On the basis of information recorded in the Statistics of Education (Vol.2, H.M.S.O., 1968 - 76 incl.) and more recent reports on examination entries obtained from the East Midland Regional Board at the time of the enquiry, the four main science subjects to be taught and examined at C.S.E. level were identified as Biology, Chemistry, General Science and Physics. Given the popularity of these subjects alongside a C.S.E. philosophy encouraging a degree of flexibility in the construction of examination syllabuses, it seemed appropriate therefore to address the questionnaire to all teachers whose responsibilities included C.S.E. work in these subjects, irrespective of whether or not they made use of pupil project work in their teaching programmes.

The questionnaire consisted of four sections:

Section A was to be completed only by those teachers who used (or sometimes used) project work as part of their C.S.E. science course. It was designed to identify the different types of projects being undertaken in the schools and colleges in the region and to investigate the organisation and management of such work within the science departments. In this section, an attempt was also made to gain an understanding of teachers' perspectives of project work in relation to pupil ability and the acquisition of skills.

Section B was to be completed only by those teachers who did not, at that time, use project work as part of their C.S.E. science programme.

It was designed to determine whether or not these teachers had ever employed project work and, if so, the subjects and examinations in which they had used it. The respondents were also asked to outline their reasons for not undertaking project work with pupils during the period of the enquiry. Sections C and D were for completion by all the science teachers involved in the survey. Section C was an attempt to identify the teachers' views on a number of positive and negative statements relating to pupil project work, and to define the major constraints operating on both staff and pupils in science departments throughout the region. Section D, in contrast, sought information about the age, sex, qualifications and work experience of the respondents.

Three main types of question were incorporated into the questionnaire; most questions required only a single tick in the box alongside the most appropriate response. Others consisted of a column of boxes aligned with a number of replies, one, some or all of which might be relevant. Such questions required a tick in each appropriate box.

A few items on the questionnaire were open-ended in that the teachers were asked to give details about themselves, their views and their teaching situations. It was appreciated, however, that not all the major issues could be tapped in these structured questions and so at intervals throughout the document ample space was provided for teachers to volunteer comments and observations freely.

In the questionnaire, frequent reference was made to the term 'average pupil' and a number of items specifically required teachers to use this as a basis for their response. In its Seventh Report (1963), the Standing Committee of the Secondary School Examinations Council had defined C.S.E. Grade 4 as reflecting 'the standard of performance to be expected from a sixteen year old of average ability in the subject' (see Chapter 1, Section 1.3.), but the findings of more recent research (Cross 1979) had suggested that the 'average pupil' could now reasonably be expected to gain a Grade 3 in the C.S.E. science examinations. Thus, for the information of the respondents, the term 'average pupil' was defined in the questionnaire as follows:

... a pupil who could reasonably be expected to gain a Grade 3 or 4 in the final C.S.E. examination.

At no point in the document was the term 'project work' (or 'Project method') defined. This was a deliberate omission made to avoid influencing the respondents in any way; it was an attempt to gain the teachers' own interpretations of the term.

To facilitate easy coding of the completed questionnaires for the purposes of computation, numbered boxes were drawn up in a separate column down the right-hand side of each page. Each box was constructed to hold a code to signify a specific response to a particular item on the questionnaire. In this way, the risk of errors arising in the transfer of information from the questionnaires to the computer cards was reduced.

Of the six hundred and nine questionnaires initially despatched, four hundred and sixty-one copies were returned

for analysis. A further eleven teachers responded to the communication but felt unable to participate in the study due to altered circumstances (e.g. retirement, resignation, promotion, changed teaching commitments). Eight teachers refused to assist in the study. These figures represented an overall response rate of 78.8% and an adjusted response rate of 78.4% (see Appendix IV).

2.4. The Interviews

The response to the questionnaire (as shown in Appendices IV and V) was exceptionally encouraging in terms of both the quality and the quantity of information it generated. As expected though, a range of further important questions emerged from it and the need to follow up certain points was soon recognised. Issues requiring additional clarification were identified in the following areas:-

- The school/college environment and the working conditions
- The organisation of science classes throughout the school/college
- The operation of the C.S.E. examinations
- The content of the science syllabuses
- The teaching strategies employed in C.S.E. science subjects
- The internal procedures for assessing pupils' achievement in science
- The constraints upon the respondents in their specific teaching situations

It was essential to obtain a fuller and more accurate picture of these aspects of C.S.E. science teaching and

examining throughout the region.

Having considered a number of possible approaches, the value of making personal visits to the school/colleges used in the survey, with a view to interviewing the respondents on these matters, was immediately apparent. Clearly, extended structured interviews with all the teachers would have been ideal but, bearing in mind the many constraints (time, finance, mutual convenience, etc.) restricting such a venture, a 10% stratified sub-sample of the respondents seemed an appropriate and realistic alternative. The teachers were selected using random number tables and, ensuring that the inter- and intra-county ratios were kept consistent with those of the original survey population, the final number invited for interview totalled forty-two (see Appendix VI).

The selected respondents were contacted by letter in the first instance. This initial communication served to remind the teachers of the C.S.E. research programme and to explain the need to gather additional information by personal interview. A reply form suggesting a range of dates on which the proposed interviews could take place in their specific locality was included in each mailing. The teachers were asked to complete and return the form indicating whether or not they were willing to be interviewed. If so, they were invited to designate a time and date when they would be available to receive the interviewer at their school/college. The teachers were assured of both^{the} anonymity of their previous responses to the questionnaire and the confidentiality of any future communication.

By the end of the interviewing period, thirty-six replies had been received from the forty-two teachers initially contacted. Three of these respondents refused to participate in the interview programme and three felt unable to be of any further assistance either because they were no longer teaching any appropriate C.S.E. science subject or because they had left the school or college being used in the survey.

Thirty teachers in all were formally visited and interviewed as part of the follow-up study although many more informal contacts were made during the interview period. All the interviewees were responsible for the teaching of one or more of the main C.S.E. science subjects and fourteen of them used the project method as part of their teaching strategy (see Table 2.1 and Part B of Figure 2(i)).

TABLE 2.1.

THE INTERVIEWEES: BY SUBJECT AREA AND USE OF PROJECT WORK

SUBJECT AREA	Use of Project Work with C.S.E. Science Pupils(a)			TOTAL (b)
	YES	NO	SOMETIMES	
Biology	6 (7)	3 (6)	- (0)	9 (13)
Chemistry	5 (5)	6 (7)	- (0)	11 (12)
General Science	2 (2)	- (0)	- (0)	2 (2)
Physics	1 (1)	7 (13)	0 (1)	8 (15)
Totals	14 (15)	16 (26)	0 (1)	30 (42)

(a) Analysis made on the basis of teachers' earlier response to item 1, section A of the questionnaire.

(b) The figures in brackets refer to the number of teachers invited for interview in each category.

2.4.1. The Interview Schedule

In order to tap all the possible responses of the science teachers it was considered necessary to keep the form of the interview as flexible as possible. An interview schedule was subsequently designed which aimed to provide structure without rigidity. It consisted of four main sections and included questions on a range of topics set out as follows:

Section 1 - Subjects taught at C.S.E. level.
 Subjects taught at other levels.
 Current size of school/college; its projected size.
 History of establishment; its catchment area.
 Number of staff (teaching and non-teaching) in science department.
 Organisation of examination classes in science in 4th and 5th years.
 Incidence of mixed ability teaching; banding; setting; streaming.
 Teachers' views on class organisation; preferred type of organisation.
 Decisions about examination entries - how, when, by whom?
 Incidence of dual examination entry.
 Teachers' views on examination entry arrangements.
 Most and least satisfactory aspects of practical examinations in science at C.S.E., G.C.E. O- and A-level.
 Advantages and disadvantages of continuous assessment.

Section 2 - For this part of the interview the teachers were provided with a list of twenty topics frequently found on the Mode I C.S.E. examination syllabuses for their specific science subject (see Appendix VIIa). The teachers were then asked to select three topics which they considered to be the most satisfactory with respect to the 'average' C.S.E. pupil. Using the same criteria, they were then asked to identify three topics which they regarded as least satisfactory. In each case, the teachers were asked to give the reasons behind their choice.

Section 3 - In this section, the teachers were given a list of eleven teaching strategies and a list of eight assessment procedures that might be used in C.S.E. science teaching (see Appendix VIIb). The teachers were then asked to indicate the main and subsidiary teaching strategies they used (or would use) for topics they had selected in the earlier part (Section 2) of the interview programme. Similarly, they were asked to name the procedures they used (or would use) to assess the pupils' progress in each case.

Section 4 - In this final part of the interview the teachers were given a list of seventeen possible constraints which might operate on teachers and pupils in schools and colleges throughout the region (see Appendix VIIc). The respondents were invited to comment on any which they felt were relevant to their present teaching situation and their specific type of régime.

The duration of the interviews varied between forty-five minutes and two hours depending on the teachers' response. The dialogue was recorded by hand on a prepared work-sheet and later transcribed in full. In most cases a tour of the laboratories, teaching and preparation rooms was included in the visit, and on a number of occasions specimens of pupils' work, school syllabuses and examination papers were made available.

2.5. The Observational Study - A Pilot Scheme

The data collected through questionnaires and personal interviews were valuable in providing a vast amount of information about teachers' perspectives on a variety of issues relating to the teaching and examining of C.S.E. science. Important points emerged concerning the practicalities of project work for C.S.E. pupils, and there appeared to be varying levels of support for it as a teaching/learning strategy and as an assessment procedure.

The respondents focussed considerable attention on the actual activities of pupils engaged in project work and, clearly, many different forms of pupil participation were envisaged. Such differing degrees of pupil involvement was a cause of concern to many teachers and the need to gather additional material in this area acted as the stimulus to further research and formed the basis of this pilot study.

Furthermore, there was a wealth of evidence to show that teachers' perceptions of events in the classroom or

or laboratory may be quite different from those which actually occur (see, for example, Elliot 1976). In other words, it could be argued that what happens in a teaching situation cannot be ascertained solely from teachers' descriptions of their intentions nor from their personal accounts of what takes place.

When viewed in this light, some of the data obtained from the questionnaires and interviews has obvious limitations. Therefore, at this stage in the enquiry it was important to include some sort of small-scale research study to investigate more fully the extent to which the perceptions of the C.S.E. science teachers were true interpretations of the working situation.

In their questionnaires and interviews, the respondents had made certain assertions about the project method and its relevance and usefulness for the 'average' pupil. Negative as well as positive features of project work were identified even by those teachers generally in favour of the method and a number of conflicting ideas emerged. Among the claims which, it was felt, required further investigation were:

1. Pupils vary in their ability to benefit from project work:
 - (a) Pupils of above-average ability are more enthusiastic about project work in science; they are more motivated, are more able to sustain effort and as a result gain greatest benefit.
 - (b) Pupils of below-average ability tend to adopt a 'passenger' role, indulge in large amounts of indiscriminate copying, require excessive guidance and tend to lack enthusiasm and motivation. These pupils gain least benefit.
2. Many pupils waste time during class periods allocated to project work.

3. Project work encourages co-operation and communication between pupils and teacher.
4. Enquiry skills are developed through project work.

The aim of this pilot study was therefore to develop an instrument to investigate these claims more fully.

As a research tool, systematic classroom observation had initially been the target of a good deal of criticism (see Chapter 7) but having considered the arguments for and against its use, it seemed reasonable to conclude that given a specific hypothesis to test or problem to investigate, the method could make a valuable contribution to our overall understanding of project work in action, complementing rather than opposing the other research strategies employed in this study. Clearly, when used with care and interpreted with caution, systematic observation and the recording of behaviour as and when it occurs could be a useful method of investigating pupil activity, being a less subjective and more reliable means of identifying the exchanges between pupil and peer, and pupil and teacher during class periods.

The centre chosen for the observational study was a large school/community college situated on the outskirts of Leicester. A number of features made this establishment an appropriate base for the research.

Firstly, as an upper tier (14-18) comprehensive establishment, it held pupils from across the whole ability range. Previously, it had been argued that the school's catchment area was especially biased towards the professional classes and therefore gave rise to pupils that were largely atypical of the C.S.E. population. However, for

this particular study, the matter of social class bias was not seen as a direct or immediate problem. In fact, the middle-class rating of the school was a feature generally in its favour since there were few discipline or behavioural problems to cloud or confuse the issues under investigation in this pilot scheme. Moreover, the teachers were generally happy in their teaching environment; they had responded well to both the questionnaire and the interview programme, and initial discussions with them had revealed that they were interested in the C.S.E. research study and willing to participate further.

A second important feature of the school concerned the organisation of science teaching. All fourth and fifth year pupils⁽²⁾ were required to study at least one science subject, which meant that pupils of lower ability/motivation could not opt out of science altogether. Consequently, the full ability/motivation spectrum was represented in these years. Furthermore, in order to cater for the varying needs of these pupils in the sciences three 'bands' were set up:

- i. F-Band - Composed of pupils of above average ability (3) following G.C.E. 0-level course(s) in science.
- ii. S-Band - Composed of pupils of average ability following C.S.E. science course(s).
- iii. G-Band - Composed of pupils of below average ability and near remedial status, following C.S.E. science course(s).

The pupils in the S-Band and the G-Band studied Combined Science, a single school C.S.E. Mode III Course which had been operating in various forms for eight years. The course was well-established in the school but in

recent years the staff involved had grown increasingly critical of it. Built on a project-type basis, the pupils were required to undertake on average four projects per term for the two year duration of the course. All the project topics were pre-assigned and the necessary resources were provided in the form of practical worksheets and information booklets⁽⁴⁾. Several teachers were beginning to feel that this type of approach was no longer satisfactory; the resources too were regarded as somewhat out-dated and inappropriate, restricting pupil initiative. With these things in mind, the whole course was coming under review. Thus, it seemed an ideal time to observe the course in action and, perhaps, assist the teachers in their evaluation of this type of approach to project work.

Thirdly, from a purely practical point of view, the school was ideally situated; located four miles out of Leicester, it was easily reached by means of a regular and reliable bus service. This was a useful facility ensuring that this aspect of the research programme could be undertaken with relatively little inconvenience to either the researcher or the staff involved in the study.

All the arrangements for the observational study were made through the Combined Science Course Organiser. He selected two C.S.E. Combined Science classes, one from the S-Band (his own responsibility) and the other from the G-Band (taught by another member of staff). The classes were selected on the basis that they could both be observed on the same half-day each week. This was a valuable saving on time and travelling expenses.

The two members of staff responsible for the classes were briefed about the aims and objectives of the observational exercise and were then asked to assist by selecting appropriate pupils for observation. The female teacher in charge of the G-Band was required to designate four pupils whom she regarded as 'least able' (i.e. pupils who could not reasonably be expected to gain any grade higher than a 5 on the final C.S.E. certificate). The Course Organiser, responsible for the S-Band class, was asked to select four pupils of 'above-average' ability (i.e. pupils who could reasonably be expected to gain a grade 1 or 2 on the final certificate). The pupils in each class were identified and for the purposes of reference and analysis they were allocated identity numbers (01 - 08). At no time during the observation period were the pupils informed of the role of the investigator nor were they aware that they themselves were being observed.

2.5.1. The Observation Schedule (see Table 2.2)

The basic structure of the observation schedule used in this investigation was derived from the Science Teaching Observation Schedule (S.T.O.S.) which had been developed by Eggleston, Galton and Jones (1975) for their study of the 'Processes and Products of Science Teaching'.

S.T.O.S. was designed around a single dichotomy (i.e. the events initiated by the teacher and those initiated and/or maintained by the pupil) and sought to direct the observers' attention to the range of intellectual

transactions taking place in science lessons (e.g. asking questions, making statements, giving directions, etc.).

The items included on S.T.O.S. were studied in relation to the observations and comments made by the C.S.E. teachers in response to the questionnaire and interview programme used earlier in the enquiry.

On a number of points, S.T.O.S. was able to fulfil the requirements of the present investigation. Firstly, it facilitated the recording of intellectual behaviours associated with science and the compilation of fairly detailed records e.g. of the types of questions being posed in the classroom or laboratory. Secondly, it distinguished the interactions between pupils and teacher, between pupils themselves, and between pupils and resources. And thirdly, it was not predominantly concerned with managerial manoeuvres.

However, one major feature of S.T.O.S. made it inappropriate for use in the current investigation. S.T.O.S. had been developed to focus on those intellectual transactions which facilitated differentiation among teachers whereas the immediate concern of this study was the identification of activities differentiating pupils during project work in science.

Faced with this incongruity, a number of modifications and elaborations were made to S.T.O.S. and a new science pupil observation schedule was finally produced (see Table 2.2.). It was designed to permit the full and systematic observation of pupils engaged in project work and by combining the established items from S.T.O.S. with those derived from the C.S.E. respondents, it was hoped that this

new schedule would tap those issues highlighted earlier in Section 2.5.

The framework of the science pupil observation schedule showing the itemisation of the four main pupil activities (talking, reading, writing and practical work) during project lessons is outlined in Figure 2(ii).

TABLE 2.2.

SCIENCE PUPIL OBSERVATION SCHEDULE

ADAPTED FROM S.T.O.S. (Eggleston et al. 1975)

A. TALKING TO PEER(S)

01. Non-related to topic

Related to topic

- 02. Asks question about the facts/principles
- 03. Asks question about the application of facts/principles
- 04. Asks question about the hypothesis or problem
- 05. Asks question about the procedure
- 06. Replies to question about the facts/principles
- 07. Replies to question about the application of facts/
principles
- 08. Replies to question about the hypothesis or problem
- 09. Replies to question about the procedure
- 10. Makes comment/observation about the facts/principles
- 11. Makes comment/observation about application of facts/
principles
- 12. Makes comment/observation about hypothesis or problem
- 13. Makes comment/observation about procedure
- 14. Asks question about results/data/recordings
- 15. Replies to question about results/data/recordings
- 16. Makes comment/observation about results/data/
recordings

B. TALKING TO TEACHER

17. Non-related to topic

Related to topic

- 18. Asks question about the facts/principles
- 19. Asks question about application of facts/principles
- 20. Asks question about the hypothesis or problem
- 21. Asks question about the procedure
- 22. Replies to question about the facts/principles
- 23. Replies to question about application of facts/
principles
- 24. Replies to question about the hypothesis or problem
- 25. Replies to question about the procedure
- 26. Makes comment/observation about the facts/principles
- 27. Makes comment/observation about application of facts/
principles
- 28. Makes comment/observation about the hypothesis or
problem
- 29. Makes comment/observation about procedure
- 30. Asks question about results/data/recordings
- 31. Replies to question about results/data/recordings
- 32. Makes comment/observation about results/data/recordings

TABLE 2.2. (Cont.)

C. PUPIL READING

- 33. Non-related to topic
- 34. Alone)
- 35. With peer(s)) Related to topic
- 36. With teacher)

D. PUPIL WRITING

- 37. Independently)
- 38. From prepared text) Alone
- 39. With peer(s) and no text
- 40. With peer(s) and using text
- 41. With teacher and no text
- 42. With teacher and using text

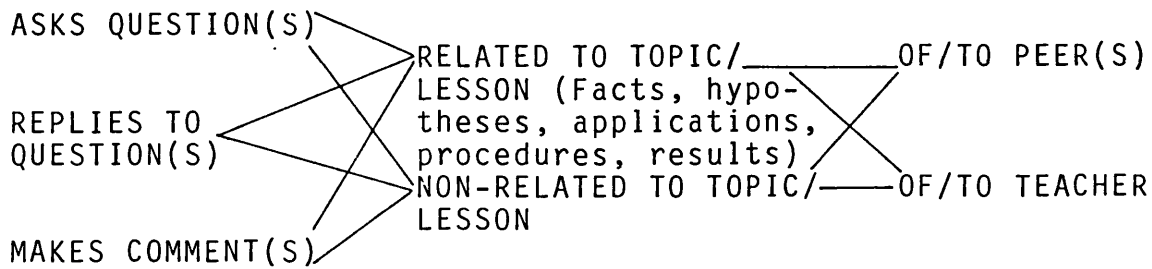
E. PUPIL PRACTICAL WORK

- 43. Non-related to topic
- 44. Preparing material/setting up apparatus
- 44. Alone)
- 45. With peer(s)) Related to topic
- 46. With teacher)
- 47. Managing/observing the investigation
- 48. Recording the results/data

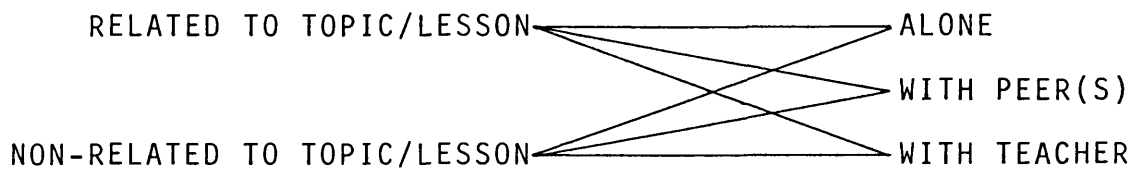
FIGURE 2(ii)

SCIENCE PUPIL OBSERVATION SCHEDULE : BASIC STRUCTURE

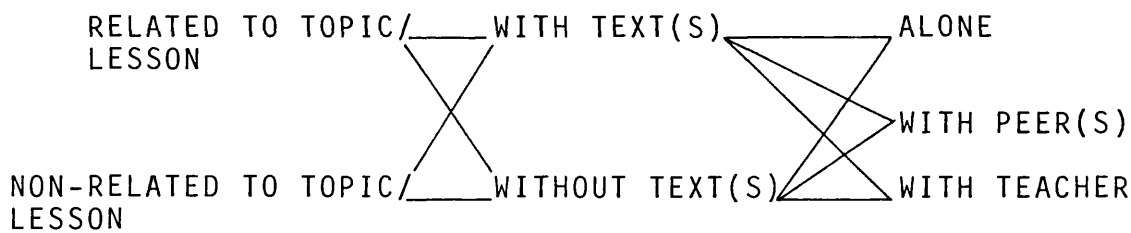
(1) PUPIL TALKING



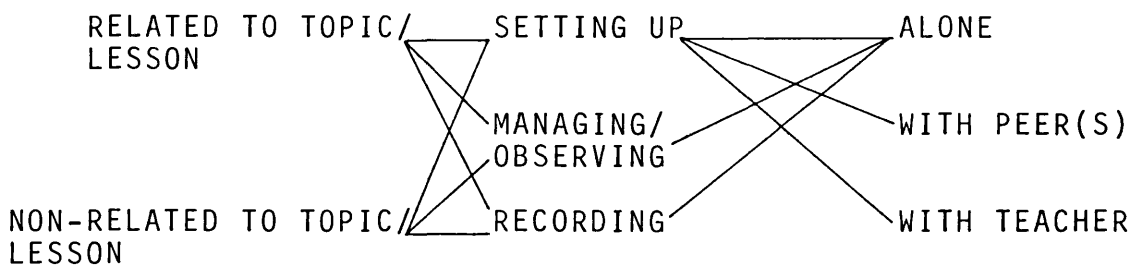
(2) PUPIL READING



(3) PUPIL WRITING



(4) PUPIL PRACTICAL WORK



2.5.2. The Observation Strategy

Using the newly developed schedule together with a grid chart for recording the data, the pilot observational study was begun.

Each selected pupil was observed for a period (i.e. 'unit') of four minutes at a time. The sequence of 'units' for observing pupils during the course of a lesson was determined randomly (see Appendix VIIla). The observational 'unit' had been set at four minutes on the understanding that this was a manageable period of time which would permit a number of separate observations to be undertaken during the fifty minutes of each class lesson. In addition, observations distributed randomly throughout the class period would, it was hoped, adequately sample the range of activities performed by pupils engaged in project work.

Regrettably, because of delays at the start and end of each lesson together with problems in the collection and recording of data (pupils, it should be remembered, had to be kept unaware of the task of the investigator and their own role in the investigation), only eight 'units' could be satisfactorily documented during the fifty-minute class period. This meant that in a single class period, each pupil was observed twice.

Contrary to the technique employed in the original S.T.O.S. investigation, it was decided not to record pupil activity at set intervals (e.g. every two seconds) during the four-minute observational period since such a rigorous procedure demands considerable skill if it is to be implemented reliably. In the absence of adequate training in these skills, a simpler approach seemed more feasible.

Thus, during an observational period, each time a pupil under investigation displayed one of the activities itemised on the schedule (i.e. talking, reading, writing or practical work) a tick was placed in the appropriate box of the grid chart. When the pupil's activity changed, then the new behaviour was recorded in the same way.

A preliminary trial revealed that this system of recording worked well for those short-term transactions which could be easily distinguished as separate events (e.g. item 02, the pupil asks question about the facts). Under these circumstances, the record provided data of a quantitative nature (e.g. how many questions the pupil asked) and a qualitative nature (e.g. what type of questions the pupil asked). However, for activities such as reading, writing and practical work (items 33 - 48 on the schedule) which may occupy the pupil, undistracted, for much longer periods of time, the system had obvious limitations since it provided no data on the actual duration of these activities. This was clearly unsatisfactory. Hence, for items 33 - 48, a sub-scheme was developed in which any activity that continued for longer than five seconds was re-recorded. The same scheme was also employed for those transactions which were seemingly unrelated to the project topics i.e. items 01 and 17.

At the end of each four-minute period, a vertical line was drawn through the grid to indicate the end of one observational 'unit'. Four lessons in all were observed and thirty-two observational 'units' (i.e. four units per pupil) were recorded for analysis.

For the results of this observational study alongside a more detailed discussion of the technique of systematic observation, the reader is referred to Chapter Seven.

2.6. Processing the Data

The responses to the questionnaire were analysed by computer using the Statistical Package for the Social Sciences (S.P.S.S., see Nie et al. 1975). The programs available in this package and utilised in this research study included the following statistical procedures:

- raw and percentage frequency counts, means and standard deviations;
- cross tabulations (contingency tables) of selected pairs of items;
- tests of significance (chi-square);
- factor analysis.

The manual devised by Nie et al. (1975) provides a useful account of the data processing techniques employed in S.P.S.S., the limitations of the procedures and the operating information.

The technique of Cluster Analysis described in Chapter Six (Section 6.4.) utilised C.A.R.M. (Cluster Analysis by Relocation Methods), a computer subprogram available through Programmed Methods for Multivariate Data (P.M.M.D.) at the University of Nottingham. For full details on the applications of C.A.R.M. the reader is referred to Youngman (1976, 1979).

The interview data and the results of the observational study were processed manually since in these enquiries the number of cases involved was much smaller.

The need for care in the processing of data and the compilation of statistics cannot be over-emphasised, and for those with little previous experience in this field some guidance is essential. Numerous texts, some quite elementary, others more advanced have adequately described data processing facilities and provided guidance on the application of appropriate statistical tests. In this study, the following references were found to be especially valuable: Adams and Torgerson (1964); Bennett and Bowers (1976); Cohen and Holliday (1979); Hays (1974); Mardia et al. (1979); Maxwell (1961); Parten (1950); Robson (1973).

NOTES

1. In May 1979, Union sanctions were brought into action; the Labour Government was defeated in the General Election and a Conservative Minister, Mr. Mark Carlisle, was appointed the new Secretary of State for Education and Science. In October 1980, in a government re-shuffle, Sir Keith Joseph (former Minister for Industry) replaced Carlisle.

The Conservative Government supported proposals for a new common system of examining at 16-plus but called for further studies to be undertaken in the area. The date for the introduction of the new system (set initially at 1983) was delayed until 1987 and then, as a result of continued controversy (see Chapter 1, Note 25) temporarily frozen.

2. The labels 'fourth year' and 'fifth year' were applied in the usual way even though pupils did not enter the school until fourteen years of age i.e. their 'fourth year'.

3. Pupil ability used here and throughout this study refers to the conventional rating given to pupils on the basis of their past performance and their expected future progress in the school system. A discussion of the factors affecting pupils' ability rating is not broached although it is acknowledged that the term 'pupil ability' may, in many instances, be better interpreted as 'pupil attainment'.

4. 'Electricity' and 'Fibres and Fabrics' were the main topics being undertaken at the time of the study.

CHAPTER THREE

PUPIL PROJECTS

- 3.1. The Types of Project Work Undertaken by Pupils following C.S.E. Science Courses
 - 3.2. Topics for Project Work: Their Choice and Assignment
 - 3.3. Summary and Discussion
- Notes

3.1. The Types of Project Work Undertaken by Pupils following C.S.E. Science Courses

As discussed in Chapter 1 (Section 1.4.), the project approach can be interpreted in a number of different ways and as such is likely to produce a variety of outcomes, some of which may be favourable, others less so. Thus, at the outset, the need to identify the different types of projects being undertaken by C.S.E. science pupils was recognised as an important feature of this research. Hence, in item 5, Section A of the questionnaire (see Appendix I) an attempt was made to investigate this aspect more thoroughly. In this item, the teachers were provided with a choice of four alternative types of project approach, namely:

TYPE A : A reporting type in which pupils collect information from books, journals and other secondary sources and then write an account in the form of a booklet, folder or the like.

TYPE B : A discovery type in which the pupils attempt to answer a question by means of information gathered through experimentation and/or observation; the project being written up in the form of a simple research paper.

TYPE C : A combination of the reporting and the discovery type.

TYPE D : Other Types (to be specified by the respondents if A, B, or C not appropriate).

Given these four descriptions, teachers were asked to indicate which one best characterized the type of project work actually carried out by the majority of their C.S.E. science pupils. The reported incidence of each type (within C.S.E. science as a whole and within each of the four main science subjects under investigation) is shown in Table 3.1.

TABLE 3.1.

THE TYPES OF PROJECT WORK BEING UNDERTAKEN BY PUPILS IN THE
FOUR MAIN C.S.E. SCIENCE SUBJECTS

TYPE OF PROJECT	FREQUENCY OF RESPONSE (% age)				
	BIOLOGY	CHEMISTRY	GEN.SCI.	PHYSICS	ALL SUBJECTS*
A. Report	37(a) (60.7)	6 (16.7)	17 (42.5)	9(b) (50.0)	70 (43.8)
B. Discovery	0 -	4 (11.1)	1 (2.5)	1 (5.6)	6 (3.8)
C. Combination	22 (36.1)	21(c) (58.3)	20(d) (50.0)	7 (38.9)	71 (44.4)
D. Others	1 (1.6)	4 (11.1)	2 (5.0)	0 (5.6)	11 (6.9)
Not ans.	1 (1.6)	1 (2.8)	0 -	0 -	2 (1.3)
Totals	100%	100%	100%	100%	100%
n =	61	36	40	18	160

* Five of the respondents were responsible for C.S.E. science subjects other than the four main ones under investigation so that Integrated Science, Engineering Science, Rural Science and Mode III Combined Science are included in this analysis.

Using the descriptions provided, 43.8% of the 160 respondents implementing project work at the time of the enquiry (70 teachers in all) named Type A, the report-type project, as most typical. A slightly higher percentage, 44.4% (71 teachers) specified Type C, the combined report/discovery approach, as the most characteristic whilst only six respondents (3.8%) described the project work undertaken by their C.S.E. pupils as discovery-based i.e. Type B.

Eleven teachers (6.9%) felt unable to assign the types of projects carried out by their pupils into any one of the defined categories; these respondents provided their own descriptions under the heading 'Other Types'. The types outlined in this group were found typically to consist of a series of practical exercises supported and linked together by background reading around the theme. For example, as explained by one teacher during the course of his interview:

I use the project work as a follow-up to class work; after teaching 'A Balanced Diet' with practical exercises in class, the pupils do a project on 'Obesity', and after teaching 'Reproduction', they do a project on 'Contraception'.

(131, Biology, interview)

Another alternative approach to project work was apparent in the observational study piloted at the end of this enquiry (see Chapters 2, Section 2.5., and 7). In the Mode III Combined Science course under investigation, all the project topics were pre-assigned by the staff and all the necessary resources were provided for the pupil in the form of practical work-sheets and information booklets. 'Writing up' in this instance entailed the

completion of project record sheets for incorporation into a project file on each topic.

Only two respondents (1.3%) failed to complete this questionnaire item but judging by their willingness to co-operate on later items it seems likely that their failure to provide information on the types of project work carried out by their C.S.E. pupils was the result of error than deliberate omission.

With reference to the separate subject areas shown in Table 3.1., the teachers of Biology and Physics tended, in general, to engage their pupils in projects which were largely of the reporting type (see Table 3.1., (a) and (b)). A number of respondents explained that project work of this type was especially appropriate for topics such as 'Pollution' and 'Conservation' on the Biology syllabus, and for 'Astronomy' and 'Radioactivity' in the Physics course.

In further discussions of this type of reporting exercise, many teachers expressed concern about the high incidence of plagiarism that emerged from it. Moreover, in Section C (item 8) of the questionnaire, 91.4% of the teachers using the report-type approach agreed that it resulted in 'large volumes of material being copied directly from books and journals'. This finding was highly significant ($p < 0.001$) compared with the response obtained from teachers using other forms of project work (see Chapter 5, Section 5.3.1.). It seemed that regardless of clear guidelines being given to the contrary project work of the report-type, when undertaken by C.S.E. science pupils, frequently consisted of wholesale,

indiscriminate copying accompanied by little true understanding of the topic under study. As one former Chief Examiner observed:

I found this trend to copying whole chunks of information to be a general pattern.
(147, Chemistry)

Similarly, having worked with pupils on projects, another respondent commented:

Pupils seem to have the impression that if they copy enough from books, put in a few pamphlets and pictures, then this is all that is needed. It must be neat, of course!

(057, Biology)

In the discussion of project reports, several teachers commented on the neatness of the enterprises and in response to item 10, Section C of the questionnaire, 44.3% of those teachers using the report-type approach agreed that 'Project work ensures that pupils take care over the presentation of their work' (see Chapter 5, Section 5.7). Work of this nature (i.e. the neat report) was considered by some to be a desirable feature of C.S.E. science projects. It is interesting to speculate whether this was, perhaps, because untidy presentations were more difficult to assess and reflected badly on the staff supervising them, or whether the well-disciplined approach to a monotonous task such as neat copying was to be encouraged as part of the tenacity and dedication required of a science student.

Several respondents were however plainly opposed to both these viewpoints maintaining that such perspectives were largely irrelevant to the real aims and objectives of C.S.E. science project work. Two teachers went on to suggest that the occurrence of project work involving

neat exercises in plagiarism was more symptomatic of the inadequacy and/or inexperience of the staff rather than that of the pupils. Although the notion of teacher expertise and experience in the handling of project work is discussed more fully in Section 3.2. of this chapter and later in Chapters 6 and 8, the following extracts highlight some of the areas of difficulty:

The 'project' work undertaken by these pupils does not follow the current concept of projects - which are in many ways far removed from the original concept of 'discovery'. Projects have come to be thought of as 'teacher aids' rather than as a means of allowing children to use books, follow interest etc. with guidance. Many projects are merely the copying of a book by a pupil.
(137, Biology)

Inexperienced teachers seem to often wish to use projects in unguided situations because it looks as though the kids are working hard and producing lots of work. The amount of information learnt though seems low ...
(034, Chemistry)

Thus, on the strength of statements presented so far, one might readily suspect that much of the project work undertaken in C.S.E. science inevitably entails extensive copying from books with the compilation of a neat lengthy project report as the chief target. Fortunately, for those who expect slightly more from the project approach, this does not represent the total picture: additional data collected from the questionnaires indicates that other, less passive types of project work may be realistically envisaged.

In Chemistry and General Science, pupils were more frequently engaged in 'combination' type projects (see Table 3.1., (c) and (d)). In this approach, an attempt was made to marry the theoretical and experimental aspects

of a topic by combining the 'reporting' and 'discovery' elements of it. The pupils were required to answer some question or investigate some problem by means of information gathered from texts, and data collected through simple experimentation and/or observation. In Chemistry, 'Chromatography' was cited as a good topic for this type of approach in that the separation and identification of pigments involved practical, experimental techniques whereas the molecular basis of the phenomenon had to be tackled from a largely theoretical standpoint.

Similarly, from the General Science syllabus, 'Soil and Food Production' as an optional extension exercise was considered an appropriate topic for this combined type of approach. The study of soil provided many openings for practical experiments and demonstrations, and the section on food production inevitably involved reference to the existing literature.

It could, however, be argued that the incidence of project work of the combined-type (as reported by seventy-one of the respondents) may well be inflated since in recent years, teachers have been bombarded with prescriptions for 'effective' science teaching, with the need for pupils to be encouraged in the 'processes' of science receiving considerable attention both in the official documents and the popular press. There is now a wealth of literature advocating a practical, investigative approach in science teaching, a recent addition to this being the 1979 Report on secondary education produced by H.M. Inspectorate which criticised the lack of practical investigations found in secondary school science,

condemned the didactic approach observed in the examination classes and strongly recommended that pupils should experience the 'processes' as well as the 'products' of science in their school lessons:

Regrettably, not all the teaching methods were effective. In many of the science departments the teaching seen offered few opportunities for pupils to show initiative or to develop speculative thinking. They were frequently asked to copy copious notes from the blackboard or were given dictated notes which demanded little or no thought ...

... Some schools achieved good external examination results by these methods but nevertheless it was felt that the excessive use of them detracted from the overall quality of the science lessons⁽¹⁾.

Furthermore, on the question of experimental design, the Report advised that:

... even if many of the present examination procedures made little or no formal assessment of this skill, pupils ought not to be denied the opportunity to gain experience of this important feature of science as a process⁽²⁾.

Given then the widespread support for these recommendations as 'better' approaches to science teaching, teachers not actually implementing them may feel reluctant to admit it. Thus, the 'combination' type of project work, being a half-way stand between straight reporting and full discovery, may gain an unrealistic level of support from the operators of the project method in science teaching programmes. However, at the present time, any such conclusion must be drawn tentatively; the extent to which project work of the combined type is actually undertaken at C.S.E. level remains speculative. Clearly, further, more extensive and systematic observation of project work in progress is required to provide the additional information necessary

to confirm or reject these claims.

The reported incidence of project work of the 'discovery' type was, in contrast, very low. The 'discovery' project relied on pupils using the results of their own experimentation, observation and practical exercises to answer a specific question or test a specific hypothesis, the findings being written up in the form of a simple research paper. Only six science teachers (4 in Chemistry; 1 in General Science and 1 in Physics) indicated that their pupils' projects were fully discovery in nature (see Table 3.1.).

The reasons for the discovery projects being so rarely utilised were many and varied. Several respondents discussed the problems of obtaining the necessary materials (living organisms in the case of the biologists) and providing the essential apparatus and facilities. For example:

Large classes - small laboratories - very limited facilities.
(082, Biology)

We do not have the resources, time or technical assistance needed.
(100, Chemistry)

were typical of the comments made by teachers to explain their failure to implement a discovery approach.⁽³⁾

Other respondents considered the syllabus to be a major constraint; the teachers explained that their syllabuses were often too wide and too deep to permit the discovery approach. It was felt that if all the mandatory sections were to be adequately covered, then much of the project work had to be undertaken at home, out of school hours. This was an obvious restriction on the type of

project work that could be attempted. The teachers of Physics were especially critical of the 'traditional' theme running through their Mode I, Syllabus 1. They maintained that large portions of it were largely irrelevant to the average C.S.E. pupil and certainly inappropriate for the 'discovery' type of exercise. This general finding supports that of Armstead (1975) whose investigation into the attitudes of Chemistry teachers towards project work in modern Chemistry courses revealed that the existing Chemistry syllabuses were not really conducive to investigative project work.

In addition to the inapplicability of the science syllabuses, some of the participants in this study also argued that:

... Pupils following an all C.S.E. programme
are overloaded with projects.
(100, Chemistry)

and that:

Most pupils have their fill of project work in humanities' subjects and only welcome 'exciting' projects. Finding 'exciting' experiments which pupils can perform alone, whilst the other nineteen are doing different 'exciting' experiments is not easy!
(043, Chemistry)

In relation to the types of project work that could be successfully implemented, a large number of respondents commented on the attitudes and abilities of their C.S.E. candidates. Of particular interest was the teachers' response to item 3, Section C of the questionnaire under which 29.4% of the teachers actually using the project method agreed that 'Project work of any real value to the pupil is beyond the scope of an average C.S.E. candidate' (see Chapter 6, Table 6.12.). In some cases, it was felt

that the general ethos of secondary education with its selective and didactic traditions, combined with the notion that the C.S.E. examination was 'second-best' compared to the G.C.E. O-level, was responsible for the production of pupils who were, in the main, incapable of initiating an experimental programme and insufficiently motivated to sustain one. The following comments explain these views:

In my opinion a well-motivated, more able pupil can gain much from individual project work. In my experience, however, the 'average C.S.E. pupil' does not often fit this description in both respects - due no doubt, to the present O-level/C.S.E. system!

(233, Chemistry)

C.S.E. pupils have neither the intelligence, academic background, ability to concentrate or simple curiosity necessary to research a topic thoroughly. The work remains superficial and often plagiarised even though it may be beautifully presented.

(041, Biology)

In his thesis on the effect of project work on pupils' attitudes to science, Wilmut (1971) had also recognised the difficulties associated with project work for the less able/motivated pupil, noting that:

A quite commonly held view at one time was that creative practical work provided an antidote for the child sick of academic work ... But it would seem as though the administration of projects with this type of child is especially hard.

(Wilmut 1971, p.35)

However, in the pupil's defence, one respondent maintained that:

This is inevitable. After three years of being told what to do and being constantly 'spoon-fed' information, it is not surprising they are at a loss when expected to think for themselves. They have to learn how to make good use of time ...

(423, Chemistry)

Along similar lines, a number of teachers in this study advocated that project work of the discovery-type would be far more successful at C.S.E. level if it were introduced to pupils earlier in their school lives. It was felt that in order for the project method to be implemented as a really valuable and effective teaching/learning strategy, pupils required a period of training and induction into its use. The recommendations set out below neatly reflect these views:

Project work could be useful if the curriculum of the school enabled it to be introduced as part of the approach from the first year. In this way, the idea of doing a project and what is required from it would be known to the pupil before the start of the examination course.
(102, General Science)

There has to be considerable preparation for project work in the teaching prior to the carrying out of the project. In a sense, the pupil should be 'taught' how to tackle a project.
(050, Physics)

The ideas and recommendations expressed above receive support from a number of previous investigators in the field. Porter (1970), for instance, emphasised the need for a progression towards full assumption of responsibility for the project on the part of the pupil, and Wilmot (1971) in his study of project work in Nuffield A-level Physical Science suggested that:

... there is some justification for delaying the onset of project work until the pupil is in a position to make judgements of a sufficiently complex and comprehensive nature to make the project worth doing (Wilmot 1971, p.53).

Similar issues emerged from an Anglo-American study of primary education. In a report produced by Cook and Mack (1971), on the basis of interviews with teachers attempting to implement the integrated day according to

the 'Plowden-style' philosophy in infants and junior schools, it was noted that:

With children who have had a formal education, seeing results is a slow process. Such children have difficulty in following through on something; they aren't confident in themselves. They need a tremendous amount of approval and support. But one does, after a while, begin to see breakthroughs. It just takes a lot of time, and confidence in oneself, and trust in the children.

(Cook and Mack 1971, p.52)

The same report also drew attention to the judgements teachers have to make with regard to the guidance and supervision given to pupils engaged in independent study of a discovery nature. The point of intervention by the teacher was seen as a critical decision to be made with respect to the pupil as an individual having personal needs, interests, skills and learning styles. The importance of these issues in relation to the successful implementation of project work is discussed further in Chapters 4 and 5.

3.2. Topics for Project Work: Choice and Assignment

Possibly one of the more interesting findings to emerge from this part of the study relates to the method of topic selection, focussing on the question 'Are the topics for project work assigned or do the pupils choose their own topics?' In the previous section, brief reference was made to some of the topics frequently adopted for project work. These topics were taken from the existing C.S.E. science syllabuses. However, further enquiries revealed that the decisions about topics were far from simple, often being based on complex reasoning by the teaching staff.

What follows is an account of the methods by which topics for project work were adopted with a discussion of the main factors guiding and influencing teachers in their decisions about topics.

The evidence presented here is drawn from the teachers' response to item 3, Section A of the questionnaire and additional comments and observations volunteered during the course of the enquiry.

The adoption of topics for project work arise by four main routes. These are summarised in Table 3.2. together with an analysis of their occurrence in each of the C.S.E. science subjects under study.

As shown in Table 3.2., one quarter of the teachers implementing the project method (40 in all) permitted their pupils to choose their own topic independently, giving guidance only when required. When asked to name those factors guiding them in their decision to allow pupils to choose their topics, 50% of these respondents indicated that they regarded pupil interest and attitude (especially motivation) as paramount to the successful implementation of a project topic and its subsequent effectiveness as a teaching/learning strategy. Hence, these teachers might be regarded as more especially pupil-orientated in that they tended to base their decisions about project topics on the variety and span of their pupils' own interests and attitudes (see Table 3.3.(a)). The comments which follow illustrate this point of view.

Self-selection guarantees a greater involvement in the project and leads to a more satisfactory product.

(073, Chemistry)

TABLE 3.2.

THE ASSIGNMENT AND CHOICE OF TOPICS
FOR PUPIL PROJECT WORK IN EACH OF THE MAIN C.S.E. SCIENCE SUBJECTS

Method of Assignment/Choice	FREQUENCY OF RESPONSE (% age)				
	Biology	Chemistry	General Science	Physics	All Subjects *
1. All pupils are assigned specific topic(s) for their project work	32 (52.5)	4 (11.1)	11 (27.5)	4 (22.2)	51 (31.9)
2. All pupils select their own topic(s) from a number of assigned ones	9 (14.8)	8 (22.2)	14 (35.0)	8 (44.4)	41 (25.6)
3. All pupils choose their own topic(s) independently with guidance where necessary	12 (19.7)	18 (50.0)	10 (25.0)	0 -	40 (25.0)
4. Some pupils are assigned their specific topic(s), others choose their topic(s) with guidance where necessary	7 (11.5)	6 (16.7)	5 (12.5)	5 (27.8)	25 (15.6)
Not answered	1 (1.6)	0 -	0 -	1 (5.5)	3 (1.9)
n =	61	36	40	18	160

* see Table 3.1.

TABLE 3.3.

FACTORS GUIDING TEACHERS IN THEIR
DECISION TO ASSIGN TOPICS OR GIVE PUPILS CHOICE

METHOD OF TOPIC ADOPTION	GROUPS OF TEACHERS				All respondents
	1 All pupils are assigned specific topic(s) for their project work	2 All pupils select their own topic(s) from a number of assigned ones	3 All pupils choose their own topic(s) independently with guidance where necessary	4 Some pupils are assigned specific topic(s); others choose their topic(s) with guidance where necessary	
(i) Pupil Interest and Attitude to work.	15.7%	29.3%	50.0% (a)	44.4% (c)	32.5%
(ii) Relevance of Topic to Syllabus and Examination.	43.1% (e)	26.8%	17.5%	24.0%	30.0%
(iii) Pupil Ability to choose and handle topic.	15.7%	29.3%	27.5%	44.4% (d)	27.5%
(iv) Availability of Resources and Facilities.	25.5%	34.1% (b)	15.0%	32.0%	25.6%
(v) Organisation and Management of Project Work.	19.6%	22.0%	7.5%	12.0%	16.25%
(vi) The Content of the Topic and its potential for practical work.	9.8%	22.0%	12.5%	8.0%	8.75%
(vii) The Method of Assessment of Project Work.	3.9%	-	2.5%	8.0%	3.75% (g)
(viii) The Ability and Aptitude of the Teacher	3.9%	7.3%	-	-	3.1% (f)
n =	51	41	40	25	160

The pupils are more likely to co-operate if given a free hand in choice. (083, General Science)

In order to sustain interest over two years of project work I feel that if pupils choose their project from their own interests, this will be easier accomplished. (009, Biology)

The project must grow out of interest rather than hope the project will generate interest. (008, Chemistry)

The notion that project topics should, if possible, be chosen by the pupil so as to encourage greater motivation has also been put forward by Armstead (1975 p. 76) on the basis of observations and recommendations made by Dowdeswell and Tricker (1970) in their earlier discussions on the use of biological projects in Nuffield Advanced Science. It is however interesting to note that none of the Physics teachers participating in this study gave this freedom of choice to their C.S.E. pupils (see Table 3.2.). The reasons why this should be so remain speculative but the constraints of a fairly rigid and traditional syllabus as mentioned in the previous section) seem to have some influence on these kinds of decision.

As an alternative to the method outlined above, forty-one teachers (25.6%) utilised a selection system in which the pupils were required to select their topics from a number of assigned ones (see Table 3.2.). This particular method was regarded favourably by Small (1973) whose study of student project work in Further Education revealed that those students who had some degree of choice (i.e. they chose from a list of topics) tended to perform better than those who were given free choice or no choice. However, in the C.S.E. enquiry reported here, improvement in pupil

performance did not appear to be an important factor under consideration by teachers using the selection scheme. From the information collected on this item, it seemed that although pupil interest and ability did guide these teachers in the compilation of their topic lists, the cost of project work made the availability of appropriate resources and facilities the chief factor influencing their decision to adopt this particular method (see Table 3.3., (b)). Some of the constraints experienced by the teachers with respect to project topics are reflected in the comments which follow:

Pupils are offered limited choice ... the limits are set by the facilities offered by the school and neighbourhood being appropriate and adequate. (085, General Science)

... a large amount of resource material has been collected together. Other topics which the pupil might choose would present difficulty and much less material would be available. (170, Biology)

In an earlier study by Hewitt (1970) the provision of adequate facilities had been identified as 'probably the greatest problem' and in the investigation of the use of project work in Chemistry (cited earlier), Armstead (1975, p.5) too had seen it as one of those problems that 'stubbornly remain'. Thus further constraints on the selection of topics would seem to be afforded by the availability of key resources and facilities and, clearly, for some teachers in this study, the provision of adequate materials, equipment and accommodation was an important issue in assessing whether or not topics for pupil project work were feasible.

Twenty-five teachers (15.6%), in contrast, operated a dual system by allowing certain pupils to choose their topics whilst assigning specific ones to other class members. As might be expected, two main factors (see Table 3.3., (c) and (d)) guided these teachers in their decision to assign topics or give pupils choice:

- i. the pupils' interest and attitude to work,
- ii. the pupils' ability to choose and handle the topic.

On the whole the teachers felt justified in using this type of approach. As one respondent explained,

More able pupils are able to make decisions as to the suitability of particular topics for project work, and can realise the practical possibilities of a project. Less able (and less motivated) pupils need guidance ... (003, Chemistry)

Another teacher of Chemistry argued,

Experience shows that some topics which attract pupils are not capable of being sustained.
(027, Chemistry)

However, in the implementation of the dual scheme it was also stressed that:

If pupils select a suitable topic for themselves (that is, if the apparatus is available and the experiments are safe) this is preferred. Those who do not, have a topic suggested ...
(200, Chemistry)

It seemed therefore that the teachers in this group preferred to draw out topics which were of interest and appeal to the pupils themselves but, in keeping with earlier findings in this area (see, for example, Hewitt 1970) they were also forced to consider those less able pupils who found it difficult to choose and analyse a project topic in the first instance.

Having considered the factors guiding teachers in their decision to give pupils some degree of choice in their project topics, it is interesting that almost one third of the respondents (the majority of whom were teachers of Biology) assigned specific topics to all their pupils irrespective of their individual abilities and interests (see Table 3.2.). These teachers were found to attach more overt importance to the final examination and could, perhaps, be regarded as more syllabus-orientated. Indeed, 43.1% of them made their decisions about a project topic on the basis of its immediate relevance to the syllabus and examination (see Table 3.3., (e)). In this context, one teacher wrote:

The syllabus is the prime consideration.
(363, Chemistry)

while another, who taught Physics, favoured the assignment of topics because:

A free choice produces topics with little
syllabus content. (326, Physics)

The suggestion that assignment reduces motivation, interest and originality was either dismissed or rationalised by the teachers adopting this type of approach. When interviewed, some respondents proposed that by assigning a topic that was realistic, pupils were more likely to achieve something positive from the exercise. It was further suggested that their success with the undertaking then acted as a stimulus, encouraging them to sustain effort. Others argued that the assignment of project topics did permit a considerable degree of originality in that pupils were able to expand or play down certain

aspects of the topics according to their own interests and inclinations. Several respondents went on to suggest that the 'average' C.S.E. pupil actually prefers to be given set assignments and tends to flounder or panic if left in an open-ended situation with regard to the choice of a topic.

Continuing this theme, five teachers expressed concern about their own lack of expertise and/or interest in certain fields of study. Their deficiencies, they felt, often restricted their selection of topics and narrowed their use of the project method (see Table 3.3.,(f)). Similar but less direct references to teacher ability and aptitude were made by many more respondents in other contexts. The possession of appropriate skills as well as personal interests were seen by some teachers as important factors guiding their decision to assign topics or allow pupils a limited choice. Moreover, it was suggested that project work could only be really effective if properly planned and directed, and therefore the success of the project method was seen to depend to some extent on the ability of the teacher to plan and direct the work effectively.

Similar findings had emerged from the investigation carried out by Small (1973) cited earlier. She found that the project tutors often experienced difficulty in identifying suitable project topics and providing adequate resources, sentiments which were echoed by the C.S.E. respondents used in this study:

Project work is rarely exploited to its full potential largely due to the inadequacy of the staff involved. (267, Biology)

I feel my personal problems will arise from lack of variety of topics, lack of resources due to my own inexperience. (190, Biology)

The staff concerned also feel that while they have a deal of subject specialism, they need to develop different techniques to apply them to a project-based course. (211, General Science)

Such comments hold clear implications for the pre- and in-service training of teachers and raise serious questions about the experiences of science teachers outside the field of education and their ability to apply their academic knowledge to practical situations. (These issues are discussed more fully in Chapter 6, Section 6.2. in the light of further data on the qualifications, training and work experience of the teachers involved in this investigation, and in Chapter 8, Section 8.9. where major constraints on the implementation of project work are considered.)

An additional finding to emerge from the data relates to the assessment of project work. Surprisingly, of the one hundred and sixty teachers implementing the project approach, only six (3.75%) of them named project assessment as a factor guiding their decision to assign topics or give pupils a choice (see Table 3.3.(g)). This was especially interesting in view of the fact that ninety-nine (61.9%) of the respondents agreed with a later statement on the questionnaire, namely that 'Project work cannot be reliably standardized; a pupil may be severely handicapped by his/her choice of topic' (see Chapter 6, Table 6.12.). One respondent did however provide a detailed account of the problems of assessment he had personally encountered:

When I first started project work it was stressed by the Examining Board that the emphasis was on practical exercises and not on copied written work. We exhibited all the students' work and the examiner/moderator called to see the work and to interview some of the students. Then costs became prohibitive and the Examining Board scrapped the system and requested us to send projects by post. When I enquired about the difficulties of sending samples of chemicals etc. and the dangers and impossibilities attending that exercise, the Board said to send only the papers! After that, our interest in project work slumped!

(219, Chemistry)

Dissatisfaction with the operation of a postal moderation system was expressed by a number of teachers during the course of the enquiry and there was obvious concern about the assessment of project work for examination purposes (see Chapter 4) but, on the whole, assessment procedures in relation to the selection of topics was not, it seems, a major consideration for the majority of science teachers involved in this study.

3.3. Summary and Discussion

A variety of different forms of project work was found to exist in schools and colleges in the East Midland region. This chapter has reviewed the types of project work being undertaken in the four main C.S.E. science subjects under investigation, and discussed the selection of topics used in the project method at this level.

In terms of the descriptions employed in this study, two main types of project work were found to predominate. These were (i) the 'report' type and (ii) the 'combination' type. In the former, the pupils were required to collect

information on a specific topic from a range of literary sources, organise the material and then present it in the form of a written report. 43.8% of the C.S.E. teachers using the project approach indicated that their pupils were engaged in this type of exercise although the incidence of it was found to be higher among the teachers of Biology and Physics. Many of the teachers employing the report method regarded it as a valuable means of promoting interest in the subject although the vast majority (91.4%) also expressed concern about the heightened incidence of plagiarism that tended to emerge from it.

In contrast, 44.4% of the respondents used what was described as the 'combination' approach to project work where pupils were required to answer some question or investigate some problem by combining the theoretical and practical aspects of the topic under study. This type of exercise was more popular among the teachers of Chemistry and General Science who regarded it as more applicable to their C.S.E. syllabuses and examinations.

The full 'discovery' type project based on practical experimentation and investigation was, according to the definition provided, rarely used. The inability of pupils to cope with an open-ended situation, the lack of facilities and resources, and the pressures of the examination syllabus were the main reasons put forward to explain teachers' failure to implement this type of approach.

A few alternative forms of project work were described. These usually took the form of structured exercises using the prepared work-sheets. Such approaches did not appear

to play a significant part in the project method as understood by the majority of teachers although from later comments it became apparent that many respondents felt that these types of exercises may be more useful for C.S.E. pupils (see Chapter 7).

From the discussions about project topics, it was clear that a wide variety of factors guided and influenced teachers in their decisions about whether to assign topics or give pupils choice, and a range of difficulties presented themselves. Those teachers giving their pupils an open choice about project topics (Group 3, Table 3.3.) and those giving choice to some and assignments to others (Group 4) tended to attach importance to the attitudes of their pupils. Pupil characteristics, especially their interest, enthusiasm and motivation, were awarded a good deal of attention by these two groups of teachers on the understanding that favourable attitudes such as these were conducive to effective and worthwhile project work.

Pupil ability was also discussed at some length as an additional factor influencing those teachers operating the dual system of choice/assignment of topics (i.e. Group 4). In general, it was agreed that ideally pupils should choose topics for themselves but that for those pupils who were not able to choose topics that were realistic and manageable, topics had to be assigned that were appropriate to both their intellectual and practical capabilities.

Finally, it was clear from the discussions that, in some instances, teacher as well as pupil characteristics influenced the selection of project topics to be undertaken

at C.S.E. level. From their comments it seemed that some respondents were more likely to accept as realistic, topics chosen by the pupils, if they themselves were interested in the choices and had the expertise to direct them as part of a pupil project. If, on the other hand, a teacher knew little about the proposed topic, found it uninteresting, or felt unable to supervise it competently, then the topic might be rejected for another about which the teacher felt more confident. It was suggested that the ability of the teacher to undertake the necessary planning and provide the appropriate level of supervision was important since at C.S.E. level many pupils without good guidance would feel lost and frustrated by the project approach.

Thus, from the evidence presented in this chapter, it can be seen that several factors influenced teachers in their decisions about project work but perhaps of greater interest is the apparent divergence of opinion that emerged in connection with the function of project work as perceived by the respondents. On the one hand, there were those who saw the project method as a means of developing skills, and therefore placed greater emphasis on the personal characteristics of their pupils, their interests and motivations. These teachers tended to concentrate less on the actual content of the projects i.e. the 'products' of science, and more on the development of scientific skills i.e. the 'processes' of science. In contrast, there were those who viewed the project method as a direct teaching/learning strategy to cover specific areas of the

C.S.E. examination syllabus. These teachers tended to attach more importance to the content of their courses and the amount of learning in the form of knowledge acquired at the time of the examination. These two perspectives presented something of a dilemma to many teachers. They felt concerned about the decisions they had to make with respect to science teaching in general and the project method more specifically. Should they, for instance, allow pupils to extend their own scientific interests in the form of projects that are intrinsically satisfying for them, or should they instead assign topics to pupils, topics which they know will serve them well in the final examination?

Without doubt, such questions raise a number of provocative issues in relation to the relevance of existing science syllabuses to the 'average' C.S.E. pupil. Two possible explanations of these findings might be that:

- i. the interests and aptitudes of the pupils and the form and content of the examination syllabuses are mutually exclusive,
- ii. the topics and methods of study favoured by the 'average' science pupil cannot be usefully or reliably examined.

Interpreted in this way, a clear dilemma between pupil bent and syllabus content would seem inevitable for the users of the system. From the evidence presented in this chapter, it is plain that there are some teachers who see more value in the acquisition of personal skills and attitudes in pupils, and conversely, there are some who

place greater emphasis on the pupils' success in the final examination. Clearly, as long as this division persists, the use of pupil project work and its justification will polarize. However, the hope of developing a more effective and meaningful form of project work is not lost; it lies with those teachers who fall between the poles of contention and who manage to combine the two important aims by promoting pupil growth as well as examination success. If a workable solution to this dilemma is to be found, then the starting point must surely involve a closer and more rigorous analysis of the teacher characteristics alongside those patterns of organisation and management associated with the more successful forms of pupil project work. These and other relevant issues are discussed in depth in later chapters.

NOTES

1. See Aspects of secondary education in England: A Survey by H.M. Inspectors of Schools, H.M.S.O., December 1979, Chapter 8, para.9.2./3., pp.182-183.
2. Ibid., Chapter 8, para.12.11., p.190.
3. In addition to the obvious problems to arise from shortage of ancillary assistance, the work of Armstead (1975), p.iv) has suggested that, on balance, laboratory staff prefer to prepare for traditional practicals rather than for project work.

CHAPTER FOUR

THE ORGANISATION AND MANAGEMENT OF PUPIL PROJECT WORK

- 4.1. Pupil Organisation: The Individual and Group Approach
 - 4.2. Guidance and the Supervision of Pupil Project Work
 - 4.2.1. Current Findings (i) Levels of Guidance
(ii) The Time for Guidance
 - 4.2.2. The Question of Guidance: An Extended Discussion
 - 4.3. Working on Projects: The Time and Place for Project Work
 - 4.3.1. The Place of Project Work in Formal Class Periods
 - 4.3.2. The Time Spent on Project Work by C.S.E. Science Pupils
 - 4.3.3. Working on Projects: A Summary
- Notes

4.1. Pupil Organisation: The Individual and Group Approach

The organisation of pupils engaged in project work, whether they are required to work independently, in pairs or in larger groups has important implications in terms of the provision of resources and facilities, the opportunities for direct teacher/pupil contact and supervision, and the subsequent use of project work as a teaching strategy and assessment procedure.

Early discussions in this area had revealed a variety of patterns of organisation for project work and the importance of investigating this aspect in more depth was quickly recognised. As a consequence of these preliminary enquiries, a questionnaire item was constructed in an attempt to gain both a qualitative and quantitative picture of the types of organisation operating at that time.

Using information collected informally at the start of the study, item 7, Section A of the Questionnaire (see Appendix I) was compiled which contained brief descriptions of three likely methods of organising pupils for project work. These were:

- i. On an individual basis, working and writing up independently.
- ii. In pairs or groups, working together but writing up independently;
- iii. In pairs or groups, working and writing up together.

Those teachers who used pupil project work as part of their C.S.E. science teaching programme were asked to indicate which of the three types best represented the one they most usually adopted with their C.S.E. pupils. In the

second part of this item (part 7(b)), the same respondents were then asked to state which type of organisation they actually preferred. If none of the descriptions adequately fitted the arrangement they used or preferred, the respondents were given the opportunity to specify the alternative forms of pupil organisation envisaged in each case.

The incidence of each type of arrangement, across C.S.E. science generally and within the four separate science subjects under investigation, is shown in Table 4.1. The final column in this table represents the teachers' preferred organisation.

As figured in Table 4.1., the majority of teachers (60.6%) indicated that they usually organised project work on an individual basis, with pupils working and writing up independently. The response to item 7(b) also showed that this type of arrangement was the one most generally preferred by 56.3% of the respondents. The individual approach to project work was especially favoured by the teachers of Biology and Physics who, as discussed in Chapter 3, Section 3.1., most frequently engaged pupils in projects of the reporting type. These teachers held the view that such an approach was essential if individual pupils' efforts were to be clearly identified and fairly assessed.

Conversely, the teachers of Chemistry and General Science (41.7% and 47.5% respectively) showed a marked tendency to organise their pupils in pairs or groups for project work, as well as on an individual basis. In these subjects, the 'working-together' arrangement was often

TABLE 4.1.

THE INCIDENCE OF PROJECT WORK ON AN INDIVIDUAL
AND GROUP BASIS: THE USUAL AND PREFERRED ARRANGEMENTS

TYPE OF ORGANISATION	% age Frequency of Response				All Respondents	
	Biology	Chemistry	Gen. Sci.	Physics	Usual Organisation	Preferred Organisation
(a) On an individual basis, working and writing up independently	73.8	47.2	42.5	72.2	60.6	56.3
(b) In pairs or groups, working together but writing up independently	13.1	41.7	47.5	16.6	28.1	33.8
(c) In pairs or groups working together and writing up together	1.6	-	-	-	0.6	-
(d) Other arrangements (as specified by respondents)	9.8	11.1	10.0	11.1	10.0	6.9
Not answered/specified	1.6	-	-	-	0.6	3.1
n=	61	36	40	18	160	160

adopted to help overcome the problems of resources and equipment associated with the 'combination' type exercise which was the one most commonly used and which by definition involved some measure of practical, investigative work (see Chapter 3.1.). Furthermore, it was suggested that pairing or grouping of pupils for project work permitted the pooling of abilities and encouraged communication and co-operation between pupils of differing backgrounds, interests and aptitudes. For these reasons, over one third (33.8%) of the respondents preferred this type of organisation.

The recognition of the 'passenger' within the pair/group situation was identified as a possible problem but the compilation of personal project reports by each pupil was seen as one method of overcoming this difficulty. It was suggested that the presentation of such reports enabled individual progress to be assessed, and revealed quite reliably those project members who had been 'carried along' and achieved little of individual merit.

There was virtually no support for project work as a fully combined activity with pupils working and writing up collectively in paired or grouped situations. The one Biology teacher who did implement (and prefer) this type of organisation used project work only as a teaching/learning strategy and not as a procedure to facilitate some form of course assessment. In his arrangement, the projects were 'field topics' (for example, the treatment of sewage which involved visits to local sewage plants) on which the pupils, under his supervision, worked together as a class or in smaller sub-groups. Back in the classroom,

the pupils and teacher discussed their findings and decided which aspects of the topic to include in the final project report. The pupils pooled their resources and presented their information in the form of posters, displays and specimens to be put on show for friends, parents and employers to see on Open Day. In a sense, project work along these lines may be regarded very much as a public relations exercise, designed to promote interest and goodwill between those inside and out of the field of education. The respondent using this approach argued that learning by this strategy went beyond the mere acquisition of knowledge and involved, to a greater extent, those socio-attitudinal skills (described in Chapter 5) which perhaps in the final instance would equip pupils more appropriately for life in the 'real world'. However, in the context of the external examination scheme with, it was claimed, its continuing emphasis on factual recall, many respondents felt reluctant to organise such an approach on the grounds that it did not ensure the acquisition of a good grade on the final certificate. Thus, it would seem that the issues discussed in the previous chapter - those of pupil interest, syllabus content and examination success - appear once again as an important influence on the operation of project work in C.S.E. science.

To summarize, it seems then that for the formal assessment of pupils the teachers in this study tended to organise project work on an individual basis although pairing and grouping of pupils was more common in project work of a practical nature where it was used to overcome

shortages in equipment and resources. Paired and grouped project work was also favoured as a means of encouraging communication and co-operation between pupils although all the teachers using this type of organisation preferred their pupils to compile project reports independently so that individual effort and achievement could be more easily assessed.

4.2. Guidance and The Supervision of Pupil Project Work

The difficulty of providing the right amount of guidance at the right time has been identified by a number of earlier investigators of teaching methods at all levels of schooling. For example, Cook and Mack (1971) in their study of primary school teaching have quoted one teacher in their investigation who clearly experienced this problem in her attempt to implement the 'integrated day'.

... there is a lot to cope with in this way of working. One must try to learn when to leave things alone, and when to intervene. Always we must be aware of the danger of leaving things too long.
(Cook and Mack 1971, p.43)

Kaye and Rogers (1968) in their account of group work in secondary schools have also acknowledged this dilemma, offering the following advice to teachers:

... The first question the teacher must always ask himself before pointing out any errors in plans of work is whether or not the child in question will benefit more from making the mistake than from correcting it beforehand. (Kaye and Rogers 1968, p.32)

Similarly, Small (1973) in her study of project work in Further Education has identified the difficulties associated with the tutor's role during project work.

She has advocated that during the first few weeks the tutor should adopt the traditional lecturing role to ensure that the students have a good grounding in their project topics and that following that period of induction, the tutor should operate in the background, always available for advice but intervening only if essential. Small has stressed that the basis of this approach is to direct attention towards the project 'process' and to reduce the emphasis on the project 'product' (Small 1973, p.7).

Thus, from the research already documented, it was recognised that the type and timing of intervention by a teacher might be critical to the progress and achievement of pupils involved in project work. However, in this particular study the concern about guidance and supervision of pupils was not confined solely to the individual attainments of those pupils. From the informal discussions with the teaching staff at the start of the investigation, other more controversial issues were raised in the context of national examination methods. Teachers were clearly concerned about the effects of differing levels of guidance and patterns of supervision on the outcome of formal assessment.

Hence, the importance of establishing appropriate guidance and supervision practices was seen to be two-fold, helping in the first instance to make the project method a more effective teaching/learning strategy and, in the second instance, a more reliable and valid means of assessment. For these reasons, an attempt was made in this

enquiry to identify the different levels of guidance and modes of supervision being given to C.S.E. science pupils undertaking project work, in the hope that certain guidelines might emerge which could provide valuable information on these two aspects of the project method.

4.2.1. Current Findings

i. Levels of Guidance

To avoid the many problems associated with attempts to quantify 'guidance', three levels of guidance (considerable, limited and minimal) were defined in item 4(a), Section A of the questionnaire. The teachers were then asked to estimate the amount of guidance they usually gave to C.S.E. pupils undertaking project work in science and to base their responses on the definitions provided. The results showing the levels of guidance usually provided for C.S.E. pupils engaged in project work are shown in Table 4.2.

As shown in Table 4.2., using the prescribed categories, 61.9% of the respondents using the project method described their level of guidance for pupils as 'limited'. These teachers received suggestions for project topics from their pupils and then discussed with them the feasibility of the exercise and possible lines of enquiry. They directed the pupils through the more difficult aspects of their topics and offered advice about likely resources. The respondents offering this sort of assistance to pupils frequently claimed to do so in view of the past education and training these pupils had received. Being accustomed to having most

TABLE 4.2.

LEVELS OF GUIDANCE FOR PUPILS ENGAGED IN PROJECT
WORK IN C.S.E. SCIENCE

LEVEL OF GUIDANCE	FREQUENCY OF RESPONSE (% age)
<u>A considerable amount of guidance -</u> Pupils are assigned specific topics; they are guided through them and given all the necessary resources. They are advised about the presentation of their work and directed towards its conclusion.	49 (30.6)
<u>A limited amount of guidance -</u> After suggestions have been made and discussed, pupils select their topics. They are guided through the difficult areas and given advice about possible resources.	99 (61.9)
<u>A minimal amount of guidance -</u> After discussing the aims and objectives of project work, pupils choose their own topics. From then on, they work independently, assuming personal responsibility for both the content and presentation of their work. They are assisted only when problems beyond their control are encountered.	12 (7.5)

(n = 160)

of their decisions made for them, it was felt that pupils were not usually in a position to suddenly accept total responsibility for their project work at the start of a C.S.E. course. Furthermore, in support of the views of Kaye and Rogers (1968) cited earlier, many respondents acknowledged that:

... with classes unused to group work or other informal methods ... to give children too much responsibility for their own programme of work at the outset simply leads to anxiety and consequent disorder (Kaye and Rogers 1968, p.5).

A limited amount of guidance was therefore deemed necessary in order for pupils to gradually assume this increased

level of freedom with competence and confidence. Thus, in the early stages of project work these teachers saw themselves as providing the basic framework within which the pupils could then make their own decisions and implement their own strategies.

In contrast, other responses to the questionnaire item showed that almost one third of the teachers (30.6%) provided guidance far in excess of the 'limited' amount just described. These teachers gave 'considerable' assistance to pupils in that they usually assigned specific topics, provided continual supervision and ensured that all the necessary resources were available for them. In addition, they advised their pupils about the presentation of their work and directed them finally toward its conclusion. In a number of schools, like the one visited as part of the observational study (see Chapters 2 and 7), work-sheets, job-cards or project booklets were provided by the teachers. Such items gave the pupils clear guidelines about the experimental design, practical investigations and the possible applications of the project topics under study. Quite often, such support material had the added advantage of being linked to the examination syllabus. Many of the science teachers were, however, highly critical of this 'cook-book' type of approach, suggesting that it led to 'a mechanical performance of ideas suggested by others' (274, Chemistry), but Rowe (1959) in his discussion of the education of the average (secondary modern) pupil suggested instead that the job-card facility:

... avoids the invertebrate lack of direction and control and the wayward finding out of more and more about less and less of significance that mar so much activity and project work.
(Rowe 1959, p.64)

In contrast to this somewhat prescriptive approach to project work, twelve respondents (7.5%) claimed to adopt an entirely different scheme. These teachers indicated that they provided only 'minimal' guidance to their pupils, with the responsibility for nearly all aspects of their projects, from inception to completion, being left in the hands of the pupils. Under these circumstances, guidance was provided only when serious and unavoidable problems, which could block progress, were encountered.

ii. The Time for Guidance

In response to item 4(b), Section A of the questionnaire, the majority of teachers (85.0%) indicated that they usually gave guidance to pupils on project work during the teaching periods at school. (This result encompassed all 160 respondents irrespective of whether the level of guidance provided was rated as 'considerable', 'limited' or 'minimal'.) A small percentage of teachers (3.8%) maintained that they usually provided assistance at other times in the school day, outside formal teaching periods.

Sixteen respondents (10.0%) felt unable to categorise their responses as requested; fourteen of them responded by placing ticks in both boxes 1 and 2, demonstrating that they gave guidance at school, during and outside formal teaching times. Two teachers ticked all three boxes indicating that they helped pupils during each of the three listed periods. A further two respondents failed

to pinpoint any time and did not, consequently, complete the item for analysis.

These findings are summarised in Table 4.3.

TABLE 4.3.

THE PERIODS DURING WHICH GUIDANCE WAS USUALLY GIVEN TO
PUPILS UNDERTAKING PROJECT WORK IN C.S.E. SCIENCE COURSES

Period when Guidance was usually given by Teacher	Frequency of Response (%age)
During teaching periods	136 (85.0)
During school hours, out of teaching periods	6 (3.8)
Out of school hours	0 -
Other Responses	16 (10.0)
Not answered	2 (1.3)

(n = 160)

In further discussions around this topic, a number of teachers expressed concern about the lack of available time in which to provide adequate guidance and supervision for pupils undertaking project work. As one respondent commented:

One of the greatest factors causing inefficient use of time by pupils (I think) is lack of individual tutorial time which is drastically reduced ... Therein lies a weakness of the 'project method' of teaching.
(309, Physics)

Without doubt, a large number of teachers felt they needed more time to lay down the guidelines for project work, more time to provide a balance of supervision and direction for their pupils and more time to undertake fuller and more structured forms of continuous assessment. Lack of time was therefore a widespread problem experienced by many

teachers involved in the teaching of C.S.E. science subjects.

However, the information summarised in Table 4.3. possibly reveals further issues worthy of comment.

The indication that very little guidance was given out of school and lesson time suggests that projects for C.S.E. pupils were not generally envisaged as part of extended field-trips, industrial visits or other activities outside the school science departments. From other findings (see Chapters 3, Section 3.1. and 4, Section 4.3.) it also seems likely that the projects undertaken by the C.S.E. science pupils for the most part involved activities and exercises carried out within the confines of the classroom or laboratory, backed by small portions of work completed out of school with little direct supervision. If this is the case, and project work is concentrated within the school environment, then the significance of projects for these pupils immediately comes into question: do pupils see project work as just another school activity designed to encompass some aspect of the syllabus for examination purposes, or do they regard it as a means of extending their experiences and developing skills relevant to the 'real world' of home and work?

These are questions which must surely be acknowledged in any meaningful evaluation of project work in C.S.E. science. (For further discussion of these aspects of the project approach, the reader is referred to Section 4.3.1. of this chapter, and Chapter Five which follows.)

4.2.2. The Question of Guidance: An Extended Discussion

On the question of guidance, the majority of respondents thought that average C.S.E. pupils required some degree of guidance if project work in science was to be successful in developing both intellectual and socio-attitudinal skills.

The quality and quantity of help given was seen as important to the personal development of each pupil, as was the timing of such assistance. From the comments volunteered on the questionnaire and during the course of the interviews, it seemed that if too much help was given with projects prematurely or in too great a detail, there was a real risk that the pupils would become swamped by the intellect, interests and enthusiasms of their teacher. As a consequence, the projects might easily be 'taken over', with the pupils becoming intellectually lost, psychologically undermined and effectively isolated from the project topic. Conversely, if guidance was provided too late or in too little detail, it seemed that the problems pupils might encounter and the mistakes they might incur would weaken their motivation and finally result in them feeling confused, frustrated and largely disenchanted with the project exercise.

Thus, it would appear that in any independent learning situation, the difficulty and importance of providing the appropriate level of guidance for pupils, at the correct time in their programme of work, cannot be over-emphasised. From the discussion so far, it would seem that the type of supervision given to pupils alongside the timing of any

intervention by the teacher may be critical to the individual progress made by those pupils. Moreover, in agreement with a number of earlier writers in this field (for example, Cook and Mack 1971; Kaye and Rogers 1968; Small 1973) the perspectives of teachers participating in this current survey clearly suggest that guidance when well-timed, carefully structured and thoughtfully administered may assist in the acquisition of skills and the development of a mature attitude to work, and ensure that each pupil finds project work a rewarding and fulfilling experience.

The provision of guidance in relation to pupil achievement cannot however be considered in isolation since, as discussed earlier, the amount of guidance given to pupils has additional implications for the formal assessment of those pupils for examination purposes. In further discussions around this theme, several respondents in this investigation expressed concern about the high levels of guidance that were, in some cases, being given to pupils undertaking project work as part of their C.S.E. assessment. Anxieties were directed especially towards those Mode III science syllabuses in which a course work assessment - often made on the basis of pupil project work - constituted a large percentage of the final examination. With reference to the teaching of such syllabuses, one teacher asserted that:

Too many projects are so teacher-directed as to be meaningless as far as I can see in C.S.E. Mode III assessing. (157, Biology)

Another respondent provided a more explicit account of his own difficulties vis à vis guidance and assessment in the project method:

Two groups are taught at this school. I taught according to 'limited' guidance. The projects they produced were much their own work, own expts., own conclusions, etc. The other group were taught according to 'considerable' guidance. The final written projects could easily be distinguished ... the 'limited' guidance pupils came off worst because they did not compare favourably in appearance, number of experiments or the way it was written up - even though it was more 'their own work' (as stated by syllabus) rather than a copy of other teachers' handouts, etc. ... (182, Chemistry)

This last comment highlights the problems associated with the assessment of project work both internally and by the system of postal moderation. It reflects the many difficulties still to be overcome in the use of project work for examination purposes on a national scale. Given the formal specifications laid down in the science syllabuses, it would appear that there still exists considerable variation in the amount of help given to pupils even within the same school science department. This being the case, then the problems of assessment and its standardization must inevitably be greater still between different staff in different establishments throughout the region.

In conclusion, it is clear from the range of views expressed in the preceding pages that the teacher's role in the provision of guidance for pupils engaged in project work is far from easy to define. Perhaps, as Kaye and Rogers (1968) suggest, the teacher should learn to regard himself more as a promoter, co-planner and sounding-board for ideas rather than as a source of information; or possibly, as Cook and Mack (1971) propose, the teacher should be there to assist, support and instil confidence in pupils. However, irrespective of the different phrases one selects to describe the teacher's role and the varying

slants one subsequently places on it, key features have emerged which seem to typify the teacher's own interpretations of their function in project work. In brief, it would appear that to ensure both the optimum development of pupils in the 'processes' of science and the valid assessment of their achievements, the teacher has to strike a careful balance between an attitude of laissez-faire non-involvement on the one hand and that of total, unrestrained monopoly on the other. If such a balance can be achieved and maintained, then a form of project work which is effective both as a teaching/learning strategy and as an assessment procedure might be realistically envisaged.

4.3. Working on Projects: The Time and Place for Project Work

4.3.1. The Place of Project Work in Formal Class Periods

The early initiative for this research study arose, as discussed previously, out of the fact that project work may be interpreted in a number of different ways, carry a range of aims and objectives, and play a variable role in the formal assessment of pupils. Moreover, it was recognised that different project approaches made varying demands on specialist knowledge and resources so that in the school context, for example, they may necessitate close collaboration with the teacher, the use of laboratory facilities, interviews with outside authorities, or simply the availability of appropriate texts for reference.

This being so, it was clear that some projects by their very nature had to be undertaken at school whilst others gave pupils the freedom to explore avenues of enquiry away from the school setting.

Certain clues as to the value of a teaching strategy that enabled science to be taken outside the confines of the classroom and to draw on external agencies to generate interest and enthusiasm, were found in the 1980 E.M.R.E.B. C.S.E. syllabus for Biology (Mode I) where one of the major aims was:

To develop and encourage an attitude of curiosity and enquiry and to instil an awareness of the place of Biology in the world at large.

Similar aims were implicit in the 1980 syllabuses for Chemistry and Physics:

To develop awareness of the importance of science in everyday life by reference to practical situations and applications.

Hence, to give pupils the opportunity to see science in relation to their own lives could be regarded as an important feature of science courses at this level and could, in turn, be interpreted as a recommendation for the pursuit of project work out of school. Certainly, the notion that experiencing science in a relevant context deepens understanding and promotes learning has been widely supported (see, for example, Hadow 1931, Whitehead 1947, Travers 1969, Newsom 1963) although the case for project work as an out-of-school activity has not been so conclusive.

In recent years, some doubt has been cast on the validity of project work undertaken outside formal class periods, particularly when it is used as part of the

formal course assessment for national examinations such as the C.S.E. This reticence is reflected to some extent in the official E.M.R.E.B. documents where clear directives on teaching strategy have been provided. By way of illustration, the 1980 syllabuses for Chemistry and Physics stated that the continuous practical assignments (i.e. the selection of mini-practical 'projects' used as a course work assessment in place of a final practical examination and carrying 30% of the final mark):

... must be carried out in normal class-time and the results should be presented in a separate book or file for postal moderation.

(Interestingly, the use of the individual pupil project as a formal examination exercise, initiated and undertaken independently by each pupil, was abandoned by E.M.R.E.B. a few years before on the understanding that it was not a satisfactory means of course assessment.)

The 1980 syllabuses for Biology and General Science made no explicit specifications about the time or place for similar exercises although the former did stress that:

... Candidates must produce evidence of individual practical work and individual course work completed during the two years of the course ...

and weighted the course work assessment accordingly.

Similarly, in the General Science syllabus, the 'ability to follow instructions individually ... to handle apparatus and to show initiative and inventiveness' were aspects of the optional extension exercises that received considerable attention in the assessment criteria.

It seemed therefore that in order to fulfil the stated directives and to make the sorts of assessments

required of the C.S.E. examination, candidates needed to undertake some, if not all, of their individual work during formal class periods, within the vicinity of the teacher who was to carry out the assessments. However, from informal discussions at the start of the study, it was apparent that not all teachers supported the directives set out in the official documents. For some, they were seen as a serious constraint on the implementation of investigative science teaching outside the classroom and some degree of resistance to the formal schemes was detected.

Hence, it was clearly important to investigate these perspectives more fully and to determine where, according to the teachers, most of the work for projects should be undertaken.

Item 8, Section A of the questionnaire provided some quantitative data on these issues whilst the comments and observations volunteered on the questionnaire and during the programme of visits and interviews helped to explain the teachers' views. The findings are summarised in Table 4.4.

Of the teachers using the project method at C.S.E. level, over half (58.1%) indicated that they thought most of the work for projects should be undertaken at school/college during formal lesson periods.

Analysis of the responses on the basis of the type of project work used (i.e. Reporting v. Non-Reporting, see Chapter 3) showed that among the teachers implementing a non-reporting type project strategy a slightly higher

TABLE 4.4.

THE PLACE OF PROJECT WORK IN FORMAL CLASS PERIODS

PLACE OF WORK	Frequency of Response from Teachers (% age)		
	Type of Project Work*		
	Report-type	Non-Report-type**	All Types
At school/college during science lessons	31(44.3)	62(68.9)	93(58.1)
At school/college during free time	1 (1.4)	3 (3.3)	4 (2.5)
Out of school/college	31(44.3)	17(18.9)	48(30.0)
Not answered	7(10.0)	8 (8.9)	15 (9.4)
n =	70	90	160

* As defined in Chapter 3, Section 3.1.

** 'Discovery', 'Combination' and 'Other' Types are included in this category.

percentage (68.9%) opted for the majority of pupil work being undertaken at school during science lessons. A number of reasons were put forward to explain this view.

Firstly, it was suggested that projects of the non-reporting type - which by definition incorporated some element of practical investigation - frequently required the specialist equipment and facilities found in the school laboratory and could not therefore be easily pursued off the school premises.

Secondly, it was emphasised that free time at school was limited for pupils and that the opportunities to use it for project work were not readily available given the

existing health and safety regulations under which all pupils working in laboratories have to be supervised by a qualified member of staff. In addition, school laboratories were often heavily booked to accommodate other science classes throughout the school day. Consequently, they were rarely accessible to pupils and their projects outside formal teaching periods.

Thirdly, there was some anxiety about pupils' home environment. It was recognised that for some pupils parental interest and involvement in project work could be high and that in some cases its influence on the final product could give the pupils an unjustifiable advantage over peers whose parents showed no such directed encouragement and whose homes were perhaps similar to the type portrayed in the following extract:

... School is in a Social Priority Area ...
home interests and facilities for study are
low or non-existent; books get lost; work
is mutilated by smaller children, dogs ...
tea spilt on it, etc., etc. ... I am
reduced to nagging and punishing pupils and
still the work is never completed to their
satisfaction - never mind mine!

(096, General Science)

Thus, in implementing project work, it was recognised that the domestic situation could, for some pupils, be counter-productive whilst for others it could provide a highly resourceful and supportive environment. It was therefore thought to be unfair to ask pupils to undertake the bulk of their work for projects at home⁽¹⁾.

Finally, but equally important, were the considerations about the assessment of project work. Generally, the view was held that projects completed mainly out of school were

not easy to assess due to the difficulty of monitoring individual effort and achievement according to the criterion set out in the examination syllabuses. As one respondent wrote:

They (i.e. the pupils) start well and then begin to drift. They also tend to be dishonest in the work by not using homework time. They avoid open discussions ... This is a silly complaint but it is difficult to monitor pupils' out-of-lesson work. (263, Chemistry)

Furthermore, it was stressed that many of the syllabuses operating at that time specified, either directly or indirectly, that work of this type must be undertaken as part of the normal class and home time allocation and not extra to it.

Not all teachers were, however, convinced that project work should necessarily be undertaken during formal lesson periods. The teachers employing the report-type project work were, for example, more divided in their views. As shown in Table 4.4., 44.3% of them agreed that projects should be pursued mainly at school during class lessons, but an equal proportion of the respondents in this category also felt that projects of this type should be undertaken out of school time. In the discussion surrounding this issue, it was suggested that to engage pupils in report-type projects during science lessons was wasteful of school resources, of teacher expertise and of a potentially valuable teaching/learning situation. In other words, these teachers were of the opinion that reporting projects, although valid in science courses, should not be undertaken during class periods when possibly more specialist skills could be acquired by pupils working in the school laboratories.

In support of project work as an out-of-school activity, one teacher provided an outline of his own particular project strategy:

The project work I have set has been for bright pupils in school holidays where they have been expected to visit libraries, possibly museums, dentists, National Parks, zoos, etc. ... Their parents have welcomed this (Guidance notes etc. have been provided). Very many pupils expressed how much they enjoyed the tasks set.
(284, Biology)

Several other teachers commented on the success of this type of project exercise in generating pupil interest and enjoyment in the subject. Studied in this way topics, it was suggested, became less academic and more meaningful for the average C.S.E. pupil.

In addition, it was felt that certain topics were essentially more fitting for study outside in the community rather than within the confines of a classroom. Themes of a socio-ecological nature, especially those involving survey or casestudy work, were regarded as particularly dependent on this type of approach. In this context, one respondent reported:

At present, I am teaching C.S.E. 'Education for Parenthood' which includes project work. The majority of work is done out of school.
(320, Biology)

Along similar lines, an extract taken from a departmental list of project proposals given to pupils studying a C.S.E. Biology course neatly illustrates the point:

Child Development: Study of the growth and development of a baby or young child. Preferably with reference to an actual child. For example, records of weight and size increases over several months and a record of the development of various abilities over the same period e.g. crawling, walking, speech, etc.
(059, Biology)

Considering teachers' thoughts on the most appropriate place for project work, it is clear then that the type of project approach has in many ways influenced teachers in their decisions about where the work should be undertaken.

In general, projects of the non-reporting type, which entailed a degree of practical laboratory work, were thought to be best undertaken during formal class periods under the guidance and supervision of the teacher whilst those involving surveys and observational studies were thought to be more usefully applied as an out-of-school activity. Teachers' views on projects of the reporting-type, which required pupils to write an account on the basis of information collected from the literature, were on the other hand more divided. Some felt that projects of this type were best pursued at school but, equally, some respondents maintained that this type of exercise should be undertaken out of school in pupils' free time.

Whether projects should be carried out at home or at school, during class periods or free time has also depended to some extent on the directives set by the Examination Board, but where no formal specifications have been given, then the decision has been left with the teacher. However, from the comments and observations volunteered by the respondents, it would seem that in making this decision certain key arguments have had to be considered. These may be summarised as follows:

- i. Project work undertaken outside school allows pupils to work independently and to pursue topics which may not otherwise be covered during the formal class

periods. It enables science to be taken out of the classroom and in this way helps to make it more relevant to the lives of the pupils.

Assessment of projects undertaken outside school may however be problematic due to the difficulty of monitoring individual progress. Moreover, parental involvement in project work may amplify the problems in that pupils from resourceful homes can gain an unfair advantage.

- ii. Project work undertaken in school is more easily standardized. Working conditions are the same for all pupils so that any problems arising out of pupils' home environment are minimized. Assessment of projects presents fewer difficulties since individual progress can be more easily monitored, and pupils can be given the opportunity to work with specialist laboratory equipment under the supervision of the teacher.

Progress in project work is, however, often slow and when a syllabus has to be covered, it may be an uneconomic use of class-time. In addition, projects of the reporting-type undertaken at school can be wasteful of school resources and teacher expertise.

In acknowledging these broad statements it follows that the final decision as to whether project work should be undertaken at school or outside must, in the end, rest on the balance of these two sets of arguments, adjusted according to each teacher's unique situation.

4.3.2. The Time Spent on Project Work by C.S.E. Science Pupils

A limited amount of research has sought to investigate the importance of time allocation for pupils attempting project work and to ascertain a possible optimum time period for working on projects.

In her study of the use of project work with students in Colleges of Further Education, Small (1973) produced some evidence to suggest that the amount of time spent on project work significantly affects student performance, and for the technician mechanical engineering course used in her investigation, it was found that students timetabled for between 70 and 90 hours tended to do better than those who were allocated less than 70 or more than 90 hours. Perhaps from this it follows that if too little time is provided, students may be unable to really get to grips with the task in hand. Alternatively, if the time allocation is over-generous, the students may become too casual and may fail through lack of pressure to produce a satisfactory end-product. Other students may, on the other hand, become over ambitious and then find themselves frustrated in their attempts to fulfil their project aspirations.

Following through this line of investigation, Small found that certain factors were instrumental in determining the actual time spent on project work by students and the final results of their efforts. Situations in which students were given some degree of choice in their project

topics, where tutors carefully planned the work programmes and provided guidance and continual monitoring were shown to produce more favourable outcomes in terms of the time students committed to their work. In addition, the availability of college facilities to students outside normal school hours was found to influence the amount of time and effort spent on project work.

Other studies in this area have highlighted the problems associated with the management and organisation of project work in the school situation, and although these investigations have seemingly failed to provide any direct answers, they do go some way towards clarifying the questions. Armstead (1975), commenting on the managerial difficulties of project work, recognised that:

Proper facilities and a generous allowance of time are conditions absent in most state schools.
(Armstead 1975, p.89)

In this context, Green (1976) and Watts (1977) in their publications relating to Countesthorpe College described how the constraints afforded by time-tabling were minimized to facilitate the successful implementation of the individualized learning approach characteristic of the Leicestershire College. At Countesthorpe, the school day from the outset was organised into four long periods of 80 minutes duration. This was a deliberate attempt to allow pupils to follow through their work and thus reduce some of the regular interruptions brought about by the more traditional timetables composed of lessons of 35-40 minutes duration.

Kaye and Rogers (1968) in their investigation of group work have also recognised the importance of lesson

periods in generating a degree of success. Appreciating that the provision of class-time is often difficult, they stressed that a certain minimum number of lessons is essential if the work is to be carried out satisfactorily, although they acknowledged that this 'minimum' would vary according to the nature of the activity in question.

Wilmot (1971) in his study of the effects of project work on the attitudes of pupils to science has identified another restrictive influence:

In the secondary school, the project has become a specific piece of work rather than a general approach to science and craft teaching ...
(Wilmot 1971, p.1.2.)

and has suggested that once a project article has been produced, all the work and effort may automatically cease, sooner or later depending on the pupils' ability to utilise this type of approach.

On a more positive note, Cowan (1969) in his study of the project approach in History with secondary modern boys demonstrated that project work produced a significant increase in the amount of homework and additional work undertaken by pupils of both low and high ability groups. More pupils voluntarily undertook homework when previously they had not, and class attendances improved during the project periods. Reid and Booth (1971) researching into independent learning situations have however provided additional evidence to indicate that more able pupils work faster than usual when working independently and so gain more in a shorter time from the independent learning situation, a finding that may have serious implications for the 'average' pupil within a mixed ability situation.

Furthermore, the ability of different pupils to utilise their time effectively and so profit from a course based wholly or partly on the project method may be critical to those assumptions underlying the use of project work as a teaching/learning strategy and as an assessment procedure.

Thus, from the interesting but limited research undertaken in this area, it seemed, at the start of this enquiry, that for any teacher about to venture on the project method, time allocation must be an important consideration. Moreover, it was felt that more specific information about the duration of project work in C.S.E. science subjects, and the class time formally and informally allocated for it, could prove helpful and illuminating to teachers attempting such an approach.

What follows is an account of the attempt to procure such data together with a survey of the findings to emerge from it.

Under item 9(a), Section A of the questionnaire, those respondents using project work as part of their C.S.E. science teaching programme were asked to estimate the total number of school hours (per course) spent on project work by the 'average' C.S.E. candidate. To assist them in this task, the teachers were provided with seven categories of response, ranging from '10 hours or less' to 'Over 60 hours' with intervals of 10 hours, their estimation being made on the basis of a tick placed alongside the most appropriate category. The results are shown in Table 4.5.

TABLE 4.5.

THE TOTAL NUMBER OF SCHOOL HOURS PER COURSE SPENT ON PROJECTS
IN C.S.E. SCIENCE SUBJECTS

		Frequency of Response*		
Hours	Interval (x)	Raw (f)	% age	fx
10 or less	5	27	16.9	135
10+ to 20	15	51	31.9	765
20+ to 30	25	30	18.8	750
30+ to 40	35	28	17.5	980
40+ to 50	45	8	5.0	360
50+ to 60	55	5	3.1	275
Over 60	-	(6)	(3.8)	≤fx = 3265
Not answered	-	(5)	(3.1)	
		n = 149 (160)		

* Estimated mean number of school hours spent on project work per C.S.E. science course = $\frac{fx}{n} = \frac{3265}{149} = 21.9$
 ± 22 hours

The majority of respondents (50.7%) indicated that their pupils spent between 10 and 30 hours on projects during school time, the overall estimated mean being approximately 22 hours.

As it stands however, this information provides only a very general view of project time since it gives no indication of the type or number of projects undertaken nor their distribution throughout the two-year duration of the C.S.E. course. For example, a pupil spending twenty hours on project work may, within this time, be undertaking just

one project on which he works for two hours per week for just one term. Alternatively, he may be carrying out, say, five different projects, spending four hours on each, spread over five terms of the course. Thus, the data may conceal many variations in the operation of project work at this level and must therefore be treated with caution. Nevertheless, when viewed in relation to responses to later items on the questionnaire, the figures are of further interest.

The second item required teachers to indicate the amount of time they thought pupils should spend on project work in total for their C.S.E. science course (i.e. the total number of hours at home, school and elsewhere). As with part (a), the respondents were asked to categorize their replies into one of seven categories, ranging from '15 hours or less' to 'Over 90 hours', with intervals of 15 hours. The results are given in Table 4.6.

The greatest proportion of respondents (45.6%) indicated that they thought their pupils should spend between 15 and 45 hours on project work, the mean being slightly under 40 hours. Interpreted in relation to the previous finding, this second figure raises some interesting points.

Firstly, the difference between the two estimated mean values (22 hours and 40 hours) is in the region of 18 hours, and may be thought to represent the average amount of time teachers think pupils should spend on project work over and above the time they currently spend in school. However, this time difference is only a

TABLE 4.6.

THE TOTAL NUMBER OF HOURS PER COURSE TEACHERS THINK PUPILS
SHOULD SPEND ON PROJECT WORK

		Frequency of Response*		
Hours	Interval (x)	Raw (f)	% age	fx
0 to 15	7.5	15	9.4	112.5
15+ to 30	22.5	41	25.6	922.5
30+ to 45	37.5	32	20.0	1200.0
45+ to 60	52.5	35	21.9	1837.5
60+ to 75	67.5	15	9.4	1012.5
75+ to 90	82.5	9	5.6	742.5
Over 90	-	(5)	3.1	
Not answered	-	(8)	5.0	$\Sigma fx = 5827.5$
		n = 147 (160)		

*Estimated mean number of hours that should be spent on project work per course = $\frac{fx}{n} = \frac{5827.5}{147} = 39.6$

≈ 40 hours

theoretical estimate and it may be interpreted in a number of different ways. For example, it could represent any one or more of the following:

- i. the amount of out-of-school time which teachers think pupils should spend on project work for their C.S.E. science course.
- ii. the amount of free time at school which teachers think pupils should spend on project work, over and above that formally allocated for the exercise.
- iii. the amount of time teachers think should be formally allocated to pupils for project work, over and above that made available to them at the time of the enquiry.

Although, in retrospect, it is unfortunate that this study was unable to throw further light on these issues and to determine whether, in the teachers' view, this additional project time should be spent in or out of school, during free time or formal lesson periods, the basic observation remains intact. The results of the survey demonstrate clearly that of those teachers using project work in C.S.E. science, many thought that their pupils should be spending considerably more time on it than was being spent in their schools at the time of the enquiry.

Continuing the investigation of time spent on project work, the third and final part of this questionnaire item (9(c)) was an attempt to explore the teachers' perceptions of their own pupils' efforts. In this context, the respondents were asked to indicate how, in their view, the time pupils should spend on project work related to the amount of time the majority of them actually did spend on it. The three main categories of response are shown in Table 4.7.

The greatest proportion of respondents (54.4%) indicated that the majority of C.S.E. pupils spend less time on their projects than they thought they should, whilst 35.6% of the teachers (57 in all) approved of the amount of time being spent on project work, believing it to be appropriate for 'average' C.S.E. pupils. Only nine teachers (5.6%) thought pupils spend more time on projects than they should although the tendency to exceed the required amount of time was observed more frequently among the more able girls who were, it was argued, more likely to

TABLE 4.7.

THE TIME ACTUALLY SPENT ON PROJECTS COMPARED TO THE AMOUNT
OF TIME PUPILS SHOULD SPEND ON THEM
(The Teachers' Perspectives)

Category of Response	Frequency of Response	
	Raw	% age
1. Pupils actually spend <u>more time</u> on their projects than <u>I think</u> they should.	9	5.6
2. Pupils actually spend about the <u>same amount of time</u> as I think they should.	57	35.6
3. Pupils actually spend <u>less time</u> on their projects than <u>I think</u> they should.	87	54.4
Other responses	1	0.6
Not answered	6	3.8
	n = 160	

dedicate themselves to the production of long, laborious project reports, neatly set out in elaborate folders, activities which without doubt involved lengthy work sessions⁽²⁾. Six teachers failed to respond to the item and a seventh felt unable to single out a specific category, maintaining that pupils either spend the right amount of time or too much on their projects.

Returning to the main finding, the indication by more than half of the respondents that pupils spend less time on their projects than they should cannot pass without further comment since the discussion of why this should be so raises several important issues.

Firstly, it could be argued that pupils spend less time than they should on their projects because they themselves hold unfavourable attitudes towards the science subject and/or the project method. Is there perhaps a lack of enthusiasm and commitment among the pupils causing them to give short measure and skimp the work? Certainly, from the data collected through the questionnaires and interviews, it would appear that a substantial number of C.S.E. science teachers saw their pupils' lack of motivation and interest as one of their greatest pedagogic problems (see Chapter 5, Sections 5.8 and 5.9) .

Secondly, however, it must also be asked whether pupils spend less time than they should on project work because of organisational and managerial difficulties within the system. Is there, for instance, insufficient time formally and informally available for this aspect of work? Clearly, from the discussions about timetabling, lesson periods and laboratory availability, it would seem that a number of administrative factors, both intrinsic and extrinsic to the school system, may seriously restrict pupils' attempts to implement the project approach fully and effectively (see Chapter 8).

Similar conclusions to these had been reached by earlier investigators. Kaye and Rogers (1968) found that problems with project work did not always arise from unfavourable pupil attitudes as commonly supposed, but were the result of poor organisation and management, and in the study by Small (1973) cited earlier, it was found that certain factors in particular seemed to influence the actual time spent on project work by students and the

final results of their efforts. For instance, situations in which students were given some degree of choice in their topics (see Chapter 3, Section 3.2.), where tutors planned the work programmes and provided guidance in the form of continual monitoring (see Chapter 4, Section 4.2.) and where college facilities were available to students outside school hours (see Chapter 4, Section 4.3.) were shown to produce more favourable outcomes. These factors combined with additional student variables such as motivation and tenacity were shown by Small to be important in determining the time dedicated to project work, and the final achievements.

Thus, it would appear that if pupils are not convinced of the worth of either the subject matter or the method, and if they are not supported by favourable working conditions and appropriate tutorial assistance, they cannot be expected to display any real persistence in their project task. Moreover, under these circumstances, they are unlikely to spend any additional time on the exercise, over and above that formally assigned for project work. However, it is not the intention to elaborate on these issues here; a closer examination of pupil variables affecting project work is undertaken in Chapters 5 and 8.

4.3.3. Working on Projects: A Summary

In the first part of this section the question of where project work should best be undertaken was considered. On this issue, the teachers were divided although slightly

more than half (58.1%) felt that project work should be carried out during formal class periods under the supervision of the teacher. Moreover, analysis of the responses on the basis of type of project work showed increased support for this view among the users of non-reporting projects. Several reasons were put forward to explain this.

Firstly, some of the examination syllabuses specified, either directly or indirectly, that work of this type should be undertaken as part of the normal class time allocation and not extra to it.

Secondly, certain projects - particularly those of a practical, investigative nature - required the use of specialist equipment found in the school laboratory. Pupils could not generally gain access to this equipment outside formal class periods because of health and safety regulations calling for the presence of a qualified member of staff, and because of the demand placed on school laboratories by other science classes.

Thirdly, project work undertaken at school during formal lessons was thought to be fairer to pupils. It standardised the conditions under which they worked and helped to minimize the effects arising out of differences in pupils' home environment. In addition, it enabled individual pupil progress to be monitored and fairly assessed.

However, not all teachers agreed with this line of reasoning. Among those using the report-type project approach, 44.3% felt that the work should be undertaken mainly out of school. Some of these respondents set projects for the school vacations on the understanding that pupils - with appropriate guidance beforehand - could

follow many different lines of investigation using the resources available to them in the community (e.g. museums, zoos, dental surgeries, etc.). It was also suggested that for certain topics (e.g. 'Education for Parenthood') more valuable and meaningful resources were to be found in the home and neighbourhood than in the confines of the school-room. Indeed, a number of respondents commented on the success of these enterprises in generating pupil interest and enjoyment in the subject.

Thus, from the evidence presented, it was clear that teachers may hold quite opposing views about the most appropriate place for project work although from the soundness of the arguments put forward in support of each case, both viewpoints seemed reasonable. In conclusion, therefore, it was stressed that decisions about the best place for project work must depend ultimately on the balance of these sets of arguments as assessed by each teacher in his/her individual situation.

In the second part of this section, the discussion was extended to consider the period of time spent on project work by C.S.E. science pupils, and certain anomalies were found to exist in this area too.

Among the teachers approached in the investigation, considerable variation was found in their estimates of the amount of time pupils spend on project work. The majority of respondents indicated that their pupils spend between 10 and 30 hours during school-time on projects for their C.S.E. course. The mean number of school hours was found to be 22 although the overall spread was large. In addition, it was found that teachers in general felt

that pupils should be spending more time than this on projects and, in this context, an average of almost 40 hours was estimated. It was, however, not possible to ascertain whether teachers thought this extra time should be completed by pupils in or out of school, during free or formal class periods. Such issues raised some interesting speculation although there was a clear need for more information to be gathered in this area.

In this part of the study, an attempt was made to also determine teachers' perspectives of the effort made by their C.S.E. pupils in project work. On this issue, the greatest proportion of teachers (54.4%) felt that their pupils spend less time on their projects than they (their teachers) thought they should and, as a consequence, a number of questions were raised concerning (i) pupils' attitudes towards science and project work, and (ii) the managerial and organisational provisions made for project work within the schools and colleges. This section attempted to clarify these issues and to begin to set out some of the problems confronting teachers in their attempts to implement a project approach in science.

In the chapters which follow, with the support of additional data, these aspects are re-examined. In Chapter 5, a more detailed discussion of pupil variables affecting project work (i.e. their attitudes towards it and their ability to profit from it) is undertaken and in Chapter 8, the constraints afforded by the schools are considered.

NOTES

1. In response to item 19, Section C of the questionnaire, 76.6% of the survey population (353 teachers in all, Users and Non-Users of project work) agreed with the statement 'Project work favours the child from the resourceful home;' see Chapter 6, Table 6.12.

2. For further discussion of girls' attitudes towards science and project work, see Chapter 5, Sections 5.6.1., 5.7., and 5.9.

CHAPTER FIVE

THE ROLE OF PROJECT WORK IN THE ACQUISITION OF SKILLS AND THE DEVELOPMENT OF FAVOURABLE ATTITUDES TOWARDS LEARNING AND SCIENCE

- 5.1. The Background to the Research
- 5.2. The Results of the Enquiry: General Findings
- 5.3. The Acquisition of Cognitive Skills
 - 5.3.1. Research Findings
- 5.4. The Development of Organisational/Management Skills
 - 5.4.1. Research Findings
- 5.5. The Acquisition of Practical/Manipulative Skills
 - 5.5.1. Research Findings
- 5.6. Socio-attitudinal Aspects of Project Work
 - 5.6.1. Research Findings
- 5.7. Combined/Related Skills
- 5.8. The Ability of Pupils to Benefit from Project Work
- 5.9. The Attitudes of Pupils of Varying Ability towards Project Work

Notes

5.1. The Background to the Research

Much has been written and argued about the acquisition of skills and the development of favourable attitudes in pupils studying science and, in this context, a range of studies attempting to prescribe workable definitions of effective science teaching has been undertaken. In relation to this particular study, a review of the literature suggests that these enquiries have been pursued at three distinct levels:

- firstly, the discussions have centred upon the general aspects of secondary science teaching, i.e. the general aims of secondary school science;
- at another level, attention has been focussed on the functions of specific science courses, e.g. the objectives of a C.S.E. science course;
- and, thirdly, more specifically, the efficacy of different teaching strategies (e.g. pupil project work) in fulfilling these aims and objectives has been investigated.

Thus, in order to achieve the proper perspective in this study, it would seem important at the start of this chapter to consider each of these levels in more detail since it is against this contextual backcloth that an evaluation of the role of project work in the acquisition of skills and the development of favourable attitudes is to be made.

Since before the turn of the century, the aims of secondary science education have periodically reached the forefront of debate. Smithells, for instance, was just one of the leading educationalists who, through publications, lectures and committee work, condemned the preponderance

of learning by rote and the lack of experimental work in science observed in schools at that time (see Flintham 1977). He set out to develop curriculum reforms that would enhance science teaching in schools by making the courses more meaningful, their roots being in the common phenomena of everyday experience. In maintaining that science should have a social significance for pupils, Smithells threw emphasis upon general rather than specialized knowledge in science, and his concern that science courses should grow out of practical observation was apparent in his pursuit of non-specialist science curricula for pupils across the whole ability spectrum and his participation in the movement to improve the science education of girls. In both these activities, Smithells attempted to introduce into the curricula topics which might help pupils to relate science studies at school to their own experiences in the home. In addition, he urged for the provision of more appropriate training courses for science teachers, and stressed the need for more enlightened teaching methods.

In 1938, the sentiments expressed by Smithells were in part reiterated by the formal document produced by the Consultative Committee on secondary education - now commonly referred to as the Spens Report. Among its recommendations, the Committee called for secondary schools to be brought into closer contact with practical affairs of life and expressed the hope that the curriculum of the future might be thought of more in terms of activity and experience rather than knowledge to be acquired and facts to be stored (Spens Report 1938, IV, pt.II, para.13/18).

In time, the discussion of educational aims moved away from these general and somewhat vague notions of what school science should and should not involve. More precise guidelines were developed and attempts to define final outcomes of science courses in terms of behavioural objectives became the important and popular concern. The fervour of educational behavioural objectives brought with it a variety of schemes, ranging from brief synopses outlining the activities expected of pupils during a course to more rigorous hierarchical frameworks defining the acquisition of specific skills and attitudes in the cognitive, affective and psychomotor domains (see Bloom 1956).

In his book The Education of the Average Child Rowe (1959) - a progressive for his time - provided an outline of the skills and attitudes expected of pupils at his school. Under Rowe's methodology, the following targets were set for pupils:

The knowledge of where to seek for information and the power to select from it what is relevant and to combine what has been selected into a new whole, as well as the power to speak and write with fluency, economy, directness, and fitness for purpose... (Rowe 1959, p.61)

By Rowe's reasoning, all these skills were inseparable from the pupil's development as a person and the philosophy of a 'whole' education.

A few years later, the concept of a 'wholeness' in education received further attention in a report produced by the Central Advisory Council for Education, popularly named the Newsom Report after its Chairman, John Newsom. Expounding the desire for a fuller education for pupils of average ability and below, the Report stressed that:

... certain skills of communication in speech and in writing, in reading with understanding, and in calculations involving numbers and measurement ... are basic, in that they are tools to other learning and without some mastery of them the pupils will be cut off from whole areas of human thought and experience. (Newsom Report 1963, para.76)

But the report could not accept that these skills alone represented an adequate minimum at which to aim:

All boys and girls need to develop, as well as skills, capacities for thought, judgement, enjoyment, curiosity. They need to develop a sense of responsibility for their work and towards other people, and to begin to arrive at some code of moral and social behaviour which is self-imposed. It is important that they should have some understanding of the physical world and of the human society in which they are growing up. (Ibid.)

In relation to the science education of 13-15 year olds, the Report was critical of that tradition of science teaching which consisted of confirming foregone conclusions; this was seen as a kind of anti-science, detrimental to the lively mind and perhaps fatal for the not so bright pupils. According to Newsom, for pupils of average ability and below, in science as in mathematics, the spirit of genuine enquiry was the essence of effective teaching (para.423). The call for more research into teaching techniques and the introduction of more 'realistic and adult' courses for these pupils were powerful themes running through the Newsom Report. In addition, among its main recommendations was the suggestion that final-year school programmes should be more deliberately outgoing, linking where possible with the youth employment services, further and adult education and, perhaps, including some kind of work experience for those pupils who would, in the future, be required to stay on at school until the age of sixteen.

The Newsom Report made a number of important recommendations ranging from R.o.S.L.A. (the raising of the school leaving age) to guidelines for more imaginative school courses and more constructive programmes of teacher-training. For political reasons, a number of the recommendations did not reach fruition but it is true to say that as a result of the Report, many new courses (examination and non-examination) were developed that incorporated the Newsom philosophy of a more outgoing, realistic form of education for average pupils about to leave school and begin working life.

The need to establish closer links between school and work received further attention a few years later in a Schools Council Working Paper entitled Closer Links between Teachers and Industry and Commerce (No.7, H.M.S.O., 1966). After an experimental 'introduction to industry' scheme which concerned itself with the connection between the curriculum and the young school-leaver, the sixty-six teachers contributing to this paper concluded that the skills and qualities most often sought by employers were common sense, self-reliance, resourcefulness, ability to express oneself clearly and accurately, a sense of discipline and a capacity for mixing and co-operating with others. Furthermore, the teachers were impressed by the fact that many employers were prepared to forego high academic attainment in favour of well-developed personal qualities (ibid., para.50, p.12).

The realization that the possession of a large store of facts and a good academic report may not be a reliable indicator of job prospects was acknowledged by Kaye and

Rogers (1968) in the study cited earlier. They maintained that factual knowledge was not what was looked for in school-leavers but rather a knowledge of and an ability to manipulate fundamental information together with evidence of personal skills including those of investigation, interpretation and creativity. Such skills, they suggested, were not easily developed under a traditional subject-centred teaching approach (i.e. in science, verbal exposition followed by demonstration).

Tisher et al. (1972) expanded the criteria of science education to include the acquisition of these personal attributes. In a discussion of the science curriculum, the following list of objectives for pupils on a science course was compiled:

- know the fundamental facts and principles of science;
- be able to apply scientific knowledge to new problems and situations;
- possess the skills to engage in the processes of science (e.g. to formulate problems, to plan experiments, to develop explanations);
- to make and prefer judgements based on probability;
- to develop favourable attitudes to science (e.g. interest, dedication etc.).

Tisher et al. qualified these objectives by explaining that the period spent at school cannot hope to equip young people with all the facts, concepts and principles that will be needed through life since those which we hold today may be redundant tomorrow. At best, we might hope to develop only those fundamental concepts and ideas which have the widest explanatory power, to tie together the different experiences and to kindle an intrinsic interest

in pupils to equip them with the necessary tools which make learning a self-propelling continuous process.

Head (in Sutton and Haysom 1974) gave some support to these objectives by suggesting that we best prepare students for later life by teaching them how to study on their own and to work independently. Whitfield in the same collection of articles also identified the development of interest in science and of inquiring minds as important aims of science education.

In 1974, the Association for Science Education (A.S.E.) at its annual meeting in Leeds considered the problems of teaching science to less academically-motivated pupils in secondary schools. The difficulties at that time had been made more acute by two important measures: the raising of the school leaving age, and the move towards comprehensive education. Later in that year, in response to the concern expressed in this area, the Education Research Committee of the A.S.E. set up working groups to examine ways in which science might be presented more effectively to these types of pupil. As a result of these studies, the L.A.M.P. Project was established and a range of materials (topic briefs) and methods were rapidly developed for teaching science to pupils in the lower levels of the fourth and fifth forms of secondary school. The Teachers' Handbook No.1 (1976) which accompanied the Project provided information on the use of the available materials and set out the general teaching aims of the Project; these were:

1. The formation of maturing relationships with adults and peers.
2. The development of self-confidence and esteem through successful experience.

3. The development of skills of communication and number work through practical experiences.
4. The development of observational skills, thinking and judgement.
5. Science as a means of providing education for leisure.
6. The development of the pupil's self-knowledge.
7. A growing awareness of science in society.
8. A developing understanding of basic scientific ideas.

It is important to appreciate that the pupils implicated in this Project were unlikely ever to become scientists in the full sense, and it was on this assumption that the Project attempted to provide the sorts of school science experiences that might introduce pupils to certain activities (e.g. horticulture, photography, motor mechanics) which they could then pursue at their leisure in later life. The aims of L.A.M.P. outlined above reflect therefore the Project's orientation towards education through science as opposed to offering pupils an education in science.

In 1977, more specific guidelines for science teaching were given in Curriculum 11 - 16, a sequence of working papers produced by H.M. Inspectorate, which sought to develop the idea of a checklist of eight essential areas of experience: the aesthetic and creative, the ethical, the linguistic, the mathematical, the physical, the scientific, the social and political, and the spiritual. It was suggested that a curriculum whether made up of 'traditional' subjects or otherwise might be so designed that each component contributes to these 'areas of experience'. Contained in this document, the chapter on science set out

eight criteria for the presentation of science in schools. Science should, it was purported, be conducted in such a way that positive responses may be obtained to the following questions:

1. Is the pupil observant? (i.e. does he see all that there is to see, or does he rely on being told what to see?)
2. Does he select from his observations those which have a bearing on the problems before him?
3. Does he look for patterns in what he observes and is he able to tie in to his current observations others he has made earlier? (i.e. can he recall other observations which contribute to the pattern?)
4. Does he seek to explain the patterns? If he can offer more than one possible explanation, does he attempt to rank them in order of plausibility?
5. Does he have an acceptable level of practical skills in the efficient and safe handling of apparatus and equipment?
6. Can he devise, or contribute to the devising of, experiments which will put to the test the explanations he suggests for the patterns of observations?
7. Does he possess the verbal and mathematical skills adequate to allow him to interact with his classmates, his teacher and the written and other material to which his attention is directed?
8. Does he respond to a novel situation by recalling and applying facts and generalisations previously acquired? Does he do this when the situation is outside the immediate content of the school science courses? (i.e. does he see the relevance of what he has learnt in the science lessons to situations outside the laboratory?)

It was anticipated that pupils educated according to these criteria would develop four fundamental attitudes: curiosity, honesty in observation, willingness to make predictions and a readiness to record observations accurately regardless of whether or not they support earlier predictions.

In the late seventies, the new directions for science teaching set out in Curriculum 11 - 16 were clearly acknowledged by the Assessment of Performance Unit (A.P.U.) based at Chelsea College (University of London) and at the University of Leeds. During the period 1977-78, the Unit attempted to develop assessment instruments to monitor performance with respect to scientific development in school children at 11, 13 and 15 years of age. The test instruments focussed on scientific development as distinct from the acquisition of scientific knowledge, and emphasised the skills, attitudes and processes of science as well as its applications. A 'Process List' was subsequently produced which attempted to set out categories of scientific activity which were recognisable by, and had validity for, those involved in science education. The following items were included⁽¹⁾:

1. Using symbolic representations (i.e. relating information to its representation in graphical forms and relating objects, events and constructs to conventional representations)
2. Using apparatus and measuring instruments (i.e. making measurements, carrying out an unfamiliar and purposeful sequence of actions, following instructions)
3. Observations tasks (i.e. taking notice of relevant features, inferring patterns and assessing possible interpretations)
4. Interpretation and application (i.e. selecting, pattern-seeking and hypothesis construction)
5. Design of investigations (i.e. planning and evaluating a sequence of procedures, identifying variables, reformulating problems)
6. Performing investigations (i.e. tackling and executing an investigation or problem experimentally by involving any or all of the processes set out in categories 1 - 5).

Hence, it can be seen that from didactic beginnings when the accent was very much on the acquisition of factual knowledge, science in schools has come to be seen as an essentially observational/investigative study, and those skills demanding an active involvement in the processes of science have become the new objectives of science teaching.

Having considered the general aims of science education (i.e. level 1 of the framework set out at the start of this section), it is appropriate at this point to move on to a more specific discussion of the objectives of C.S.E. science courses. What follows therefore is a brief statement of the sorts of aims and objective formally defined in the examination regulations and their accompanying syllabuses. As the chapter proceeds, it will be interesting to compare these formal definitions of C.S.E. science with the less formal statements made by the teachers themselves.

As discussed in Chapter 1, in the late fifties and early sixties, many practitioners were harshly critical of the existing G.C.E. O-level science syllabuses because of their emphasis on topics which bore little relation to the lives of the pupils and which demanded little more than the memorisation of facts. In addition, it was becoming increasingly clear that as a result of the examination legacy, many teachers were at that time being asked to teach what others had decided ought to be examined. At its inception, therefore, the C.S.E. offered teachers the hope of departing from the more conventional aspects of examining

associated with the G.C.E. It gave them the opportunity to move towards the types of syllabuses and examinations relevant to the everyday lives and experiences of average pupils.

Viewed against these ideals, superficial scrutiny of the C.S.E. Mode I science syllabuses of today may prove a little disappointing; on the surface their subject matter would seem to have retained that somewhat traditional appearance, reminiscent of the older established G.C.E. syllabuses. However, to study these syllabuses in isolation is undoubtedly misleading since the work that has been undertaken to improve science teaching strategies and assessment procedures would, under such circumstances, almost certainly be overlooked. For the development of new techniques on these fronts, the C.S.E. must without doubt be worthy of some credit.

In this respect, Mode III syllabuses have perhaps shown the greatest insight; local interest topics (e.g. coal and mining technology) have been included and new forms of assessment have been introduced so that course work has now become an accepted part of the examination. As a demonstration of special commendation, some of the outstanding Mode III syllabuses have become incorporated under a Mode I scheme and in this way have become available to all schools and colleges in the region. The examination papers have also taken on a new look, structured to tap skills as well as factual knowledge. (Further examples of these innovations will be provided in due course.)

Many regional subject panels for the C.S.E. now preface their Mode I syllabuses with a list of aims and objectives, and thus provide some guidance as to the requirements for Mode II and Mode III submissions. The East Midland regional examination panels are no exception. Tables 5.1.a., b., and c. demonstrate the range of aims and objectives specified on the 1980 Mode I syllabuses for Biology, Chemistry, General Science and Physics (see pp. 156 - 158). Moreover, the E.M.R.E.B. 1980 Regulations governing the submission of Mode II and Mode III syllabuses also provide clear directives. Each submission must, it is stated, include:

A clear statement of the assessment objectives - i.e. a list expressed in behavioural terms, of those skills and abilities which candidates will be expected to demonstrate in the assessment (p.3.)

together with

An outline of the scheme of assessment and its relation (expressed as percentages) to each of the objectives (p.3.).

Thus, under Board Regulations, each examination syllabus is required to define those types of skills and abilities expected of pupils undertaking the course, and to provide a scale of weighting on which each objective is to be assessed. In addition, the Regulations state that:

In order to be accepted, a Mode II or Mode III syllabus should show a significant difference in syllabus content and/or scheme of assessment from any corresponding Mode I syllabus (p.2.).

Given then that by definition each Mode II and Mode III syllabus must be unique in some respect, it is perhaps more useful at this point to consider in more detail the objectives set out in the E.M.R.E.B. Mode I science syllabuses, which have been in operation throughout the region.

TABLE 5.1a.

E.M.R.E.B. MODE I C.S.E. BIOLOGY SYLLABUSES

1980: AIMS AND OBJECTIVES

AIMS	OBJECTIVES	Weighting in each syllabus (%)		
		1	2*	3**
1. To develop and encourage an attitude of curiosity and enquiry and to instill an awareness of the place of Biology in the world at large.	Not assessed.	-	-	-
2. To teach the art of planning scientific investigations.	(a) planning ability using simple apparatus available in most schools (b) knowledge and use of the simple means of controlling common variables (c) the ability to recognise the relevance of hypothesis to experiment (d) the ability to criticise an experimental procedure	10	15	10
3. To teach skill in handling apparatus and carrying out experiments.	(a) the ability to handle and manipulate simple pieces of school apparatus with efficiency and safety (b) the ability to follow instructions accurately (c) the ability to carry out experiments in such a way as to produce reasonably consistent and accurate results (d) the ability to make accurate observations (e) the ability to record results clearly and accurately	15	15	10
4. To teach fundamental Biological facts and principles.	(a) the ability to recall facts demanded by the syllabus (b) the ability to understand the fundamental concepts and principles in the syllabus	50	25	30
5. To develop skills in handling and interpreting information.	(a) the ability to understand scientific information presented in the form of simple graphs, diagrams, tables and prose (b) the ability to present information in these ways (c) the ability to translate information from one form to another (d) the ability to carry out simple mathematical processes involving addition, subtraction, multiplication, division, averages, percentages and ratios (e) the ability to draw valid conclusions from such data (f) the ability, in simple situations, to extrapolate this data	15	30	20
6. To develop the ability to apply previous understanding to new situations.	the ability to apply previous understanding to new situations	5	10	15
7. To develop competence in reporting.	the ability to report clearly on laboratory work, or surveys which have been carried out	5	5	15
Totals		100	100	100

* Mode I, Syllabus 2 i.e. an alternative biology course set up in response to the Nuffield Initiative.

** Mode I, Syllabus 3 i.e. Human Biology.

TABLE 5.1.b.

EMREB MODE I C.S.E. SYLLABUSES FOR CHEMISTRY AND PHYSICS 1980 (shared aims and objectives)

AIMS:

1. The intention of this syllabus is to provide pupils with a knowledge and understanding of Chemistry/Physics.
2. To give training in scientific methods through observation and experiment.
3. To develop awareness of the importance of science in everyday life by reference to practical situations and applications.

OBJECTIVES: The Scheme of Assessment is designed to test the following skills and abilities:	WEIGHTING (%)				TOTALS
	CONTENT AREAS				
	Basic Core	Topic	Practical/ Cont.Ass.		
1. The ability to demonstrate under examination conditions a knowledge of: (a) Scientific terminology (b) Scientific facts	24	16	-		40
2. The ability to recognise and handle apparatus, follow instructions and carry out experiments.	-	-	10		10
3. The ability to record observations with a reasonable degree of accuracy, and to be aware of simple sources of error.	-	-	15		15
4. The ability to apply knowledge and experience to solve problems and explain new situations	7	3	2		12
5. The ability to relate laboratory experience and scientific knowledge to everyday life.	7	3	-		10
6. The ability to interpret given data to solve problems.	7	3	3		13

TABLE 5.1.c.

EMREB MODE I C.S.E. GENERAL SCIENCE SYLLABUS 1980:
Main Objectives

OBJECTIVES: Candidates will be expected to acquire the following skills:	
(i)	scientific observation and readings, with a reasonable degree of accuracy
(ii)	the recording of scientific data
(iii)	the correct use of apparatus
(iv)	the ability to make deductions from observations and recordings
(v)	simple factual recall
(vi)	ability to apply facts and principles to problem solving

Scrutiny of the 1980 syllabuses for Biology, Chemistry General Science and Physics suggests that five behavioural objectives are by and large common to all of them. An outline of these 'collective objectives' appears in Table 5.2. together with examples of typical examination exercises (overleaf).

In brief, pupils are expected to be able to recall scientific knowledge, to handle apparatus, to make observations and to record the results, to interpret the findings and by applying their knowledge and experience to new situations, the pupils should be able to solve specific types of problems. Additional objectives, although not always stated directly, would also seem to be implied either in the syllabuses themselves or the corresponding examination papers. These include, for example, the ability to follow instructions, to carry out simple laboratory

TABLE 5.2. (Continued overleaf)

THE MAIN BEHAVIOURAL OBJECTIVES COMMON TO THE EMREB MODE I C.S.E. SYLLABUSES
FOR BIOLOGY, CHEMISTRY, GENERAL SCIENCE AND PHYSICS (1980)

OBJECTIVES	EXAMPLES OF TYPICAL EXERCISES EXPECTED OF THE PUPIL
1. The ability to handle apparatus commonly found in the school laboratory	<p>a. "Add two drops of phenolphthalein, using the dropper" (Biology, Practical Exam. 1980, 3 (a))</p> <p>b. "Take a single crystal of A and crush it with the back of your spatula filter part of the mixture" (Chemistry, Practical Exam. 1980, 1 (a)(d)).</p> <p>c. "Place the tube in the bath of boiling water and hold a piece of moist universal indicator paper near to the mouth of the tube" (General Science, Practical Exam. 1980, 11)</p> <p>d. ".... take and record each reading The reading of the hydrometer is _____, The acute angle on the diagram is _____, The minimum reading indicated by the thermometer is _____" (Physics, Practical Exam. 1980, c)</p>
2. The ability to recall scientific facts and principles set out in the syllabus	<p>a.* "What is evolution?" (1980, 25 (a))</p> <p>b. "Name the two allotropes of carbon (1980, 1 (a))</p> <p>c. "State two processes in which oxygen is important to our lives" (1980, B4(c)(i))</p> <p>d. "Name the three processes by which heat can be transferred from one place to another (1980, B4 (a)(i))</p>
3. The ability to handle and interpret data	<p>a. "What is the ratio of shortback piglets to longback piglets in the litters produced by Delilah?" (1980, 24 (e))</p> <p>b. "Methane reacts with oxygen according to the equation What is the mass of 1 mole of methane gas? (1980, A5 (e)(i))</p> <p>c. "Twenty woodlice were placed at the centre of a container subjected to different conditions The results are shown below What do these results tell you about the woodlouse?" (1980 B6 (a)(i))</p> <p>d. "The diagram below shows a section of a ticker tape which was attached to a trolley By looking at the tape above what can you state about the motion of the trolley?" (1980 B1 (d)(i))</p>

TABLE 5.2. (Continued)

OBJECTIVES	EXAMPLES OF TYPICAL EXERCISES EXPECTED OF THE PUPIL
4. The ability to apply previous knowledge and experience to new situations to solve problems	<p>a. "Which do you believe is dominant, shortback or longback? Explain why you think so." (1980, 24 (f))</p> <p>b. "The table shows the electron arrangements in the atoms of sodium and chlorine respectively Single atoms of aluminium and argon have 13 and 18 electrons respectively. What is the electron arrangement in each?" (1980, 11 Cl (b)(i))</p> <p>c. "If electricity costs 3p per unit, what would be the cost of using the following on a 250 v mains circuit? A 100 w lamp for 10 hours per day for 100 days." (1980, B3 (b)(i))</p> <p>d. "A loudspeaker emits a note of wavelength 0.33 m. If the speed of sound in air is 330 m/s, calculate the frequency of vibration of the loudspeaker cone." (1980, B5 (b)(i))</p>
5. The ability to record and report observations and results accurately and effectively	<p>a. "Repeat the experiment twice more Give your results clearly, being sure to set out any differences you notice." (1980, Pr., 3 (b))</p> <p>b. "Describe the effect of heat on solid R What did you see in the cool part of the test-tube? Describe the result of adding silver nitrate." (1980, Pr., 4 (a)-(e))</p> <p>c. "Record the temperature of the 100cm³ sample every 30 seconds for 7 minutes Plot all your results on the graph paper. Draw a smooth curve to show the rise in temperature of the 100cm³ sample." (1980, Pr., 12)</p> <p>d. "Measure the angles of incidence and refraction, and put their values in the table below Plot a graph of angle of incidence against angle of refraction Using your graph, what angle of incidence gives an angle of refraction of 25°?" (1980, Pr., (D))</p>

* As indicated under objective 1, the following examination codes apply:

a = Biology; b = Chemistry; c = General Science; d = Physics.

procedures and experiments, to present information effectively (using graphs and tables etc. as appropriate), to perform simple mathematical procedures (calculating means, percentages, ratios etc.) and the ability to detect common errors in laboratory practice. It is also interesting to note that the syllabuses for Biology, Chemistry and Physics all lay emphasis on the development of an 'awareness of the importance of science in everyday life by reference to practical situations and applications' (E.M.R.E.B., Chemistry and Physics 1980) and 'the place of Biology in the world at large' (E.M.R.E.B., Biology 1980). Furthermore, a leading aim of the C.S.E. Biology course as defined in the syllabus is 'to develop and encourage an attitude of curiosity and enquiry'.

Thus, in summarising the main objectives of school science at this level, it can be seen that the skills pupils might be expected to acquire during a C.S.E. science course may themselves be categorized into five general groups, namely:

1. Cognitive skills e.g. comprehension, interpretation, prediction
2. Organisational/Managerial skills e.g. planning simple investigative procedures
3. Practical/Manipulative skills e.g. handling apparatus, taking measurements
4. Socio-attitudinal skills e.g. seeing science in the social context
5. Combined/Related skills e.g. writing scientific reports and manipulating data for clear presentation, which require a combination of science-based and non-science-based abilities.

It is on the basis of these skill categories that the use of project work at C.S.E. level will be analysed.

Let us now examine the specific question of project work and its role in the acquisition of skills and the development of favourable attitudes towards learning and science.

In 1967, the Schools Council provided support for the development of a new scheme called Project Technology. The main terms of reference for the Project team were to create foundation material upon which new courses in engineering and technology might develop. The results of these endeavours sparked off an enthusiasm for project work in schools and, alongside the widespread dissemination of both materials and methods, helped to cultivate the following aims for technology courses employing this approach:

- i. to provide a link between the school and the external environment;
- ii. to increase interest and motivation, and to encourage creativity;
- iii. to provide opportunity for open-ended research and to permit the study of problems in depth;
- iv. to give practice in scientific writing;
- v. to show the challenge of technology and applied science.

In Project Technology, the project method was seen as the means by which these ends could be reached.

The value of project work in providing the unique opportunity for students to tackle genuinely open-ended problems was also acknowledged by Kelly and Dowdeswell (1970) in an evaluation of the A-level Nuffield Biological Science Project. The criteria for the assessment of

project work for this A-level course possibly provide a still clearer indication of the perceived objectives of such a strategy. In this context, five operational divisions were construed:

- i. identification of a problem
- ii. design of the investigation
- iii. carrying out of the practical work
- iv. analyzing the results and drawing inferences
- v. relating the findings to background knowledge.

i. and ii. in the above list are not be found among the aims and objectives of the C.S.E. science courses set out in syllabuses surveyed earlier. Perhaps, as seems likely, abilities such as these are associated only with the more mature scientific minds and are, therefore, not to be expected of the 'average' fifteen to sixteen year old. Items iii. to v. on the other hand are readily translatable into C.S.E. terms.

Jones (1970) also made reference to the use of the project approach in more advanced courses, namely those operating under the auspices of the National Examinations Board in Supervisory Studies (N.E.B.S.S.). Established in 1964, the Board sought to provide national examinations in the field of foremanship and supervisory studies. Within this vocational setting, the project was envisaged as primarily an activity method of study, designed to provide practical experience in observation, analysis, communication and presentation. As outlined in the Notes for Guidance, students were required to find out information for themselves, to draw conclusions, to practise the power of reasoning and to communicate their findings (see

Chapter 1.). Jones regarded project work at this level as especially important; not only did it encourage students to apply principles and knowledge gained from the course and thus integrate theory and practice, it also allowed students to display their individual talents which in a more traditional learning situation may have remained hidden.

In 1972, Harper in a discussion of projects and their assessment in degree level examinations also assumed that project teaching was essentially concerned with experimental science, the chief aim at this level being to give experience in the following areas:

- i. Definition of a problem
 - ii. Reading and reviewing literature
 - iii. Preparation of material
 - iv. Choice and use of appropriate techniques
 - v. Choice, collection and analysis of data
 - vi. Presentation of data
 - vii. Discussion of findings in the context of the literature
 - viii. Verbal and written presentation of material
- (Harper 1972, p.319)

Although at C.S.E. level, time combined with pupil ability may preclude the in-depth approach defined in the eight stages outlined above, many of the experiences envisaged for students undertaking projects at degree level are comparable with the types of opportunities that should ideally be made available to pupils following a science course at C.S.E. level. Hence, many of the skills expected of degree students undertaking projects can be related to the general aims of the C.S.E. science courses as specified in the examination syllabuses.

In Harper's review (1972), it is interesting to note that no direct reference was made to those objectives

within the affective domain which focus on the more aesthetic/humanistic side of science. In the pilot study of A-level Engineering Science carried out by Hiles and Heywood (1972) no such omission was made. In this study, teachers were asked to rank in order of importance what they saw as the major objectives of project work. The respondents - who encompassed various fields of technology - identified the following objectives as important: training pupils to find out for themselves; giving pupils a sense of involvement; providing the aesthetic satisfaction of designing and making; developing the ability to plan and formulate policies; generating interest in the subject; developing imagination and increasing decision-making ability. On this basis, project work was seen as an important means of assessing those abilities not normally revealed by conventional examinations. Thus, although relating primarily to more advanced courses in engineering, many of the objectives of project work identified as important in the Hiles and Heywood study can once again be equated with those specified for science at C.S.E. level.

In 1975 in a dissertation which examined the attitudes of chemistry teachers towards project work, Armstead took up the question of objectives in relation to project work. Having considered the various forms in which project work may be undertaken and the types of skills and attitudes developed as a result of it, Armstead demonstrated that many of the objectives of project work may be identical to those of instructional, assigned practical work. For example, some skills - such as the ability to make accurate observation, to record results, to handle, classify and interpret

data and to present findings clearly - were not unique to project work but common to all practical work in science and could therefore be achieved equally well through more traditional instructional methods. Other objectives however may be more difficult to achieve in the typical instructional setting; Armstead identified the following objectives as especially relevant to project work:

1. Skill in devising an appropriate scheme to study a problem.
2. Skill in applying previous knowledge and understanding to new situations (e.g. techniques learnt in Mathematics and Physics such as statistical procedures and analyses applied to the project situation).
3. The ability to show creative thought and resourcefulness.

It was in respect of these objectives, combined with the opportunity for pupils to gain a real sense of involvement and cultivate an interest in the subject, that project work could, in Armstead's view, make a valuable contribution to the teaching of science.

Commenting on the problems associated with the assessment of project work, Deere (in Macintosh, 1978) also recognised the finer attributes of the project approach. Deere saw project work as basically

... a teaching/learning activity which requires the student to determine one or more of the following, his strategy, his resources, his target; which presents a task which is not artificially compartmented nor idealized; which allows of a range of solutions rather than a unique answer; ...

(Deere in 'Techniques and Problems of Assessment', edited by H.G. Macintosh, 1978)

From this standpoint, Deere went on to list a range of skills for consideration in the assessment of projects. When these skills are categorized according to the five general groups

drawn up for C.S.E. science earlier in this section the list is found to include the following relevant criteria:

1. Cognitive skills - comprehension; application; analysis; interpretation.
2. Organisational/Managerial skills - careful planning; design; resourcefulness.
3. Practical/Manipulative skills - practical acumen; dexterity.
4. Socio-attitudinal skills - responsibility; concern for the environment; independence; perseverance; character-development.
5. Combined/Related skills - communication; show appreciation of factors.

Hence, by this interpretation, it can be seen that those skills identified by Deere for consideration in the assessment of project work can be realistically paralleled with those skill areas set out in the basic framework for C.S.E. science.

Although, as Armstead (1975) has suggested, many of these skills are not acquired solely through the agency of project work, it is nonetheless clearly significant that the main writers in this field have identified the acquisition of these groups of skills as important objectives of project work in science and other disciplines.

It is therefore against this framework that an account of the results of this current enquiry into the role of project work in the acquisition of skills and the development of favourable attitudes towards learning and science will now be presented.

5.2. The Results of the Enquiry: General Findings

In general, many respondents both on the questionnaire and during the interviews offered positive expressions of the usefulness of the project method as a learning device although the 'Non-users' involved in the study tended to qualify their statements by indicating that only under certain favourable conditions could the project approach in science teaching be fully effective.

In response to item 11, Section A of the questionnaire (see Appendix I) 55% (88) of the teachers using the method viewed it as a valuable component of C.S.E. science courses in the development of skills and attitudes appropriate to the major objectives of those courses. 42.5% (68) gave a negative response to this questionnaire item, and four of the teachers felt unable to express any direct opinion on the matter.

A breakdown of the teachers' responses by (i) the type of project work they were employing at the time of the enquiry, and (ii) the C.S.E. subject area for which they were responsible, indicated that favourable attitudes towards project work were not held across the board (see Table 5.3, p.171).

Analysis by type of project work showed that those teachers using projects of a non-reporting kind with their C.S.E. pupils (i.e. the 'discovery' and 'combination' types described in Chapter 3) held generally more favourable attitudes: 63.3% of them indicated that this type of project approach helped to develop skills and attitudes which were in keeping with the major objectives of their C.S.E. courses. In contrast, only 44.4% of those teachers engaging

pupils in report-type projects felt that this was true.

Analysis of the response from teachers in each of the four main subject areas revealed a slightly different picture. The majority of Biology and Chemistry teachers (62.3% and 52.8% respectively) agreed that project work encouraged the development of appropriate skills and attitudes in pupils, but the teachers of General Science and Physics (52.5% and 61.1% respectively) held the opposing view. These respondents did not think that the project method promoted the development of skills and attitudes that could be considered appropriate to the major objectives of their particular C.S.E. science courses.

From further scrutiny of these two sets of figures, and bearing in mind that most of the projects of the reporting-type were undertaken in Biology and Physics (see Chapter 3), it is clear that the nature of project work in relation to the separate subject areas does not provide any simple or direct explanation of the value of a project approach in terms of the development of desirable skills and attitudes in pupils. The relationship between project work and skill acquisition and attitude development would seem to be complex; thus, only when viewed in relation to the teachers' additional comments on course objectives and their responses to further items on the questionnaire can the data provide a sounder basis for interpretation.

The importance of project work in developing skills and attitudes which might not otherwise be tapped in a C.S.E. science course was acknowledged by the majority of respondents using the method, irrespective of their main subject area or the type of project approach they adopted.

The relative importance of project work in this context was assessed through item 12(a) of the questionnaire, the response to which is summarised in Table 5.4, p.172.

As a follow-up to this area of investigation, the second half of this questionnaire item represented an attempt to examine teachers' perceptions more fully. Item 12(b) was an open-ended question in which the teachers were asked to specify those skills and attitudes which they thought were (or could be) developed mainly through project work. Their responses to this item were categorised into five main groups which, although not fully comprehensive nor mutually exclusive, provide a useful framework for analysis and discussion, comparing well with the types of skills and attitudes identified by earlier writers in this field (Deere in Macintosh 1978, Armstead 1975, Hiles and Heywood 1972 and others). The results, analysed according to type of project work undertaken and subject area, are summarised in Table 5.5, p.173.

It is now the task of this thesis to examine critically the range of skills and attitudes thought to be acquired by pupils through project work. Each of the five categories will be discussed in relation to:

- i. the evidence put forward by earlier investigators in the field,
- ii. the findings presented in Table 5.5., and
- iii. the teachers' responses to additional items in Section C of the questionnaire and relevant to the issue in hand.

TABLE 5.3.

PROJECT WORK AS A MEANS OF DEVELOPING SKILLS AND ATTITUDES
APPROPRIATE TO THE MAJOR OBJECTIVES OF THE FOUR MAIN C.S.E. SCIENCE COURSES

RESPONSE FROM THE USERS OF PROJECT WORK							
	By Subject area				By type of project work		ALL RESPONDENTS
	Biology	Chemilstry	Gen. Science	Physics	Report	Non-Report*	
YES	38 (62.3%)	19 (52.8%)	18 (45.0%)	7 (38.9%)	31 (44.3%)	57 (63.3%)	88 (55.0%)
NO	19 (31.1%)	15 (41.7%)	21 (52.5%)	11 (61.1%)	37 (52.9%)	31 (34.4%)	68 (42.5%)
NOT ANS.	4 (6.6%)	2 (5.6%)	1 (2.5%)	0 -	2 (2.9%)	2 (2.2%)	4 (2.5%)
n =	61	36	40	18	70	90	160

* 'Discovery' and 'Combination' type projects (see Chapter 3) are included in this category.

TABLE 5.4.

PROJECT WORK AS A MEANS OF DEVELOPING SKILLS AND ATTITUDES WHICH
MAY NOT OTHERWISE BE TAPPED IN C.S.E. SCIENCE COURSES

RESPONSE FROM THE USERS OF PROJECT WORK						
	By Subject area			By type of project work		ALL RESPONDENTS
	Biology	Chemistry	Gen. Science	Physics	Report	Non-Report*
YES	39 (63.9%)	21 (58.3%)	21 (52.5%)	15 (83.3%)	46 (65.7%)	53 (58.9%)
NO	21 (34.4%)	13 (36.1%)	19 (47.5%)	3 (16.7%)	23 (32.9%)	35 (38.9%)
NOT ANS.	1 (1.6%)	2 (5.6%)	0 -	0 -	1 (1.4%)	2 (2.2%)
n =	61	36	40	18	70	90
						160

* 'Discovery' and 'Combination' type projects (see Chapter 3) are included in this category.

TABLE 5.5.

THE TYPES OF SKILLS AND ATTITUDES DEVELOPED MAINLY THROUGH PROJECT WORK AS IDENTIFIED BY THE USERS OF THE PROJECT APPROACH AT C.S.E. LEVEL

SKILL/ ATTITUDE	RESPONSE FROM THE USERS OF PROJECT WORK						
	By Subject Area				By type of project work		ALL RESPONDENTS
	Biology	Chemistry	Gen. Science	Physics	Report	Non-Report	
Cognitive	20 (32.8%)	10 (27.8%)	14 (35.0%)	7 (38.9%)	22 (31.4%)	31 (34.4%)	53 (33.1%)
Organisational/ Managerial	29 (47.5%)	14 (38.9%)	8 (20.0%)	8 (44.4%)	28 (40.0%)	32 (35.6%)	60 (37.5%)
Practical/ Manipulative	8 (13.1%)	9 (25.0%)	9 (22.5%)	8 (44.4%)	10 (14.3%)	26 (28.9%)	36 (22.5%)
Socio- attitudinal	27 (44.3%)	11 (30.6%)	9 (22.5%)	8 (44.4%)	26 (37.1%)	32 (35.6%)	58 (36.3%)
Combined/ Related	12 (19.7%)	5 (13.9%)	5 (12.5%)	2 (11.1%)	12 (17.1%)	13 (14.4%)	25 (15.6%)
n =	61	36	40	18	70	90	160

5.3. The Acquisition of Cognitive Skills

A review of the literature suggests that cognitive skills may realistically be broken down into three main levels of activity, namely:

- i. the acquisition of scientific facts and principles leading to concept formation
- ii. the manipulation of data and its interpretation
- iii. the application of facts and principles to new situations leading to problem-solving.

These activities are closely comparable with the cognitive tasks identified by Taba (1969) and which she regarded as especially important in promoting productive thinking, a chief target of learning.

Further scrutiny of these three cognitive levels proves interesting both because of the hierarchical structure which neatly emerges from them and because of their relevance to the aims and objectives of a project approach to learning.

At the first level, few writers have felt able to commend the project method for its direct role in the acquisition of facts and principles. Indeed, several studies have indicated that the acquisition of factual knowledge remains unaffected by different teaching strategies. For instance, Oliver (1965) compared the relative effectiveness of three methods of teaching biology at high school level. The methods he investigated were (a) lecture/discussion, (b) lecture/discussion/demonstration, and (c) lecture/discussion/demonstration with laboratory exercises. Pupil achievement was measured in terms of the 'accepted outcomes of biological instruction', that is:

1. the acquisition of factual information in biology
2. overall achievement in biology
3. application of scientific principles in biology
4. student attitude toward science
5. student attitude toward scientists.

On the basis of these criteria, no significant difference was found in the acquisition of factual information by the three different teaching methods although the high I.Q. pupils acquired under each method more factual knowledge than the low I.Q. pupils. Oliver's study did not concern itself with the effectiveness of the project approach but the findings are nonetheless interesting since, in terms of the ability to store facts, they clearly suggest that method (a) - the lecture/discussion - will produce the desired outcome. Furthermore, being economical in time, effort and materials, it seems likely that the lecture/discussion strategy may represent the most attractive option for teachers.

In 1969, Cowan (cited earlier) reported the results of his evaluative study of group project work in history with secondary modern pupils. He was able to demonstrate that the project approach was superior to the more formal methods on a number of aspects relating to pupils' learning and attitudes although factual accuracy did not appear to improve as a result of the material being given a project treatment.

Similarly, in the investigation of the use of projects in Further Education, Small (1973) showed that the method was found to be generally more effective than other methods for anything other than the retention of factual information.

Flecknoe (1976) has, on the other hand, argued from another perspective; he has questioned the need for pupils to store up vast amounts of facts, stressing that in many school science courses certain facts are continued to be taught not because the facts themselves are valuable but because they are accessible to examination (that is, may be regurgitated relatively painlessly in a two hour examination). Commenting on the philosophy of science teaching at Sutton Centre (a philosophy which largely supports a project approach), Flecknoe in his address to the Association for Science Education emphasised that retention of information was not an end in itself but rather a useful by-product of the usefulness of that information. With this view in mind, science teaching at the Centre aimed to tap pupils' natural interest in science topics and to extend them so that pupils might be encouraged to see different relationships and different applications of knowledge, and in this way move on to the second level of cognitive activity.

As discussed earlier, Jones (1970), Armstead (1975) and Deere (in Macintosh 1978) had all cited the importance of project work in achieving this second level of cognition. Translation, interpretation, integration, analysis, application were the sorts of skills these writers felt able to attribute to the effective use of project work with school pupils and college students. Similarly, Reid and Booth (1971) in their resumé of the results of the trials of independent learning in biology between 1968 - 1971 were also able to show that a method which allowed pupils to work at their own pace was likely to prove superior to

conventional teaching methods for the acquisition of mental skills (e.g. constructing and using a key), the grasp of a structured concept (e.g. surface area/mass ratios) and the understanding of mechanical processes (e.g. fish movement). In addition, Reid and Booth went on to suggest that an independent learning approach in Biology was likely to be more successful than other more traditional approaches when the topics being studied were largely theoretical with few openings for practical demonstration and experimentation (e.g. topics such as immunity, human reproduction). Thus, if the theories for independent learning put forward by Reid and Booth are correct, then clearly independent learning in the form of individual pupil project work may be especially valuable not only in terms of the practical application of scientific knowledge but also with respect to the acquisition of useful cognitive skills and the formation of abstract concepts.

Wells (1972), in contrast, was somewhat sceptical of the level of cognition that might be attained by average pupils. His analysis of adolescent thinking in science threw special emphasis on 'Explainer Thinking' i.e. that level of thinking which involves comparing and evaluating hypotheses, recognising relevant principles and the use of abstraction to order facts. Wells found that the incidence of this type of thinking was rare amongst the secondary modern pupils taking part in his investigation. He concluded:

There is evidence from this enquiry that secondary modern pupils find difficulty in making inferences and drawing conclusions ... The chances of them deriving a great deal of understanding from their own unaided experiments in an entirely open-ended situation would seem to be very slight, at least until they had become more used to that form of working. (Wells 1972, p.224)

In his investigation, Wells did however find many examples of pupils developing 'low-grade' or partial hypotheses. This incomplete success, he suggested, was probably related to the pupils' lack of a rich store of concepts, their inability to test hypotheses and lack of opportunity to put these tests into practice. On this basis Wells proposed that pupils should be given every chance to build up a store of concepts and to gain experience in the processing of observations and evidence by induction and deduction. Wells stressed that pupils of this calibre need very carefully structured work initially and for this reason he advocated a kind of 'stage-managed heurism'.

The importance of appropriate previous experience for pupils attempting an open project has been emphasised by a number of writers in the field and with special reference to the development of the more high level cognitive skills - such as those employed in problem-solving - Ausubel (1968) has made similar assertions, stressing that problem-solving is dependent on prior learning, on the clarity, stability and organisation of principles and concepts relevant to the problem in hand.

Along similar lines, Heaney (1971) in her study of the effects of three teaching methods on the ability of pupils to solve problems in Biology found that the 'heuristic method' was more successful than the 'cook-book' and

'didactic-with-demonstrations' methods for the development, improvement and application of problem-solving skills. In addition, her findings tended to suggest that the 'didactic-with-demonstrations' approach may be harmful to the development of problem-solving and practical skills and that the damage may be greatest for pupils of high mental age. She concluded:

In other words pupils understand scientific method by their experience of using scientific method, and problem-solving skills are learned most effectively when pupils learn by solving problems...
(Heaney 1971 p.222)

The importance of pupil motivation and interest in the successful execution of a problem-solving exercise has also been emphasised. In this respect, Carin and Sund (1970) have suggested that efficacy in problem-solving occurs most rapidly when the problems being investigated are related to the interests of the students and are appropriate to their level of maturation.

To conclude then it would appear that the influence of project work in the acquisition of cognitive skills is both complex and hierarchical. It is doubtful whether a project approach can be of any direct help in building up a store of scientific facts to be recalled when required (Oliver 1965, Cowan 1969, Small 1973) although when constructed around problems that are relevant and interesting to pupils it seems likely that the project method may help pupils to grasp certain structured, theoretical concepts and, in this way, may help them to acquire factual knowledge and cognitive skills (Flecknoe 1976, Reid and Booth 1971, Carin and Sund 1970). In addition, project work which allows pupils

to practise the scientific method and to become actively involved in problem-solving exercises also, it is reasoned, assists in their understanding of the skills involved in such procedures (Heaney 1971). Furthermore, in order to develop their cognitive skills to the full, it is clear that pupils require experience and practice; they need to build up a comprehensive store of concepts and to be given the opportunity to use these concepts in different ways and in different contexts. It seems likely that only when pupils have been given the chance to construct hypotheses, to test them and to put the results of these tests into practice can they be reasonably expected through project work to acquire those high level cognitive skills of data manipulation, analysis, interpretation, application, and problem-solving (Wells 1972).

3.1. Research Findings

With reference to the findings of this particular research study, almost one third (33.1%) of the teachers using the project method believed that cognitive skills are, or can be, developed in pupils as a result of undertaking project work. Similar findings emerged from the informal discussions and interviews. On the cognitive issue, it was interesting to find that the perceptions of teachers using different types of project work (i.e. reporting vis à vis discovery and combination) and responsible for different C.S.E. science subjects did not differ significantly (see page 173, Table 5.5.). There was, however, a slightly increased tendency for teachers implementing project work of a non-reporting nature (i.e.

that which required some involvement in the investigation of a problem, see Chapter 3) to cite the development of cognitive skills as a valuable product of the exercise although scrutiny of the responses within the individual subject areas does not altogether support this tendency. In Chemistry, for instance, a subject in which most of the project work undertaken was of the non-reporting type (see Chapter 3), only 27.8% of the respondents in this group named the acquisition of cognitive skills as a useful outcome of the method. It would seem therefore that the value of project work in the development of cognitive skills in pupils may be influenced to some extent by both the nature of the project exercise and the subject area in which it is undertaken.

On the whole, teachers appeared reluctant to state precisely those types of cognitive skills acquired by pupils through project work. The cognitive achievements of pupils as a consequence of successful project work were seemingly difficult to pinpoint in view of the varying conditions under which the project method was being implemented. Understandably, therefore, the teachers' responses to the questionnaire item were cautious. A number of respondents were however more ready to express their views and several interesting points emerged.

In agreement with the findings of Oliver (1965), Cowan (1969) and Small (1973) several teachers rejected the project method as a useful means by which pupils might acquire factual knowledge and accuracy:

Project work is a valuable approach for part of most courses ... I have not found it helpful for learning knowledge.

(274, Chemistry)

and, in support of a suggestion made by Oliver (1965), a number of respondents saw the project approach as an uneconomical teaching/learning strategy:

If knowledge is to be acquired in a course of study then project work can take up too much time.

(002, Chemistry)

Furthermore, a project that consisted of book and literature research as its main component was seen as 'of little value' (328, Integrated Science) in promoting cognitive skills and, as expected, many teachers commented on the extent of plagiarism to arise out of such exercises. Indeed, 91.4% of the teachers using a report-type project approach with pupils agreed that it resulted in large volumes of material being copied directly from books and journals (see Table 5.6.).

Clearly, the trend towards copying was widespread and most teachers recognised it as a particularly detrimental feature of project work at C.S.E. level. Thus, the tendency for project work to develop into an exercise in plagiarism received much attention and several lines of tentative reasoning were put forward to explain it. A few respondents suggested that laziness and/or inexperience on the part of the teacher may be factors to be considered:

Inexperienced teachers seem to often wish to use projects in unguided situations because it looks as though the kids are working hard and producing lots of work.

(034, Chemistry)

TABLE 5.6.

PROJECT WORK AS AN EXERCISE IN PLAGIARISM

	%age FREQUENCY OF RESPONSE TO STATEMENTS				
	Teachers using the Project Method			Teachers not using the Project Method (n = 301)	All Respondents (n = 461)
	Report-type (n = 70)	Non-report-type (n = 90)	All Types (n = 160)		
Project work results in large volumes of material being copied directly from books and journals† (Item 8)	91.4***	63.3	75.6	77.4	76.8
	5.7	14.4	10.6	14.0	12.8
	2.9	20.0	12.5	6.6	8.7
	Agree				
	Uncertain				
	Disagree				

† Statement taken from Section C of the questionnaire (see Appendix I)

*** Significance Level $p < 0.001$

Another teacher was more scathing:

... I think the word 'project' is absolutely abused and is so often an excuse for teachers idleness or lack of originality ...

(391, Biology)

Also, it appeared that for some teachers, pupil project work rather than making 'excessive demands' on their free time as popularly conceived, actually provided them with 'abundant spare time' (202, Biology; 180 Integrated Science). (In this respect, it was surprising to find that only 33.8% of the teachers using project work felt that it made excessive demands on their free time compared to 46.5% of those not using the method, (see Chapter 6, Table 6.12.).

In addition, some teachers criticised their contemporaries for their inadequate preparation and planning, and for failing to direct pupils and guide them through those relevant experiences and reflections recognised as so important to the acquisition of high level cognitive skills (see Ausubel 1968 and Wells 1972) and the successful implementation of project work.

A few teachers commented on the problems associated with multi-racial classes. It seemed that proficiency in language and literacy was lacking in many C.S.E. pupils so that little understanding could be gleaned from literary sources. The following comment pinpoints these difficulties:

I have also found that many Asian pupils have language difficulties to the extent that they are unable to produce any original written work, so that their projects are often copied, from books or from each other.

(450, Physics)

Thus, pupils who turned to literary sources for their information often lacked the expertise necessary to interpret, select and abstract the material and, as a result, often failed to understand the underlying concepts and to define and re-structure them into clear, concise accounts. Under such circumstances, many respondents saw plagiarism as the inevitable outcome especially when the project itself was envisaged as largely a report-type exercise. On this issue, a number of teachers admitted that many pupils actually enjoyed copying work since it represented a passive occupation - one which made no real cognitive demands on them.

Problems relating to literacy were not confined to multi-racial situations and projects of the reporting type. Similar difficulties were apparent when the project approach involved some level of practical investigation on the part of the pupil:

The level of English ability is not usually high enough to expect clear, lucid, well-written projects if they did it completely on their own ... valuable laboratory time is spent re-writing work.
(182, Chemistry)

In this case, it would seem that when literacy is poor, laboratory reports about procedures, results and conclusions cannot be competently written so that evidence of acquisition of cognitive skills is likely to be scanty to all but the personal tutor who has had time to supervise the work.

Aside from these problems, projects of the 'discovery' and 'combination' type were, on the whole, commended by their users. Like Heaney (1971), many respondents felt that these approaches, by allowing pupils the opportunity to practise the processes of science, were especially

valuable in promoting the acquisition of cognitive abilities associated with scientific thinking. As one teacher aptly put it,

A project involving the study of scientific method and stimulated by pupils' own imagination/interest as much as possible is of much more use and value as a scientific training... A training in scientific method is more valuable than a training in plagiarism. (328, Integrated Science)

However, in advancing their views on the 'success' value of the project method a number of teachers felt it necessary to qualify their statements. Thus, it became clear from their responses that when conditions (such as pupil experience and motivation, school time and resources) were at an optimum, project work might be realistically envisaged as a valuable strategy in promoting the acquisition of a range of skills associated with scientific development in pupils. The following comments are some of the more typical expressions of the potential value of the project approach:

Project work ... if organised properly with sufficient equipment can be both rewarding and educationally beneficial in giving pupils training to abstract information and self-discipline themselves in the task before them. (381, Biology)

... In a different situation, projects could be used to develop experimental skills and the ability to make deductions or form hypotheses and test them as well as to further knowledge. (210, General Science)

Similarly:

When used sparingly throughout the school with co-ordination between departments ... It (project work) is important for pupils to learn the skills of research and abstraction and to develop an original approach. (055, Chemistry)

It makes the majority of pupils read and carry out minor research for themselves instead of simply accepting 'spoon-feeding' which often occurs at C.S.E. level. (376, Physics)

In addition, project work was seen as important in the development of specific cognitive skills; for example,

... a sense of investigative science i.e. how to apply the 'scientific method'; ability to think logically. (274, Chemistry)

and valuable in encouraging pupils:

to critically analyse results and research material gathered, and incorporate it in a sensible and logical manner. (009, Biology)

Moreover, those types of abilities awarded importance by Flecknoe (1976) were also seen as desirable outcomes of the project approach:

An ability to understand for themselves the complex relations between certain facts, and an ability to assess those facts both independently and as a whole. (092, Biology)

Teachers' perceptions of the usefulness of project work in promoting the acquisition of cognitive skills were assessed still further by means of Section C of the questionnaire, items 4, 13, 16 and 20 of which made special reference to the skills of application, enquiry, deduction and interpretation (see Chapter 6, Table 6.12.). Analysis of the teachers' responses to these items (i.e. their level of agreement/disagreement with each of the statements given) provided a greater insight into their views about the value of project work for the 'average' pupil. The results of this analysis are summarised in Table 5.7.

In general, project work as a means by which pupils learn 'to apply previous understanding of fundamental concepts to new situations' (item 4) was regarded with some uncertainty by 40.6% of the 'Users' of the method. A similar level of uncertainty was expressed irrespective of the type of project work the respondents were implementing

at the time of the enquiry although just over one third (35.6%) of those teachers using 'non-report' type projects agreed that application of this kind may be derived from the project strategy. The 'Non-users' of project work showed slightly more doubt about the value of project work; only 25.9% of them felt able to agree with the statement in question.

Statement 13, project work as a means of developing enquiry skills in pupils, received a more generous appraisal. The majority of the respondents, 56.4% of the total, agreed with the statement although further analysis of the responses showed a significant difference between the 'Users' and 'Non-users' of the project method. 65.6% of the 'Users' compared to just 51.5% of the 'Non-users' felt able to agree that enquiry skills were developed through project work - a result that was statistically significant at the 0.05 level.

A slight variation in response between the 'Users' of the different types of project work was also observed. Surprisingly, a marginally greater percentage (68.6%) of those teachers implementing

TABLE 5.7.

THE ACQUISITION OF COGNITIVE SKILLS THROUGH PROJECT WORK

SKILLS ACQUIRED THROUGH PROJECT WORK		%age FREQUENCY OF RESPONSE TO STATEMENTS				
		Teachers using the Project Method			Teachers not using the Project Method (n = 301)	All Respondents (n = 461)
		Report-type (n = 70)	Non-report-type (n = 90)	All Types (n = 160)		
The ability to apply previous understanding of fundamental concepts to new situations is derived from project work (Item 4)	Agree	22.9	35.6	30.0	25.9	27.3
	Uncertain	40.0	41.1	40.6	40.2	40.3
	Disagree	35.7	23.3	28.8	32.6	31.2
Enquiry skills are developed through project work (Item 13)	Agree	68.6	63.3	65.6*	51.5	56.4
	Uncertain	22.9	25.6	24.4	35.2	31.5
	Disagree	8.6	11.1	10.0	11.6	11.1
Pupils' powers of deduction are developed through project work (Item 16)	Agree	15.7	27.8	22.5	16.9	18.4
	Uncertain	44.3	51.1	48.1	45.5	46.4
	Disagree	40.0**	16.7	26.9	36.5	33.2
Skill in the handling and interpretation of data is acquired through project work (Item 20)	Agree	45.7	52.2	49.4**	31.6	37.7
	Uncertain	41.4	34.4	37.5	47.5	44.0
	Disagree	12.9	13.3	13.1	19.3	17.1

* Significance level $p < 0.05$ ** Significance level $p < 0.01$

the report-type exercise supported the notion that enquiry skills may be developed in this way. Such a finding perhaps demonstrates that for these respondents enquiry skills were not thought of solely in terms of practical laboratory investigations but covered those abilities necessary to find out facts and figures from the media i.e. the types of skills used in the reporting approach.

In contrast, statement 16, which posed project work as a method of developing pupils' powers of deduction, received little direct support. Only 22.5% of the 'Users' and 16.9% of the 'Non-users' were in agreement with the statement. Generally speaking, however, the respondents were uncertain about the role of project work in promoting pupils' powers of deduction and it was suggested that:

Although project work may force improvements in skills such as interpretation, planning etc., it cannot significantly improve skills of deduction which require more formal training.

(352, Biology)

The notion that pupils must be taught how to deduce by painstaking, stepwise guidance was echoed by a number of teachers, many of whom felt that providing pupils with the opportunity to undertake projects was of little immediate value since there was rarely sufficient time to direct pupils individually along those pathways relevant to their cognitive development.

Item 20 of the questionnaire sought to examine teachers' views relative to the acquisition of 'skill in the handling and interpretation of data' by pupils. Analysis of the responses made to this item revealed a significant difference between the 'Users' and the 'Non-users' of the project method: 49.4% of the 'Users' (52.2% of those using

non-reporting projects and 45.7% of those using projects of the reporting-type) agreed with the statement whilst only 31.6% of the 'Non-users' felt able to give this support. Applying the χ^2 test, this result was found to be significant at the 0.01 level. Thus, those teachers actually practising the project method with C.S.E. science pupils were again more favourable in their appraisal of the method. It is however interesting to note that few teachers indicated total disagreement with the statement. A degree of ambivalence was apparent among both the 'Users' and 'Non-users' of the method, greatest doubt being detected among the latter group of teachers, 47.5% of whom indicated their uncertainty about the issue in question. In the 'User' category, 10% fewer respondents felt this unsure.

To conclude the findings relating to the role of project work in the acquisition of cognitive skills, it would appear then that those teachers using project work - and more especially those using project work of a non-reporting type - were generally more favourable in their appraisal of the method. Whilst recognising the difficulties of discouraging large-scale copying, they acknowledged the development of cognitive skills as a valuable outcome of well-organised project work. With good guidance and supervision, the method could, they claimed, provide for pupils a worthwhile training in the scientific skills of enquiry, experimentation, analysis, abstraction and interpretation.

5.4. The Development of Organisational/Managerial Skills

Much has been written over the years about the importance of pupils assuming some personal responsibility for their work. Many have advocated the benefits of pupils managing their own learning experiences and organising their own work schedules within the confines of the school timetable. However, teaching strategies which permit a level of pupil self-management have been met with mixed feelings and have enjoyed varying degrees of success.

Horne (1943) undertook a small investigation in an attempt to compare different methods of teaching science. The pupils in his experimental group were allowed complete freedom in the use of books, equipment and apparatus. Their teachers provided help only when it was directly requested. The control group on the other hand worked by the traditional method of demonstration. Horne found that after some initial quarrelling and jealousy, the pupils in the experimental group were working well and organising their own programme of work with a real enthusiasm for the subject.

Cowan maintained that the principle aim of any system of education was:

... to teach a boy to work on his own responsibility
... The equipment he needs is the knowledge where to
go for help, the ability to use that help and to
organise the time and the task, and the self discipline
to carry it through ...

(Cowan 1969, p.23)

and in his attempt to evaluate the use of group projects for selected topics in History, he found that the project approach encouraged a number of organisational skills. The use of reference and text-books were, for instance, employed

more successfully and pupils appeared to use their time more productively, making greater use of both school and public libraries.

Jones (1970) also recognised the importance of projects in permitting students the opportunity to plan and organise their work schedules effectively in accordance with the pre-set conditions of the course. Indeed, in the assessment of project work in supervisory studies, the degree to which the project demonstrated an understanding of planning principles and techniques was an important consideration.

The value of allowing pupils the chance to rely on their own resourcefulness in the design and planning of investigations had been acknowledged in other study areas too. With special reference to the Nuffield A-level Biological Science Project, Kelly and Dowdeswell wrote:

We recommend that they (the students) should be encouraged gradually to rely more and more on their own resources, and it is partly with this objective in mind that we regard project work as so important.
(Kelly and Dowdeswell 1970, p.256)

In this context, one of the operational divisions identified as important in the assessment of project work was the design and planning of investigations (see Section 5.1.) Interestingly, the results of the evaluation studies showed that even at A-level designing enquiries was still a very real source of difficulty for students (Kelly 1971, 1972).

In 1967, the introduction of the Joint Matriculation Board A-level syllabus in Engineering Science brought with it a number of quite radical changes in course work which required the students to complete a 50-hour project with

an accompanying dissertation and to undertake four experimental investigations (later reduced to three) of up to 12 hours duration. In 1972, Hiles and Heywood published a report on teachers' attitudes to projects in this new examination course. The report examined (i) those aims and objectives considered important by the teachers directly involved with the course, and (ii) the effectiveness of the project approach in achieving those objectives. Organisational skills were ranked highly on both accounts; in terms of importance, the rank order of aims and objectives read as follows:

1. increasing self-reliance by independent work;
2. increasing decision-making ability;
3. training pupils to find out for themselves.

When asked to rate 29 possible aims of projects for their effectiveness and importance, training pupils to find out for themselves was rated 2nd, decision-making ability was rated 4th, and self-reliance was rated 5th by the teachers. Generally speaking, the teachers participating in the enquiry were enthusiastic about project work associating it with the acquisition of a range of skills and, although their enthusiasm was sometimes tempered by reality, there was clear agreement that:

Project work ... developed important aspects of character and ability that are normally ignored in teaching for examinations ... Projects encourage initiative, independence, ability to work on their own ... the ability to use a library ... to quote but some of the comments.
(Hiles and Heywood 1972, p.63)

Projects and their assessment in the context of the Scottish Certificate of Sixth Year Studies in Chemistry formed the basis of two articles published by Handy and Johnstone (1974) and McGuire and Johnstone (1974). In

the 'Project Issue' of Education in Chemistry, the authors identified a number of aims of project work within this scheme. Among them were (i) skill in devising an appropriate scheme for studying a problem in chemistry, and (ii) resourcefulness on the part of the pupil with a corresponding lessening of dependence on the class teacher. A questionnaire to teachers and pupils involved with the course to investigate their views on project work indicated a generally favourable attitude and provided evidence to suggest that the second aim, i.e. resourcefulness, was being successfully achieved as a result of it. In addition, the teachers thought that project work led pupils to make greater use of books (McGuire and Johnstone 1974). Concerning the assessment of project work, the authors acknowledged that many of the skills acquired through project work could be tested by means of a dissertation or oral interview but that:

... some of the other desired skills are not amenable to assessment solely on the basis of a written report

and that

There still remained a few objectives which could not be fairly assessed by a visiting examiner and here the class teacher could help. For example, evidence of resourcefulness and lessening dependence on his teacher could come from the teacher who worked with the student throughout.

(Handy and Johnstone 1974, p.56)

Thus, once again it appears that certain organisational skills may be important objectives of project work. In the Scottish Certificate scheme, skills such as the ability to plan investigations, to work independently and to show resourcefulness throughout the course would seem to carry significant weighting in the assessment of projects at this level.

In a similar vein, a statistical analysis of the Nuffield A-level Physical Science project assessment carried out by Hockey in 1971 demonstrated a marked emphasis on planning ability. Within this scheme, each candidate was assessed on a 5-point scale on eight different traits: ingenuity, results, planning, knowledge, practical skills, evaluation, persistence and presentation (see Woods et al. 1974). A mark of 3 represented the performance of an average A-level student. In Hockey's analysis the high loading of planning showed that this was used as a major assessment trait even though its marginally lower standard deviation suggests that it did not enable the internal assessors to discriminate between candidates so easily (Personal Communication, March 1982).

Skill in devising and planning an appropriate scheme for studying a problem was also seen as an important objective of project work in Armstead's study (1975). In fact, the majority (78%) of the 105 Chemistry teachers responding to his questionnaire felt able to confirm that:

project work provides students with the opportunity
to think for themselves and plan their work.
(Armstead 1975, p.78)

Armstead maintained that organisational skills such as those involving the design and planning of investigations are difficult to achieve by the more traditional teaching strategies (e.g. practical laboratory exercises and demonstrations) and for this reason he regarded them as a particularly valuable outcome of the project method. Furthermore, with group projects, Armstead stressed the need for each individual member of the group to attempt a specific aspect of the total project so as not to miss out

on the opportunity for planning and decision-making.

The value of project work in giving students experience in decision-making was also acknowledged by Steckline (1977) in an article which recounted his own attempts at implementing independent study in Physics in a New Jersey high school. Independent study in this setting had been operated along the lines of student projects, and these projects had taken a variety of forms. Some were assigned, others were tailored to the needs of individual students and many were small in nature and point (i.e. grade) value. They ranged from reports summarising a scientific topic in the literature to open-ended practical research studies. Either way, the general aim of the projects was summarised by Steckline as follows:

This section of the course treats the student as an individual in addition to being a physics student, so decision-making, responsibility for decision-making, and constructive use of the unstructured time join the usual reasons for an individually structured program.
(Steckline 1977, p.158)

5.4.1. Research Findings

In project work, whether it be of the reporting, discovery or combination type, most of the teachers responding to the questionnaire expected their pupils to carry out some sort of investigation into an aspect of their science subject. The investigation was envisaged as involving some form of enquiry or research either through related literature, practical exercises or laboratory investigations. This work could be undertaken either

individually, in pairs or in larger groups but almost inevitably involved some degree of organisation and management on the part of the pupils, the teacher or both. Thus, it is perhaps not surprising that over one third of the respondents considered the development of organisational/managerial skills to be an important facet of the project method.

In this particular study, analysis of the responses to the questionnaire showed that 37.5% of those teachers using the project method believed that organisational/managerial skills were developed in pupils as a consequence of undertaking some form of project work. The comments and observations which emerged from the interviews and discussions gave additional support to this finding.

No significant difference was found between the users of the different forms of project work, although the results suggest that at C.S.E. level projects of a reporting nature might be regarded as slightly more conducive to the development of these types of skills. Thus, when asked to specify the kinds of skills and attitudes developed through project work, 40% of the teachers using the report approach (compared to 35.6% using the non-reporting strategy) named organisational/managerial skills in response (see page 173, Table 5.5.). Further analysis of the responses by teaching subject reflected a similar trend. Among the teachers of Biology and Physics (that is, those who as described earlier tended to use more reporting-type project work), 47.5% and 44.4% respectively cited a range of organisational/managerial skills in response to this item.

In agreement with the findings of Horne (1943), Jones (1970) and Armstead (1975), the respondents suggested that project work in general did help C.S.E. pupils to develop the ability:

... to work independently, to organise and plan work well in advance.. (093, Chemistry)

... to work with economy of time and materials.. (423, Chemistry)

and,

... to plan in the longterm and show initiative.. (Personal communication, Leicestershire, December 1978)

Forward planning, as indicated in the above extracts, was regarded therefore as an important and desirable element of project work. In addition, the ability to organise their time and materials, and to accept responsibility for their work were seen as skills to be encouraged and extended in pupils undertaking the project method. Such perspectives were clearly held by both 'Users' and examiners of the method. One teacher, experienced in the use of project work at C.S.E. level, suggested that

Projects ... should be left as loosely-defined as possible so that pupils are able to demonstrate their ability to plan.
(Personal communication, Leicester, January 1979)

Similarly, a Chief Examiner for C.S.E. science⁽¹⁾ during the course of an interview maintained that 'evidence of independent study with foresight and direction' was a characteristic feature of good project work and as such should be seen as an important criterion for its assessment (Personal communication, Northamptonshire, November 1978).

Project work as a means of developing organisational/managerial skills was investigated further in Section C of the questionnaire. Here, among the series of items posed,

statement 17 sought to examine teachers' perspectives of the rôle of project work in the acquisition of skill in the planning and organisation of scientific investigations (see Appendix I). The results are summarised in Table 5.8. overleaf.

Over one third (35.1%) of the teachers responding to this item agreed that the ability to plan and organise scientific enquiries is acquired through project work. Surprisingly little difference was observed between the 'Users' and 'Non-users' of the project method (37.5% and 33.9% agreement respectively) although a marked difference of opinion was apparent between the two factions of the 'User' category.

The users of projects of the report-type were far more sceptical in their appraisal of this aspect of project work. Only 22.9% of the teachers in this group felt able to support the statement compared to 48.6% who, in response, expressed uncertainty about the rôle of project work in the acquisition of organisational skills associated with scientific studies. Given the nature of report-type projects with their heavy reliance on secondary sources for information and materials, such a result is perhaps to be expected since the skills employed in 'looking at science' may be very different from those employed in 'doing science'.⁽²⁾

By this reasoning, it is perhaps also not surprising that a significantly greater percentage (48.9%, $p < 0.01$) of the teachers using a non-reporting approach agreed that skill in planning and organisation is acquired through the project strategy. Non-reporting projects, as described in

TABLE 5.8.

PROJECT WORK AS A MEANS OF DEVELOPING SKILL IN THE PLANNING AND
ORGANISATION OF SCIENTIFIC INVESTIGATIONS

%age FREQUENCY OF RESPONSE TO STATEMENTS					
	Teachers using the Project Method			Teachers not using the Project Method (n = 301)	All Respondents (n = 461)
	Report-type (n = 70)	Non-report-type (n = 90)	All types (n = 160)		
Skill in the planning and organisation of scientific investigations is acquired through project work (Item 17)	Agree	22.9**	48.9**	37.5	33.9
	Uncertain	48.6	32.2	39.4	30.2
	Disagree	28.6	18.9	23.1	30.2
					27.8

** Significance level $p < 0.01$

Chapter 3, necessitate an element of practical problem-solving and present pupils with the opportunity to practise the scientific method. In this way, pupils are able to gain first-hand experience of the type of organisational skills required in scientific investigation. Thus, given this kind of project experience, it seems clearly more likely - as affirmed by nearly 50% of the teachers in this 'User' group - that pupils will actually acquire these organisational skills.

Accepting the advantages and limitations of the different project approaches in the acquisition of organisational and managerial skills, it would however be wrong to assume that all teachers were generally favourable in their appraisal of this aspect of the project method. In contrast, as shown in Table 5.8., the majority of teachers were doubtful of the value of the enterprise in promoting such skills. 36.0% of the teachers expressed uncertainty about the issue and a further 27.8% indicated their disagreement. Analysis of the responses by use and type of project work undertaken showed that negative attitudes in this respect were greater among the users of the report-type projects, 77.2% of whom were uncertain about or disagreed with the suggestion that 'skill in the planning and organisation of scientific investigations is acquired through project work'. In considering the more advanced organisational/managerial skills involved in the design, planning and implementation of an experimental study, a number of teachers demonstrated obvious reluctance to attribute the acquisition of such skills to the average (or even above

average) C.S.E. pupils. Where projects of a practical, investigative nature were undertaken, most of the experiments, it was argued, were performed 'for the sake of it' and rather than displaying evidence of forward planning and organised thinking, tended instead to be 'just a hash of oddments ... not logically following on' (104, Chemistry).

Teachers' reluctance to accept that pupils acquire organisational/managerial skills through project work was not confined to the high level abilities associated with the planning of scientific enquiries. For some even the routine planning and organisation that goes into collecting material from secondary sources and compiling a report was seen as an unrealistic expectation for C.S.E. pupils. The drawbacks are summed up in the following paragraph:

Project work that involves research of literature and synthesis of information is beyond the capabilities of poorly-motivated (not necessarily 'average') C.S.E. candidates. Pupils require very detailed instructions as to what to write; lack confidence (or ability?) to make selections themselves.
(068, Biology)

Several teachers hinted that after years of 'spoon-feeding' by the more traditional didactic methods of teaching, pupils are ill-equipped to cope with the level of personal responsibility for their own learning demanded in project work, and quite apart from the problems associated with large-scale copying discussed earlier, it was suggested that:

Most of the 4th and 5th year pupils (in both 'O' and C.S.E. streams) show reluctance to work by themselves.
(075, Physics)

They (i.e. the majority of pupils) are not able to organise or think for themselves.
(143, General Science)

Moreover, some respondents spoke of the bewilderment, panic and avoidance tactics displayed by pupils in a project work situation:

Some children get quite anxious because of the personal responsibility involved.

(030, Chemistry)

The 'average' pupil requires the security of being instructed most of the time, and tends to panic or 'switch off' when presented with any vague or open-ended task.

(119, Physics)

Clearly, it was felt that many C.S.E. pupils are unable to work in the organised, disciplined way required of project work. They are, it was argued, too immature to direct their own learning experiences in the form of a project. As one teacher remarked:

They always regard it as an optional part that can be left 'til the last minute, however hard we try to convince them that it is an ongoing integral part of their course.

(96, General Science)

Thus, it would seem fair to conclude that there was a prevailing scepticism among teachers concerning the rôle of project work in the acquisition of organisational/managerial skills, even though over one third of the respondents acknowledged the development of some such skills through the project approach. In this context, the data suggest that different types of skills were envisaged depending to some extent upon the nature of the project work being undertaken. Forward planning, the ability to work independently, to collect material, organise it and to compile a report in accordance with a pre-set time allowance were the skills most frequently quoted, although skill in the planning and organisation of scientific investigations was acknowledged in relation to projects of the non-reporting type, i.e. those which by definition

implied an element of problem-solving by investigation. Teachers using report-type project work tended to be less confident about pupils' ability to undertake this kind of scientific management and project work as a means of promoting the more rigorous organisational skills associated with scientific investigations received little support from this group of respondents.

5.5. The Acquisition of Practical/Manipulative Skills

Few studies have concentrated in any depth on the acquisition of practical skills through project work although Jones (1970), Harper (1972), Armstead (1975) and Deere (in Macintosh 1978) cited earlier, have all stressed in varying contexts the importance of project work in providing practical experience in the preparation of materials, the handling of apparatus and equipment and the opportunity to acquire the dexterity and expertise necessary to practise the 'art' of scientific technique.

A further but rather scant study by Heaney (1971), which investigated different teaching methods in Biology, has indicated that the heuristic ('guided discovery') method of teaching was more successful in improving practical laboratory skills than 'cook-book' practical approaches and demonstration methods. Her study also suggested that improvement of these skills tended to be greater (as measured by pre- and post-tests) in those pupils of low mental age than those of high mental age. It is tempting to speculate on the importance of this finding in relation

to the child of below average ability, the pupil perhaps at the lower end of the C.S.E. spectrum, but such speculation must clearly be reserved until further evidence comes to light. However, on the basis of the earlier studies in this area, it would seem reasonable to conclude that if project work is conducted along the lines of a practical laboratory investigation in which pupils are required to undertake with guidance a practical study of a problem, practical skills (including those which involve some manipulative ability) will improve as a result.

5.5.1. Research Findings

There is little dispute over the importance of practical work in science courses, and, by the same line of reasoning, few respondents in this enquiry questioned the value of a practical orientation to project work. Indeed, many lay great emphasis on it:

Projects should ideally hold a practical element; they need not be research projects in the true sense, but there should be evidence of certain practical skills such as observation ... Certain practical skills demonstrated during teaching periods may be used in projects in a modified or adapted form ... This should be encouraged as it shows application as well as comprehension of previously acquired skills.

(Personal communication, Leicestershire, January 1971)

Moreover, with reference to the assessment of such skills, it was suggested that

Skills such as the manipulation of materials and apparatus are best assessed throughout the course, either through structured practical work or personal projects.

(Personal communication, Derbyshire, November 1978)

The importance and desirability of the practical emphasis in project work was also reflected in the finding, reported in Chapter 3 which showed that 48.2% of the teachers using the project method opted for either a 'discovery' or 'combination' approach, that is, one which encouraged pupils to answer a question through the use of experimentation and/or observation.

Given therefore this degree of preference for projects with a practical bias, it was surprising that in response to the question of skill acquisition through project work, only 22.5% of the teachers made any direct reference to practical skills (see page 173, Table 5.5.). As might be expected, less support (only 14.3%) was received from the teachers using report-type projects, but even among those respondents implementing the 'discovery' and 'combination' strategies, only 28.9% specified the development of practical skills through such work.

A second analysis by subject area showed that 44.4% of the Physics teachers favoured project work for its rôle in the acquisition of practical skills, but given the small number of respondents in the Physics/'User' category this finding is of little significance.

Of the skills which were identified, manipulation of equipment and dexterity in the handling of apparatus were the most common. It was interesting to note that certain skills (such as those involved in accurate observation and measurement) which are awarded importance on the four main C.S.E. science syllabuses (see Section 5.1.) received little acknowledgement, suggesting that project work in general is not regarded as especially relevant to the acquisition of

these types of skills. Furthermore, the reluctance of teachers to cite specific practical skills may be indicative of their underlying acceptance of project work for its supportive rather than dominant rôle in the acquisition/development of such skills. Several respondents had expressed this view but the two extracts which follow serve to illustrate the point:

Project work is not necessary to acquire the skills mentioned but may benefit an individual in his skills acquisition. (434, General Studies)

I think that the abundance of practical sessions and the deductive approach I take to the subject allows the pupils to acquire and practise the skills that project work develops.
(451, Biology)

On the question of the development of practical skills in pupils of varying ability, teachers' perceptions were more mixed. Several respondents commented on the improvement in practical ability observed among pupils in the average and below average range and a Chief Examiner confirmed that the 'average C.S.E. pupil does better than expected in practical work ... Teachers tend to underrate their abilities' (Personal communication, Northamptonshire, 1978). In contrast, other teachers (as discussed in Section 5.8. which follows) shared the belief that many of the beneficial outcomes of project work could be achieved only by the more able pupils and that the less able required the more traditional, structured teaching methods.

Thus, in relation to the speculation arising from Heaney's earlier findings concerning the improvement in practical skills seen in pupils of low mental age, any additional evidence which might have emerged from the

observations of teachers participating in this study has not materialised. Hence, no statement, either for or against Heaney's conclusions, can justifiably be made. However, from the weighting of evidence presented here, it would appear that practical skills may be developed through project work but that these skills might be acquired more effectively by C.S.E. pupils through structured practical sessions in which, with the aid of well-designed sequences of instruction, pupils are taken through the stages necessary to gain working knowledge of the practical skills of science.

5.6. Socio-attitudinal Aspects of Project Work

The importance of creating favourable attitudes to learning in pupils by increasing their interest and enthusiasm and, hence, their motivation for the subject has long been the centre of discussion among those involved in science education. The more traditional teaching methods using verbal exposition followed by demonstration have been criticised for their emphasis on content rather than skills which, it has been argued, by encouraging a passive rôle in pupils, tarnishes the bright lively mind so that the intrinsic interest is lost. As a result, over the last few decades, attempts to improve pupils' attitudes to learning in science by developing new, more appropriate teaching strategies have occupied an important position in science education research programmes both in Britain and abroad, and in this respect various prescriptions for

increasing the effectiveness of science teaching have been derived.

The study by Horne (1943) cited earlier, which compared the teaching of science by the traditional/demonstration approach with a method that encouraged independent study and allowed pupils complete freedom in their use of books and equipment, showed that after a period of settling the pupils participating in the latter strategy (i.e. the one that could perhaps be reasonably equated with the project method) developed a 'real enthusiasm' for the subject.

The importance of allowing pupils the freedom to investigate and discover for themselves was also recognised by Whitehead (1947 pp. 60 - 62) who saw the aims of this type of régime as not only the 'acquisition of techniques' but also 'the evocation of interest' and 'the excitement of success'.

Similar aims were identified by Rowe (1959) and formed the basis of his topic approach, a strategy which sought to stimulate pupils' interest in learning and to promote the acquisition of the 'affective' skills.

The potential value of the topic approach in capturing interest and developing an enthusiasm for learning received additional recognition in the Newsom Report published in 1963. With particular reference to the pupil of average and less than average ability, the case was formulated thus:

Assignments on topics appropriately related to the pupils' interests and experience, yield, as well as information, the pleasure of working seriously on one's own. The results may not be wonderful at first, but the excitement of making discoveries and advancing is catching; the pupils will not be unaffected by the gradual enlarging of their powers which will follow.

(Newsom Report, para. 470)

A favourable report on the topic approach was also provided by Cowan (1969). In the study of group project work for pupils following a third year History course, it was reported that the exercise encouraged pupils to show initiative, imagination and creativity, and that co-operation replaced competitiveness as the main form of incentive. Moreover, pupils were seen to develop an increased sense of responsibility and a greater determination and effort in their work. In this respect, Cowan's findings may be important for if, as the study suggests, these skills are developed by a teaching/learning strategy in which separate topics are studied by pupils in independent project groups, then the use of such a strategy in science must surely be encouraged since there would seem little doubt as to the value of these kinds of skills for the science pupil.

Improving pupils' attitudes to learning and school had been one of the primary aims of Countesthorpe College, the first new-type, purpose-built upper school to be set up in the county after the introduction of the Leicestershire Plan. The College itself represented a deliberate attempt to implement policies of greater flexibility and interdisciplinary work and, by a scheme based upon individualised learning and project work together with more mature, egalitarian staff/student relations, sought to increase interest, motivation and responsibility (Mason 1960, 1965;

Bernbaum 1973) and 'to assist the students to take increasing control of their own destinies' (Watts ed.1977, p.37).

Project work as a means of increasing involvement and encouraging a greater degree of responsibility on the part of the pupil was also acknowledged in the Engineering Science study by Hiles and Heywood (1972), cited earlier, where 'increasing readiness to accept responsibility', 'developing creativity' and 'giving pupils a sense of involvement' were among the most common aims and objectives of project work to be identified.

A further contribution to our understanding of the rôle of project work in the development of socio-attitudinal skills was made by Small (1973). Synthesising the findings of her own and other research studies in this area, she suggested that project work - when defined as a problem-solving activity with minimal direction from the tutor - was generally more effective than other methods in increasing a student's commitment to the subject and to further self-directed learning.

Small's investigation focussed mainly on technical work in Further Education but the importance of project work in developing these types of skills and attitudes has also been studied by McCormick at sixth-form level. In a paper exploring the use of project work in sixth-form Chemistry, he wrote:

Project work could assist in making chemistry education more outward-looking and could give it an extra dimension which the usual laboratory exercise simply cannot do. ... It is a process which is hard to define, but it involves following up clues in the literature, debate, judgements, experimental design, success, the illumination which comes from failure, and the wisdom which comes from uncertainty. The process is involved with doing something rather than the proving of anything. (McCormick, 1974, p.48)

McCormick commended the project approach as a means of teaching the relevance of chemistry in an inspiring way and for the confidence and co-operative spirit it generated among pupils. However, as for increasing pupils' motivation and commitment to the subject, McCormick was more sceptical. From discussions with pupils who had undertaken industrial projects, he concluded that although they had enjoyed the experience and appreciated the challenge, their attitudes towards chemistry remained unaffected.

The part played by project work in promoting socio-attitudinal skills was considered further by Armstead (1975, 1979). He agreed that the project approach might reasonably be expected to cultivate in pupils a greater sense of involvement and interest in the subject but concerning its motivating powers Armstead, like McCormick, held a more guarded view although he did accept that:

As far as the student is concerned, project work can increase motivation towards the subject (providing project work is described in a professional manner by the teacher).

(Armstead 1979, p. 571 - 2)

With this in mind, using the results of his own survey and the recommendations laid down by Dowdeswell and Tricker (1970), Armstead drew up a number of principles which, if followed, might assist the teacher in making project work a more 'professional' undertaking. The list included among others:

- i. Full discussion of the objectives of project work
- ii. Careful consideration of the topic: its relevance, its applications etc.
- iii. Serious consideration of any practical work involved: facilities, resources, safety hazards etc.

If these guidelines were followed by both staff and students, project work could, in Armstead's view, encourage creative thought, free expression and commitment, by providing a more 'real' (and, perhaps, more motivating) situation for scientific investigation.

Thus, to conclude this brief review of the literature, it is clear that a number of important observations relating to the acquisition of socio-attitudinal skills have been noted in pupils undertaking project work.

Horne's early work (1943) indicated the importance of independent work in promoting enthusiasm in pupils and the suggestion that interest, excitement and pleasure may be generated in pupils as a consequence of adopting this type of approach to learning received further support from Whitehead (1947), Rowe (1959), Newsom (1963) and others. Project work as a means of developing a more co-operative spirit among pupils was recognised by McCormick (1974) and Cowan (1969) who also observed an increased determination and effort among pupils carrying out projects. There were some reservations about the motivating power of project work and uncertainty about the degree of involvement and commitment it created (McCormick 1974; Armstead 1975, 1979), although other writers (Mason 1960, 1965; Hiles and Heywood 1972; Small 1973) recognised these aspects of pupil project work.

5.6.1. Research Findings

In the current study, analysis of the responses made to item 12(b), in Section A of the questionnaire (see Appendix I) showed that over one third (36.3%) of the science teachers using the project approach saw the pursuit of some form of project strategy as a means of developing socio-attitudinal skills in pupils. A similar weighting of opinion was apparent in the data collected from the interviews and discussions, and it was interesting to find that the perceptions of teachers employing different types of project work were also similar, in that 37.1% of those using 'report-type' and 35.6% of those using 'non-report-type' projects specified such skills in this context (see page 173, Table 5.5.).

Substantial variation was however observed among the teachers of different science subjects. The teachers of Biology and Physics lay greater emphasis on this aspect of project work: 44.3% and 44.4% respectively acknowledged the rôle of project work in the development of socio-attitudinal skills. By contrast, less than one third of the Chemistry teachers (30.6%) and less than one quarter of the General Science respondents (22.5%) identified such skills in relation to project work.

Further analysis of the teachers' responses revealed a range of socio-attitudinal perspectives although, generally speaking, it seemed that the project method was valued more especially in terms of the 'processes' it involved and the experiences it provided rather than the direct learning outcomes it induced. It was this train of

thought that dominated the examples of socio-attitudinal skills cited by the respondents. The following comments illustrate this point more clearly:

Project work enables a pupil to appreciate more fully the boundaries of knowledge i.e. what they learn in class is not the end of the matter but in many ways only the beginning. It enables them to follow their own interests and so develop a sense of enjoyment ... To this end, it is a pity that more class time cannot be allocated.
(300, Biology)

In project work pupils develop a real awareness and first-hand experience of biological material over a much longer period than in structured biology lessons ... A chance to be autonomous and decide their own programme to achieve their own chosen goal ... A better chance to appreciate the aesthetic pleasure of the subject.
(Personal communication, Leicestershire, December 1978)

The above extracts suggest that some teachers saw project work as a form of enlightenment, as a means of developing in pupils those types of skills and attitudes usually attributed to the affective domain (Bloom 1956).

The notion of enlightenment was also raised in connection with the relevance of traditional science courses for the average C.S.E. candidate. Commenting on the inappropriateness of some of the more formal academic syllabuses, one respondent argued in support of project work from the following standpoint:

Projects at least provide the possibility of pursuing some aspect of the subject which is relevant to the pupil and thereby make the subject a more real one.
(105, Chemistry)

and allied with the views put forward by McCormick (1974) a number of teachers agreed that project work, when properly conducted, allowed pupils the opportunity to experience new and enriching aspects of science and learning, and that in this way it enabled subjects to be taught in a more

inspiring fashion. Thus, it was these qualitative experiences associated with the project approach that teachers valued.

In addition to alerting and developing pupils' awareness, the use of project work was also commended for the increased interest, enjoyment and enthusiasm it stimulated in pupils and, in agreement with the findings of Rowe (1959), Newsom (1963) and Armstead (1975, 1979), a number of observations to this effect were recorded. By way of example one Biology teacher, reporting on his own experience of assigned projects, wrote:

Very many pupils expressed how much they enjoyed the tasks set ... I am not entirely convinced that it adds to better understanding however, but undoubtedly pupils' interest is stimulated.
(284, Biology)

Similar comments were made by respondents from other subject areas too, 'to provide more involvement, enjoyment and stimulation' (285, Physics), being a typical assessment of the value of project work in this respect.

Among the other socio-attitudinal skills to be named by the teachers was the development of a pupil's own self-concept by giving him/her 'a sense of achievement and success' (91, Biology). Project work as a means by which pupils could gain confidence in themselves and their abilities was also identified as a valuable function of the project strategy. These views are well represented in the following extracts:

I believe project work can have value in generating confidence in ability to succeed in a student who has not experienced much success in his school career - this as a reason for project work quite apart from any value in the study of specific subjects.
(317, Physics)

Pupils benefit from having actually done something on their own; the individualized element gives confidence to them.
(Personal communication, Leicestershire, January 1979)

Interestingly, project work as a means of developing confidence in pupils was thought to be especially important for girls in science. In this respect, one teacher particularly concerned about both the under-representation and the under-achievement of girls in science commented,

Girls' standards in Chemistry are very worrying. Rarely is a group of girls at the top of the class. Girls often seem to recede into the background (not necessarily the pupils' fault), seem to have less confidence in their ability than the boys. Projects would give them a chance to shine which might encourage them in other areas.
(305, Chemistry)

On a similar theme, it was suggested that, when well-directed,

Projects help to overcome passivity (especially in girls) ... Achievement is through their own effort and this increases motivation.
(Personal communication, Leicestershire, December 1978)

As well as helping to generate confidence in pupils, project work was also seen by some to play a useful rôle in developing self-discipline and encouraging pupils to make a greater effort in their work, and in support of the findings of Cowan (1969) and Hiles and Heywood (1972), the following observations were reported:

Pupils learn self-discipline through project work - or knowledge of their lack of self-discipline!
(226, General Science)

They are responsible (with guidance) to themselves, and their success depends on their own effort.
(355, Physics)

Moreover, in agreement with Armstead (1975), it was suggested that:

A project can give purpose and by so doing can improve a pupils' attitude to other parts of the course.
(236, Physics)

Furthermore, closely comparable with the earlier observations of Cowan (1969), one respondent reported a greater tendency for pupils in a project situation to show 'less confrontation' and to display a 'less hostile, more amiable attitude' towards their work (380, General Science).

Thus, a review of the more typical comments made by the science teachers indicates that a range of socio-attitudinal skills may be associated with the use of pupil project work at C.S.E. level. This view was the focus of further investigation in Section C of the questionnaire, items 1, 7 and 14 of which made special reference to interest, self-confidence and self-discipline as attributes that might be acquired by pupils through project work. The teachers' response to these items as measured by their level of agreement with the three separate statements about project work is summarised in Table 5.9. Again, the analysis is made on the basis of the teachers' use/non-use of the project method at the time of the enquiry.

Of the teachers using project work with their C.S.E. pupils, almost half (49.7%) agreed that 'Project work increases pupils' interest in the subject'. 39.7% of the respondents in this category were less certain of the part played by project work in increasing pupils' interest although only sixteen (10.0%) of the teachers actually disagreed with the statement. This weighting of opinion was found to be uniformly held, irrespective of the type of project work being implemented. In contrast, the 'Non-users' of project work showed marked scepticism; 49.5% expressed definite uncertainty about the proposed relationship between project work and pupil interest and

THE DEVELOPMENT OF SOCIO-ATTITUDINAL SKILLS THROUGH PROJECT WORK

* Significance level $p < 0.05$
*** Significance level $p < 0.001$

only 29.9% felt able to support it, a finding that was statistically highly significant ($p < 0.001$).

In response to item 7 on the questionnaire, 46.3% of the 'Users' of project work agreed that 'Pupils gain self-confidence through project work' and again the same pattern of response was made regardless of the type of project work being employed. In the 'Non-user' group, only 32.2% of the teachers agreed with the statement and although the difference in response between the two sets of teachers was not as marked as in the first item, the finding was nonetheless statistically significant ($p < 0.05$).

Item 14 of the questionnaire prompted a much wider range of responses from the 'Users' and 'Non-users' of project work. The 'Users' tended in general to support the notion that 'Pupils learn self-discipline through project work'; 44.4% of them agreed with the statement as compared with only 17.6% of the 'Non-users'. Such a marked difference in perspective between those teachers using and those not using the project method was again highly significant ($p < 0.001$).

Thus, those teachers undertaking project work with C.S.E. pupils at the time of the enquiry held far more favourable impressions of its usefulness, and on the basis of information volunteered by these teachers in relation to the acquisition of skills and the development of attitudes, it is clear that a variety of attributes - which might collectively be defined as socio-attitudinal skills - were envisaged, ranging from increased awareness, appreciation and interest in the subject to improved self-confidence, discipline and determination.

5.7. Combined/Related Skills

In Section 5.3.1., certain issues were raised which illustrated the restrictive effects of pupil literacy on achievement in project work. Pupils lacking language and literacy skills were perceived by a number of teachers as severely disadvantaged under the project method of learning. Their inability to read and extract information effectively and to structure reports competently had tended to result in 'indiscriminate copying from text-books' (075, Physics) accompanied by little real understanding. Such perceptions appear valid and arguments accurate when one considers the report-type project in which 'the pupils collect information from books, journals and other secondary sources and then write an account in the form of a booklet, folder or the like' (see Chapter 3). However, the opinion that some pupils are handicapped in project work because of their low levels of literacy represents only one point of view. Commenting on this issue, some of the teachers responding to the questionnaire clearly viewed the project method somewhat differently.

For example, in response to item 12(b) of the questionnaire (see page 173, Table 5.5.), 15.6% of the teachers using the project method indicated that more general skills, encapsulating a combination of related abilities, were developed in pupils as a result of undertaking the project method of working. Most of the skills identified in this context related to the improvement in pupils' powers of communication, in their ability to handle language effectively and in their use of both the written and spoken word to

express their ideas accurately and concisely. Thus, rather than handicapping them, project work was seen by some teachers as playing a useful part in developing pupils' understanding and use of English by providing extended opportunity for reading, conversing and reporting.

These two conflicting viewpoints should not however be regarded as dichotomous, representing two opposing views, since to some extent both exist simultaneously given the varying conditions under which project work is undertaken and the varying degrees of support and guidance available to the pupils involved.

Several respondents, for instance, interpreted project work as a search for information involving the use of a library and all its associated procedures:

They have to use a library and books to find information.
(097, Biology)

... an ability just to go to the library and look up information is of value.
(305, Chemistry)

Project work is also useful in teaching children the procedures of reference in a library.
(452, Biology)

These teachers therefore saw value in the straight reading/reporting type of project exercise, seeing it as making a positive contribution to the acquisition of literacy skills.

In addition, a few teachers commented on the desirability of liaison with external agencies. For example:

In project work there are often chances for tie-ups with local industry ... It can allow staff and pupils to work in co-operation.
(200, Chemistry)

'Writing letters to firms/organisations for information' (006, Biology) and arranging visits and interviews were also considered to be valuable extensions of the project method

by providing opportunities for reading, writing, conversing, recording and reporting. All of these activities, if carefully supervised, were thought to assist in the development of communication skills, both literary and linguistic, in pupils.

Project work as a means of developing communication skills in pupils was investigated further in Section C of the questionnaire, item 6 of which assessed the level of agreement with the statement 'Communication skills are developed through project work'. The teachers' response to this item is summarised in Table 5.10., overleaf.

The results show that of those teachers using the project method with C.S.E. pupils, 50.0% agreed with this statement, just over one third (36.3%) were uncertain and only 12.5% of the respondents in the group disagreed with it. No significant differences between the responses of the 'Users' and those of the 'Non-users' were found although among the 'Non-user' group of teachers the level of agreement with the statement was slightly lower (42.5%) and the levels of uncertainty and disagreement were slightly higher (38.5% and 16.9% respectively). It was however interesting to find that in the 'User' category, those teachers using project work of a 'non-reporting' type indicated a greater degree of support for the development of communication skills through project work than those using a 'report-type' project approach. (54.4% of those using a 'non-reporting' type of approach agreed with the statement compared to only 44.3% of those using reporting exercises.) Thus, it seems reasonable to

TABLE 5.10.

THE DEVELOPMENT OF SKILLS OF COMMUNICATION AND PRESENTATION
THROUGH PROJECT WORK

%age FREQUENCY OF RESPONSE TO STATEMENTS					
		Teachers using the Project Method			Teachers not using the Project Method (n = 301)
		Report-type (n = 70)	Non-report-type (n = 90)	All Types (n = 160)	
Communication skills are developed through project work (Item 6)	Agree	44.3	54.4	50.0	42.5
	Uncertain	42.9	31.1	36.3	38.5
	Disagree	12.9	12.2	12.5	16.9
Project work ensures pupils take care over the presentation of their work (Item 10)	Agree	44.3	30.0	36.3	25.2
	Uncertain	25.7	28.9	27.5	28.2
	Disagree	30.0	40.0	35.6	44.9
					All Respondents (n = 461)
					45.1
					37.7
					15.4
					29.1
					28.0
					41.6

conclude that project work which involves 'gathering information through experimentation and/or observation', supported on occasions by material from the literature (see Chapter 3), and presenting it in the form of a simple research paper may be a valuable strategy for developing a pupil's skills in communication.

The importance of project work in this respect was acknowledged not only through the questionnaires but also during the course of the interviews, arising from the discussion of the presentation of material for assessment. One teacher of Biology put forward the following case:

Projects can demonstrate communication skills ... The manner and type of presentation is important; projects should make good use of different forms to illustrate a point. For instance, the appropriate use of charts, graphs, histograms, tables, etc. to make the work intelligible, to communicate different points to the reader are valid points to look for in assessment.
(Personal communication, Leicestershire, January 1979)

Similarly, a Chief Examiner for C.S.E. science⁽¹⁾ remarked:

Ideally, projects should provide evidence of these types of communication skills ... This is what the Examiner should be looking for ...
(Personal communication, Northamptonshire, November 1978)

In this context, communication skills can be seen to involve a combination of related abilities. Firstly, the pupils need to find out how and where to seek information. Secondly, having established the source of their material, they must select that which is relevant to their purpose and record it. Thirdly, they have to structure their material and devise the means of presenting it in a comprehensive, logical fashion. Hence, viewed in this light, communication skills as evidenced by the clear and coherent presentation of information would seem to be an important consideration in the assessment of project work at C.S.E. level. However,

the leading question as to whether project work actually encourages pupils to take care over the presentation of work in this way is possibly more fraught.

It is clear that for some pupils project work comes as a form of light relief from the rigour of more orthodox science lessons. For these pupils, the appeal of the project approach lies in the unique opportunity it provides for artistic expression, the production of an elaborate report composed of neatly mounted pictures, carefully stencilled title pages and perfectly reproduced diagrams being seen as the real challenge. In this sense, project work can provide an incentive, encouraging pupils to take greater care. But if, on the other hand, 'presentation' of a project stands for more than just its visual appearance; if, as suggested earlier, it refers to other aspects such as the clear formulation of ideas, the structuring of arguments and the development of a concise, logical framework, then the rôle of project work in promoting such skills is more questionable.

These different interpretations of the term 'presentation of work' are reflected to some extent in the teachers' replies to item 10, Section C of the questionnaire, which examined the level of agreement with the statement 'Project work ensures pupils take care over the presentation of their work' (see Table 5.10).

Analysis of the response to this item showed that only 29.1% of the teachers agreed with the statement whilst 41.6% indicated clear disagreement with it. Although no statistically significant differences were found between the responses of teachers using the different types of

project work and those not using the project approach, the respondents in the latter category, as expected, were slightly less favourable in their appraisal of this aspect of project work, whilst those teachers using project work at the time of the enquiry viewed it in a marginally more positive light. This was especially true of those teachers implementing a report-type strategy, 44.3% of whom agreed that project work was a means of ensuring that pupils took care over the presentation of their work.

On the question of presentation of work, it was suggested that:

Some pupils (girls, perhaps, more than boys) just like presenting material.
(Personal communication, Leicestershire, January 1979)

and, in agreement with earlier reports, it was observed that:

... girls tackle projects more thoroughly than boys. The best are produced by the able girls and the worst by the less able boys. Perhaps, this is because the projects in this course (Human Biology Mode III) are mainly collation and reporting with some interpretation of survey data rather than direct practical work. (157, Biology)

Thus, thoroughness and care in the presentation of work would seem to be traits more associated with girls and project work than boys, and again there emerges the suggestion that girls are better able to cope with the 'writing up' element of project work rather than the practical, investigative aspects in which they lack confidence (see Chapter 4, Section 4.3.2. and Section 5.6.1. of this chapter).

Considering this question further, it also seems that some teachers regarded the production of a project report, neatly set out and painstakingly undertaken as a worthy

achievement for those pupils who may not be sufficiently science-oriented to gain much benefit from exposure to the aims and practices of a more traditional science course. From additional comments taken from the questionnaires and interviews, it is clear that some respondents felt that project work involving the completion of a written report encouraged pupils, especially girls, to be industrious and that diligence of this kind should be rewarded. In support of this line of reasoning, one teacher of Chemistry put forward the following argument:

I would very much like project work to be included formally in our syllabus. The fourth years come here quite keen and it is a way of keeping the interest going. It seems, perhaps especially in Chemistry, that there are pupils of low ability (concerning the theory) but who are hardworkers (the 'sloggers'). Surely, a C.S.E. should be catering for the 'more willing than bright' group also.
(305, Chemistry)

Scrutiny of the 1980 E.M.R.E.B. syllabuses for the four main science subjects does not however reveal any official support for this point of view, although numerous references to literary and communication skills are found in the listings of the aims and objectives of the C.S.E. courses. Further analysis of the weighting given to these types of skills (as measured by the maximum percentage marks attainable in each subject area) indicates that literacy and communication skills are awarded greatest emphasis in Biology and least in Chemistry, and that linguistic skills receive little attention except in General Science which provides facility for oral assessment. Nevertheless, the importance of reading, recording and reporting is made clear, although it should perhaps be stressed that the clarity, accuracy, relevance and coherence of the material being

presented carry probably the greatest merit. Clearly, it could be argued that the presentation of work according to these criteria cannot be divorced from a high standard of neatness and some degree of diligence, but even if this is so there still remains no formal acknowledgement of the importance of these characteristics in the official C.S.E. documents.

In summarising the issues presented here, a number of important points arise concerning the rôle of project work in the development of those more general skills which would seem, on discussion, to combine a range of associated abilities.

It has been suggested, for instance, that project work rather than impairing the achievement of pupils in the lower bands of literacy may instead enhance their performance by encouraging them to seek information through a variety of channels and to convey that information in a variety of forms. Furthermore, it has been argued that by allowing pupils to read around their topics and to gather material from a number of different sources, they are more able to extend their vocabulary, to learn the subtlety of language and, perhaps, to acquire the means of expressing themselves more accurately and economically. In addition, from some of the respondents' comments, it would seem that project work - whether undertaken in the school laboratory, the library or in co-operation with outside organisations - prompts pupils to verbalise their experiences, to discuss their ideas and to formulate their arguments in a mature, meaningful way.

Clearly, if project work can function along these lines, it follows that by pursuing such a strategy pupils are not only able to acquire the technique of good communication but can also (as a direct result of improving their language skills) undergo some personal growth in confidence and cognitive ability. Indeed, the relatively high level of support among the respondents for project work as a means of developing communication skills gives additional weight to these arguments. Little support has however been found for the suggestion that exposure to material, presented in a variety of forms, encourages pupils to give more thought to the presentation of their own work although many respondents (especially those implementing a 'report-type' project approach) have recognised that certain pupils take a great deal of care over the presentation of their projects.

Thus, although the framework for project work set out above may be attractive, a review of the evidence as a whole suggests that pupil development in these areas may be very limited. Progress must undoubtedly be hampered to some extent by the conditions operating inside the schools. For example, unfavourable staff/pupil ratios, restrictive timetabling procedures and lack of tutorial periods can all adversely affect the acquisition of skills by pupils but, clearly, under such conditions, the damage must be greatest in those skill areas (such as communication) which by definition necessitate a high degree of teacher/pupil interaction.

5.8. The Ability of Pupils to Benefit from Project Work

Any question that touches upon the subject of equality of educational opportunity stirs up feelings of concern among those involved in education. From their practical day-to-day experience, teachers in particular are sensitive to the issue of fair play, being more aware than most of the inadequacies of themselves and their situations. However, although the research findings are confused and contradictory, there has been widespread acceptance among the theorists that educational attainment is largely independent of the type of schooling a child receives compared to the overwhelming influence of other factors such as the home environment (Douglas, 1964; Coleman, 1966; Plowden H.M.S.O. 1967; Bernstein, 1970), the genetic endowment (Jensen 1969) and the economic and political structure of society and the mutual reinforcement of class sub-culture and social class biases and expectations (Bowles and Gintis, 1976; Halsey, et al. 1980). Large scale studies have been agreed that improvement in the quality of education cannot make everyone equal i.e. it cannot compensate totally for those 'other factors' which undoubtedly influence pupils' ability to profit from the educational opportunities open to them.

Unfortunately, the picture is perhaps not as clear-cut as some writers would seem to imply. The debate about the importance of schools as an educational force continues and some of the negative impressions created by earlier research are once again coming into the discussions. There has, for instance, been some suggestion from work carried out in Britain and the United States that school

effects may be somewhat greater in subjects such as mathematics and science where most of the teaching occurs at school (Coleman, 1975; Brimer et al., 1977). In addition, a more recent longitudinal study carried out by Rutter et al. (1979), which has investigated in detail the importance of secondary schools and their effects on children, has asserted that schools do have an impact on pupils' development and the overall standards of attainment. From the findings it has been suggested that school differences are not just a reflection of intake patterns and that much of the effects of secondary schools are linked with their function as social organisations. Regrettably, the Rutter study omitted to consider the curriculum, the details of subject teaching or the particular styles of management within the schools. Since teaching is the central feature of schools, differentiating them from other types of institution, an analysis of how classroom teaching relates to the other factors which pupils bring to school with them would clearly have been useful.

Given the extent and importance of research into the effects of schooling on pupil achievement and the confusion over what 'other factors' actually influence pupil attainment, it seems both surprising and unfortunate that very little work appears to have been undertaken to investigate more specifically the ways in which the characteristics pupils bring with them into the classroom may interact with the school policies and practices to produce differential outcomes. Perhaps what is most surprising is that many influential studies seem to have assumed that the effect of teaching method is constant for all types of pupils.

Hence, in the current investigation of project work as a teaching/learning strategy it seemed imperative that some reference should be made to those pupil characteristics which might significantly affect the way in which pupils respond to this type of approach and thus influence the benefits that could be gained from it. In view of the largely independent nature of project work and the degree of personal responsibility and forward planning it frequently required, pupil ability stood out as an especially relevant characteristic to this enquiry. For these reasons, item 13 was included in Section A of the questionnaire. The two parts of this item sought to examine the importance of pupil ability in relation to the beneficial outcomes that could be gained from the project approach as perceived by those teachers actually using the project strategy. As might be expected, the item prompted a high level of response, the results of which are summarised in Tables 5.11a and b, overleaf.

In response to the first part of this item, the majority of respondents (72.5%) indicated that in their view the benefits to be derived from project work did vary according to the ability level of the pupil (see Table 10a). Only 6.9% of the teachers responded to the contrary. These teachers (eleven in all) did not consider the ability of the pupil to be a significant factor in determining the benefits to be gained from the project approach. Because of the widely differing forms of project work being implemented by the respondents at the time of the enquiry (e.g. the 'Report' type, the 'Discovery' type, the 'Combination' type), it was envisaged that the teachers

TABLE 5.11a.

PUPIL ABILITY AS A VARIABLE AFFECTING THE BENEFITS TO BE DERIVED FROM PROJECT WORK

	FREQUENCY OF RESPONSE AMONG USERS OF PROJECT WORK		
	Report Type (n = 70)	Non-Report Type (n = 90)	All Types (n = 160)
Yes, the benefits to be derived from project work do vary according to the ability level of the pupil	50 (71.4%)	66 (73.3%)	116 (72.5%)
Uncertain	12 (17.1%)	18 (20.0%)	30 (18.8%)
No, the benefits to be derived from project work do not vary according to the ability level of the pupil	7 (10.0%)	4 (4.4%)	11 (6.9%)
No response	1 (1.4%)	2 (2.2%)	3 (1.9%)

TABLE 5.11b.

THE BENEFIT TO BE GAINED FROM PROJECT WORK BY PUPILS OF
DIFFERING LEVELS OF ABILITY - WHO GAINS MOST?

	FREQUENCY OF RESPONSE AMONG USERS OF PROJECT WORK			
	No. and %age of those applicable - Report Type (n = 50)*	No. and %age of those applicable - Non-Report Type (n = 66)*	No. and %age of those applicable - all types (n = 116)*	%age of Total Sampled (n = 160)
The pupil of <u>average</u> ability gains most benefit	14 (28.0)	17 (25.8)	31 (26.7)	19.4
The pupil of <u>above</u> average ability gains most benefit	33 (66.0)	41 (62.1)	74 (63.8)	46.3
The pupil of <u>lower</u> than average ability gains most benefit	3 (6.0)	5 (7.6)	8 (6.9)	5.0
Other responses	-	3 (4.5)	3 (2.6)	1.9
Not applicable	20 -	24 -	44 -	27.5%

* See Table 5.11a.

might perceive the relative benefits of the project method in different ways according to their own personal experiences of it. Surprisingly, very little difference was found between the perspectives of those using the 'report-type' project work and those using the 'non-report type'. There was, however, all-round uneasiness about giving just one of the three responses provided under item 13(a); some respondents felt that a single response was too categorical and possibly misleading. Consequently, although in the large majority of cases the item was completed satisfactorily, additional comments expounding their views were frequently included. These comments together with data collected under item 13(b) of the questionnaire proved valuable in providing further insight into the teachers' perspectives of the usefulness of project work for different types of pupil.

Under item 13(b) those teachers who had indicated previously that the benefits to be derived from project work did vary according to the ability level of the pupil were asked to specify which level gained most benefit. Of the 116 respondents to whom this item applied, 74 (63.8%) indicated that pupils of above average ability benefited most from a project work strategy. This represented 46.3% of the total number of teachers sampled (see Table 5.11b.). Again, very little difference was found between the impressions of those teachers using the 'report-type' approach and those using the 'non-report type'.

It was suggested that pupils of above average ability gained most benefit from project work because they were, in general, better equipped to take advantage of the freedom

to explore new avenues of enquiry, better able to plan work well in advance and to select those pathways relevant to their study, and more skilled at reasoning, deduction and structuring arguments. All these abilities, it was argued, were clearly conducive to the production of worthwhile projects. Thus, if pupils possessed these skills prior to the commencement of a project they had a greater chance of achieving something of merit at the end of it. In accordance with this line of reasoning, project work for the average and below average pupil was seen to produce less favourable outcomes as reflected in the following comments:

Project work can easily just become for these (the less able) a mechanical performing of ideas suggested by others. (274, Chemistry)

It seems that the demands of a 'proper project' are incompatible with the mental abilities of the average C.S.E. pupil. (182, Chemistry)

On the other hand, some respondents recognised the value of project work for the less able pupil:

I have particularly been impressed by the understanding achieved by pupils of less than average ability and the enthusiasm that was generated by the project work. (220, Engineering Science)

Low ability, below average pupils find project work difficult but this doesn't make it any less valuable. (005, Chemistry)

and it was stressed that,

The less able child can use project work effectively to his/her own level of ability ... Although project work is difficult to start with, it can progress at the individual child's own pace so that in a mixed ability class the slow learners are not always left behind. (381, Biology)

Basically, the strength of project work is that it motivates low ability C.S.E. pupils. (106, Chemistry)

In contrast, however, a number of teachers were clearly reluctant to generalise about pupils' projects and the benefits to be accrued from them. The following comments aptly illustrate the spread of opinion on this topic:

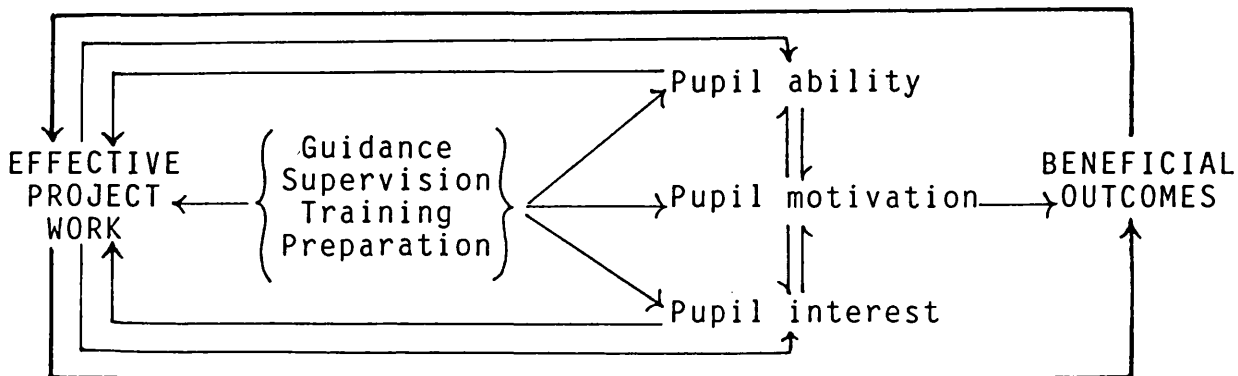
There appears to be an enormous variation in the ability of pupils to benefit from project work. The actual value derived by pupils from project work is more related to motivation than ability.
(263, Chemistry)

There is an enormous difference between intended benefits and actual benefits, especially with all the factors in project work. With the syllabuses and assessment as it is, I do not feel my pupils get the benefit they could if I could structure the work to their exact needs re - ability etc., and if there was time for more guidance.
(329, Biology)

Thus, a review of the comments made in response to item 13 of the questionnaire highlights some degree of circularity to the teachers' perspectives, and indicates that the relationship between pupil ability and effective project work is complex, being complicated further by the important factor of motivation. Figure 5(i) is an attempt to illustrate some of the complexities of the situation as perceived by the respondents.

FIGURE 5(i)

A DIAGRAMMATIC REPRESENTATION OF THE POSSIBLE RELATIONSHIP
BETWEEN PUPIL ABILITY AND EFFECTIVE PROJECT WORK



Out of this complex network, three separate arguments emerge:

- i. Some maintain that if, at the outset, pupils possess certain abilities they are more likely to produce effective project work. Project work that is effective, by definition, improves pupils' ability in certain skills and heightens their interest and motivation in the subject. In this way, more able pupils, by possessing appropriate skills at the start, have an initial advantage over the less able, an advantage that stands them in better stead to achieve greater benefits from the project approach.
- ii. Others assert that pupil interest in the subject is more relevant than pupil ability. If pupils have an initial interest in the topic, they are more likely to be motivated and to put greater effort into their project work. By making an increased effort, these pupils stand a greater chance of producing some useful projects and acquiring worthwhile skills. In this way, pupils who are genuinely interested gain greater benefit from project work.
- iii. In contrast, others stress that if project work is properly conducted, if pupils are given clear guidelines and provided with adequate preparation and training beforehand, then the project strategy is valuable in promoting the acquisition and development of certain skills and attributes in all pupils regardless of their ability level. From this perspective, project work can give every pupil some sense of success; it can awaken interest and motivation, and thereby be of benefit to all types of pupil.

Hence, from these three sets of arguments, it can be seen that any evaluation of the 'cause and effect' of successful project work inevitably involves complex lines of reasoning. Whether projects require a high level of ability, interest and motivation on the part of the pupil or whether they generate these attributes probably represents, as one respondents coined, "a 'chicken-and-egg' type situation" (433, Chemistry). However, although it may not be possible to untangle fully the relationship between project work and pupil variables such as ability, interest and motivation, there seems little doubt that the presence of these variables combined with carefully organised, well-managed project work meets with the greatest degree of success.

So far in the discussion of the benefits to be gained from a project approach, the focus has been on the acquisition of specific skills and the development of more favourable attitudes towards science and learning. However, a few teachers felt it necessary to elaborate on what they saw as this rather restricted view of the benefits of project work. Developing some of the arguments raised earlier (see Section 5.7., Combined/Related Skills), these respondents commented on the value of project work as an assessment tool for those less able/less science-oriented pupils who may not have achieved any measure of success under the more conventional examination methods. The comments which follow aptly illustrate this point of view:

The project enables pupils of average and less than average ability to produce work which can lift their final grade if they are willing to work at it. This may not be possible for them in any other way (since they may have difficulty with examinations)
(228, Biology)

General Science tends to be chosen by the less able children, and a Mode III type syllabus including topic work seems to give them at least something immediate to be assessed rather than the idea of an exam some time in the future.

(242, General Science)

Thus, it can be seen that some teachers extended their interpretation of the 'benefits of project work' to include the extrinsic reward of examination success and certification it offered to pupils who may not be among the brightest and who may not perform well in the more formal examination situations but who are prepared to work hard during the term to produce a project worthy of assessment. The attitude with which pupils approach their project work is the subject of the next section.

5.9. The Attitudes of Pupils of Varying Ability towards Project Work

In the previous section certain questions were posed concerning the importance of pupil attitude in determining the benefits to be gained from project work by pupils studying science at C.S.E. level. Much of the discussion, although interesting, was largely subjective being based on ad hoc comments and observations volunteered by the respondents in a variety of contexts. Any attempt to quantify pupil attitude in this way must clearly be open to criticism because of the ambiguity and inconsistency in the teachers' own definitions of the term 'attitude'. For this reason, a more carefully structured framework for discussion was set up under item 10, Section A of the questionnaire. Here, three simple categories of pupil attitude were defined using clear examples in each case of the pupils' general approach

to project work. The definitions went as follows:

<u>Definitely enthusiastic:</u>	Pupils are keen to begin their projects, they work well, enjoy the enterprise and are not easily distracted. Their project work tends to exceed the specified requirements of the course.
<u>Indifferent:</u>	Pupils are detached in their approach; they accept project work as part of the course but tend to fulfil only the basic requirements. They display no real enthusiasm or interest.
<u>Definitely unenthusiastic:</u>	Pupils show obvious reluctance to undertake the project work. They show no interest, are easily distracted and tend to waste a lot of time. Pupils often need to be cajoled into fulfilling even the most basic requirements of the course.

Using these three definitions as a basis for their judgements, the teachers were asked to rate the attitude of pupils of (a) average ability, (b) above average ability, and (c) below average ability towards project work. The results are summarised in Table 5.12 and Figure 5(ii), pp.244/5.

The majority of teachers (73.1%) rated pupils of above average ability as 'definitely enthusiastic' towards project work and, in support of earlier findings, it was again acknowledged that such enthusiasm was most probably attributable to the fact that brighter pupils - being in possession of the appropriate skills - had the ability to treat project material in a more organised manner and thus gain more benefit from it. Furthermore, by achieving a greater sense of success through project work, it was suggested that the resultant feedback for these pupils would provide them with additional incentive and enthusiasm for the work in hand.

This hypothesis is particularly interesting when viewed alongside the findings for the other two ability levels. Pupils of average ability were rated as 'definitely enthusiastic' by only 21.3% of the respondents, the majority of them in contrast regarding these pupils as largely 'indifferent' to the project approach. Ten teachers (6.3%) saw them as 'definitely enthusiastic'.

Pupils of below average ability were perceived as holding still less favourable attitudes towards project work. 43.1% of the respondents indicated that in their opinion the less able pupils were generally 'indifferent' and 40.6% rated them as 'definitely unenthusiastic' about project work. It appeared that this negative attitude was generally manifest in the pupils' obvious reluctance to work, their lack of interest, their time-wasting and their inability to concentrate.

For clarity, the relative ratings awarded by the teachers to pupils in the three ability levels are represented diagrammatically in Figure 5(ii).

From these bar charts, it is clear that the teachers saw their more able C.S.E. pupils as generally enthusiastic in their approach to project work. It was agreed that these pupils were usually keen to begin their projects, worked with commitment and thoroughness and, on the whole, appeared to enjoy the exercise. In contrast, for the reasons set out above, less able pupils (those of below average ability) were perceived as unenthusiastic project workers.

These findings are in good agreement with earlier studies relating to pupils' attitudes towards learning and

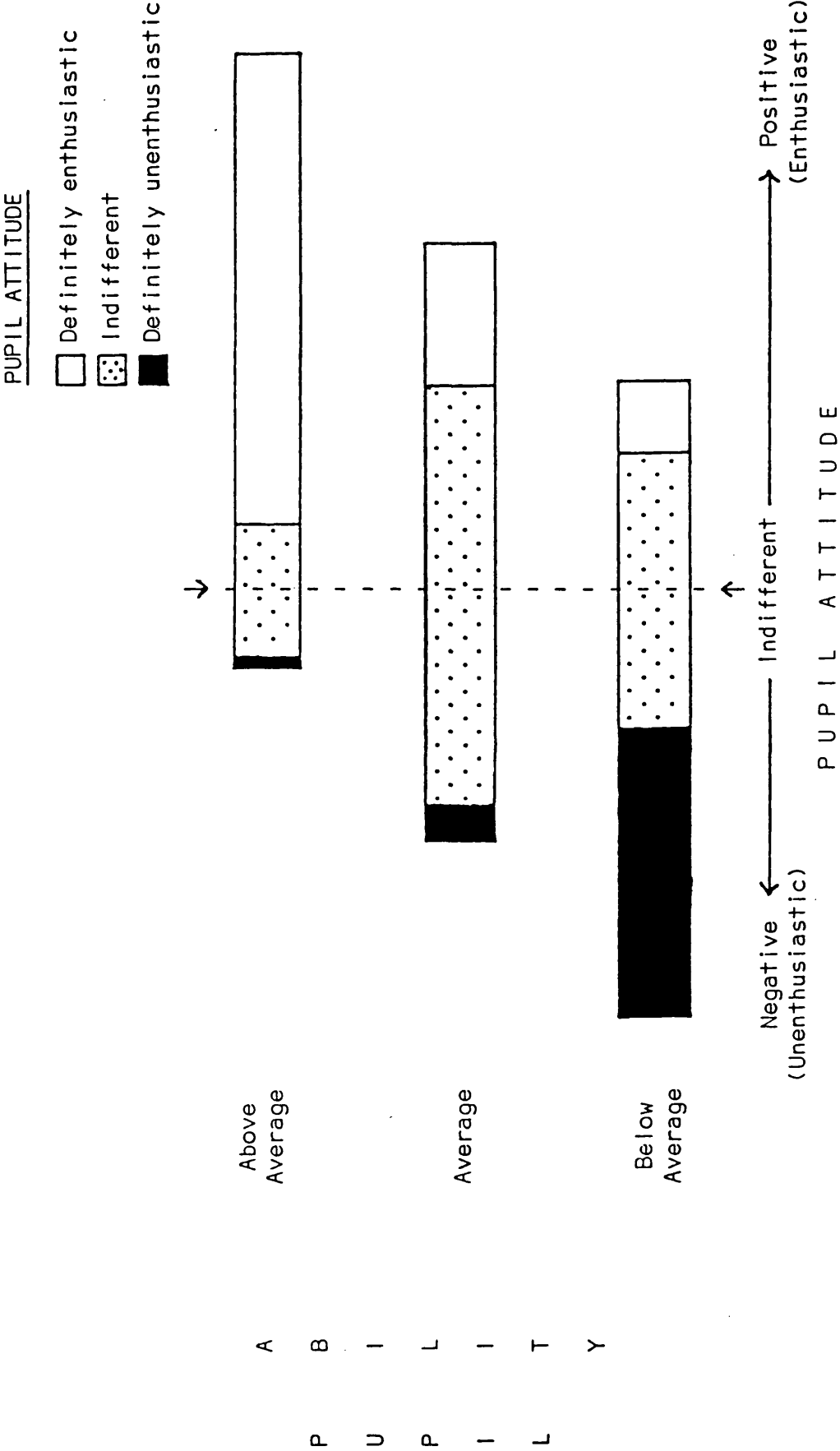
TABLE 5.12.

THE ATTITUDES OF PUPILS OF VARYING ABILITY TOWARDS PROJECT WORK
(AS PERCEIVED BY THE 'USERS' OF PROJECT WORK IN C.S.E. SCIENCE)

PUPIL ATTITUDE	FREQUENCY OF RESPONSE (n = 160)		
	ABILITY OF PUPILS		
	Below Average	Average	Above Average
Definitely enthusiastic	17 (10.6%)	34 (21.3%)	117 (73.1%)
Indifferent	69 (43.1%)	107 (66.9%)	32 (20.0%)
Definitely unenthusiastic	65 (40.6%)	10 (6.3%)	3 (1.9%)
Other Responses	2 (1.3%)	4 (2.5%)	2 (1.3%)
Not answered	7 (4.4%)	5 (3.1%)	6 (3.8%)

FIGURE 5(ii)

BAR CHART ILLUSTRATING TEACHER OPINION ABOUT THE ATTITUDES OF
PUPILS OF VARYING ABILITY TOWARDS PROJECT WORK



science. Cronbach and Snow (1969) have, for instance, concluded that instructional treatments which place more responsibility on the student for organising work are responded to positively by the more able students while less able students tend to be unable to function in such a relatively unrestrictive way. Observations made by Reid and Booth (1970, 1971) during the 1968 - 71 trials of individual learning in Nuffield Biology courses showed a similar pattern. In their study, comparison of the attitudes held by pupils in conventional and experimental classes showed that less able pupils working individually developed a marked and increasing dislike of both the subject and the teaching strategy.

It can be seen then that the discussion of pupil attitude in relation to pupil ability is especially interesting, wide-ranging in its interpretations and implications. The initial analysis of teachers' ratings implies a clear link between pupil ability and attitude to project work, the link between the two variables being reflected in the overt tendency for brighter pupils to be associated with more favourable attitudes and for the not so bright to be associated with less favourable ones. However, if the views expressed on the questionnaire and during the interviews are taken into consideration, it seems likely that the association between ability and attitude - which is without doubt interesting in a generalised context - may be misleading if applied to individual pupils. Furthermore, it should perhaps also be emphasised that there is no evidence to support any causal connection between the two

variables since although the data might seem to imply that high ability leads to greater enthusiasm for project work, it is also possible that greater enthusiasm is the cause of (or at least precedes) a high ability rating. Conversely, ability and attitudes may result from a complex interaction of variables.

With these thoughts in mind, it is clearly important that the findings should be interpreted with care. It is hoped that the comments and observations cited in the following pages will help the reader gain a more balanced view of the differing perspectives.

Several participants in the research study were obviously reluctant to support what they saw as 'sweeping generalisations' made by many of their colleagues on the question of pupil attitude vis à vis ability. These respondents were unable to accept that pupil attitude could be directly related to pupil ability, being of the opinion that:

Pupils have a range of attitudes whatever their ability (or at least that is my experience)
(265, Biology)

and that,

Pupils are individuals and whilst a higher percentage of the less able may be less enthusiastic, it is an over-simplification to bracket pupils together in ability groupings when assessing their enthusiasm.
(200, Chemistry)

Furthermore, in agreement with earlier reports (see Sections 5.6.1. and 5.7.) other respondents observed that:

The attitude of pupils to project work is often better among girls than boys ... often it is unrelated to ability level.
(036, General Science)

Girls, even of below average ability, on the whole tend to be more easily motivated into working for their projects than boys, and their standard of presentation is generally much higher. (040, General Science)

In addition, one teacher, critical of the questionnaire item, argued:

The questions don't really allow for the variation in groups from year to year. I believe that the ability of the pupil is not related to their enthusiasm for projects. Very able pupils may have little interest while the least able may have a lot ... Group attitude also plays an important part in the pupils' attitude to project work. (421, General Science)

Without doubt these comments and observations make a valuable contribution to our understanding of the variability of pupil's attitudes towards project work. Many of the views expressed are perhaps especially important because they are comparable to and receive support from a number of earlier research studies in related areas.

By way of illustration, Rowe (1959) as Head of a secondary modern school (which, at that time, was implementing a progressive and liberal approach to educating 'average' pupils) has reported that 'the average child has an amazing store of energy and ability commonly dammed off from his school life, but capable of being channelled into it with quite astonishing and unbelievable effect upon his growth as a person' (p.17). Similarly, Cowan (1969) has noted significantly improved attitudes and behaviours among secondary modern boys undertaking project work in history, whilst Kaye and Rogers (1968) in extolling the virtues of group project work, have denied the need for constant supervision of pupils and its associated system of rewards and punishment. In their thesis, they reject

the notion that pupils only learn when forced to do so by fear, trickery or cajolery but maintain that, given the opportunity, 'everybody wants to know more' (p.7.).

From these above named sources, there emerges therefore the suggestion that under the right conditions, favourable attitudes towards school work can be appreciable in pupils of average ability and below but that project work as a means of promoting such attitudes has not been fully effective since the majority of less able pupils are still seen as generally indifferent or unenthusiastic in the project situation. However, the indication by some (10.6%) of the teachers in this study that pupils in the lower ability bracket are able to generate and sustain enthusiasm for project work would seem to imply, as suggested earlier, that any relationship which may exist between the variables, ability and attitude, is confounded by a complex of 'other factors'. Thus, the overall picture is probably far less simple than the quantitative data initially suggest. Moreover, in accepting this line of reasoning, it would seem that in order to solve the enigma linking pupil ability and attitude and to answer the question 'what makes pupils enthusiastic about project work', these other factors must be an important line of investigation.

In the discussion of pupil attainment (see Section 5.8.) reference was made to a number of influential studies emphasising the importance of external factors such as the home environment, the genetic endowment, the economic and political structure of society and the differential expectations and biases associated with class sub-cultures.

However, a review of some of the less-well publicised literature concerned more directly with pupils' attitude to learning suggests that a number of additional factors may be significant.

Firstly, at the curricular level, the aims and objectives of project work clearly need to be considered as an important factor in determining the success value of the project method and its appeal to pupils. From earlier studies, it has become evident that goals must be set which are realistic and appropriate for pupils at each ability level. Rowe (1959) has stressed the significance of setting apposite targets for pupils and has indicated that the whole ethos of the school should be shaped and integrated to provide the kinds of meaningful experiences pupils need. Mealings (1963) has also emphasised the importance of developing a well-co-ordinated curriculum. Using the theories of Inhelder and Piaget as his basis, he examined from first principles the working of science problems by children in a normal school setting and has concluded:

It is possible that the loss of interest which is often observed amongst third year pupils results not only from an increase in the mathematical and theoretical content of the course, but also from the abruptness of the transition from a concrete to a formal approach.
(Mealings, 1963, p.206)

Both Rowe and Mealings focussed their discussion on the 'average' secondary pupil, but Jones (1970) has reached similar conclusions with respect to the use of project work at a more advanced, vocational level (see Section 5.1.).

The Schools Council, reporting on Mode III examinations (1976, Bulletin 34) has also placed emphasis on the develop-

ment of courses, custom-made for particular groups of pupils and has acknowledged pupils' favourable reactions to well-designed, relevant syllabuses in terms of improvement in both their behavioural and academic activities. Indeed, flexibility in the development of courses tailor-made to the needs, abilities and interests of pupils has been seen as one of the chief advantages of the Mode III system of examining. At other levels, too, the relationship between the course content (in terms of its objectives, teaching/learning strategies and assessment procedures) and the pupils' attitudes has been well-documented (see for example, Davis 1978, Deere in Macintosh 1978, Armstead 1975, Sutton et al. 1974, Small 1973, Tisher et al. 1972). The important feature to emerge from all of these studies has been the recognition that curricular factors are undoubtedly influential in determining pupils' approach to their work, their enthusiasm or reluctance as the case may be.

Secondly, at a socio-attitudinal level, a number of studies have indicated the importance of good social relations between staff and pupils in promoting favourable attitudes towards learning. For example, an American study (Ryans in Biddle and Ellena 1964) investigating the relationship between teacher behaviour and observed pupil behaviour has provided evidence to indicate that in the elementary school productive pupil behaviour is related to teacher characteristics such as understanding. Similarly, a study of 5th and 6th Grade pupils carried out by Sears (1963) has demonstrated that the opinion of teachers and peers can exert a strong interpersonal influence on the

achievement and psychological development of the less able pupils. Sears has found that for less able pupils, their own self-esteem is associated significantly with the warmth with which they are regarded by their teacher and peers⁽³⁾. Previously, Rowe (1959) had also recognised the importance of warmth and consistent encouragement in nurturing self-confidence in pupils. In addition, a series of observations of the behaviour of 5th Grade teachers and pupils carried out by Perkins (1964) has provided further data to suggest that listening/helping behaviour on the part of the teacher is important in facilitating learning. Moreover, Perkins has shown that pupils who can be classed as 'achievers' engage in significantly more social work with peers than underachievers who tend to withdraw more frequently from learning activities. More specifically in relation to the use of project work in Chemistry, Browning (1967) has suggested that the project strategy by encouraging more discussion between pupils and staff gives added stimulus to the subject and thereby makes it more interesting for both pupils and their teachers.

Thus, a number of studies have recognised the importance of pupil/teacher and pupil/pupil interaction in the development of favourable attitudes towards learning, and for these reasons many have advocated the adoption of teaching strategies which maximize opportunities for constructive social relations, the underlying assumption being that good personal relations build up self-confidence in pupils which, in turn, enable them to assume an appropriate level of responsibility for their work, and to enjoy it.

At a third level, a range of studies have indicated that managerial and organisational aspects of school/college life may be influential in stimulating or stunting pupils' interest in and enthusiasm for different types of science lessons. Kaye and Rogers (1968) have suggested that problems with projects do not arise from unfavourable pupil attitudes as popularly supposed but are the result of poor organisation and management.

Similarly, Small (1973) has identified the administration of projects and the availability of resources as important factors in determining the amount of time and effort spent on project work by students.

Armstead (1975) too has recognised that inadequate provision of resources and facilities can lead to ill-feeling and frustration in both pupils and staff.

On a slightly different theme, the more recent investigation by Rutter et al. (1979) has provided data to suggest that pupil outcomes with respect to behaviour and attainment tend to be better in schools which provide pleasant working conditions although from the analysis it has been concluded that the main source of variation between schools in their effects on children does not lie in physical factors such as buildings and resources but in their functioning as a social organisation. Furthermore, in keeping with the results of earlier studies (see Clegg and Megson 1968, and Bennett 1976), Rutter has suggested that well-prepared, well-conducted, class-orientated lessons, which ensure that pupils are engaged in productive activities, lead to better behaviour in pupils. Conversely, lessons in which the teacher fails to provide

a good model in terms of time-keeping, control and application bring about more unfavourable behavioural outcomes in pupils.

Hence, in the final analysis of pupil attitude in relation to ability, it would appear that although the brighter, more able pupils tend to be viewed as generally more enthusiastic about project work than the less able, the association between ability and attitude - being based on very generalised observations - must clearly be interpreted with caution since there seems little doubt that a number of additional factors can influence pupils' attitude, irrespective of their ability level. The set aims and objectives of the work in hand are certainly important; when they are well-defined and relevant to the needs of the pupils, more favourable attitudes are likely to result. Good working relations would also seem to be important, staff/pupil interaction being a significant factor in promoting pupil enjoyment and enthusiasm for project work, and there is a strong indication too that good classroom practice backed by pleasant working conditions can contribute to the improvement of pupils' attitudes towards learning and science.

NOTES

1. 'Science' here refers to a single science subject; to ensure anonymity for the respondent, the subject has not been named.
2. This issue was raised in a discussion of the value of the 'Science in Society' project at a conference organised by the Association for Science Education at the Centre for Science Education, Chelsea College, London, November 1978.
3. The link between teacher expectation and pupil achievement has been well documented, see for example, Rosenthal and Jacobson 1968, Seaver 1973, Pidgeon 1970, Trow 1968, Marburger 1963.

E.J. AUSTIN

A STUDY OF THE NATURE, MANAGEMENT AND RELATIVE
EFFECTIVENESS OF PUPIL PROJECT WORK IN C.S.E. SCIENCE

The findings reported in this study are based on responses made to a postal questionnaire sent to 98 schools and colleges in the East Midland region and completed by 461 C.S.E. science teachers, 160 of whom were implementing some form of pupil project work as part of their C.S.E. science teaching programme.

Supported by data from a series of formal interviews and school visits, three main types of project approach are identified and different patterns of project organisation and management are discussed. The role of project work in the acquisition of skills and the development of favourable attitudes towards learning and science is also examined.

Arguments for and against the use of project work with the 'average' pupil are subsequently considered alongside a discussion of the attitudes of pupils towards it and their ability to benefit from it.

Out of the discussion emerges the view that the project approach - although often useful as a means of increasing pupils' interest and co-operation - is not essential to the acquisition of skills and attitudes appropriate to the main objectives of existing C.S.E. science courses. The results show that what can be achieved through project work is dependent not only upon the type of project that is undertaken but also upon the planning and preparation put into it, the nature of guidance and the level of supervision given to pupils prior to and during its course, the availability of resources and teachers' confidence in it as a teaching/learning strategy and method of assessment.

E.J. AUSTIN

A STUDY OF THE NATURE, MANAGEMENT AND RELATIVE
EFFECTIVENESS OF PUPIL PROJECT WORK IN C.S.E. SCIENCE

The findings reported in this study are based on responses made to a postal questionnaire sent to 98 schools and colleges in the East Midland region and completed by 461 C.S.E. science teachers, 160 of whom were implementing some form of pupil project work as part of their C.S.E. science teaching programme.

Supported by data from a series of formal interviews and school visits, three main types of project approach are identified and different patterns of project organisation and management are discussed. The role of project work in the acquisition of skills and the development of favourable attitudes towards learning and science is also examined.

Arguments for and against the use of project work with the 'average' pupil are subsequently considered alongside a discussion of the attitudes of pupils towards it and their ability to benefit from it.

Out of the discussion emerges the view that the project approach - although often useful as a means of increasing pupils' interest and co-operation - is not essential to the acquisition of skills and attitudes appropriate to the main objectives of existing C.S.E. science courses. The results show that what can be achieved through project work is dependent not only upon the type of project that is undertaken but also upon the planning and preparation put into it, the nature of guidance and the level of supervision given to pupils prior to and during its course, the availability of resources and teachers' confidence in it as a teaching/learning strategy and method of assessment.

A STUDY OF THE NATURE, MANAGEMENT
AND RELATIVE EFFECTIVENESS OF PUPIL PROJECT WORK
IN C.S.E. SCIENCE

E.J. AUSTIN BSc., MIBiol.

Thesis submitted to the University of Leicester
for the degree of PhD.

October 1983



Thesis

17.4.1984

VOLUME TWO

CHAPTER SIX

SUBJECTS, SCHOOLS AND TEACHER CHARACTERISTICS

The Main Findings relating to the Use of
Project Work in C.S.E. Science Courses

6.1. The Survey Population

6.1.1. Subject Area and the Use of Project Work

6.1.2. Regional Locality and the Use of Project Work

6.2. The Teachers: General Characteristics

6.2.1. Previous Studies

6.2.2. Sex Ratios

6.2.3. Age

6.2.4. Qualifications and Training

6.2.5. Higher Degrees

6.2.6. Experience

(i) Years in Teaching

(ii) Previous Teaching Positions in Secondary
Education

(iii) Prior Experience of C.S.E. Science Teaching

(iv) Employment Outside the Field of Education

6.2.7. Summary

6.3. The Teachers: General Attitudes

6.3.1. Attitudes Towards Teaching

6.3.2. Attitudes Towards Project Work

6.4. Science Teachers: A Typology based on

Cluster Analysis

Notes

6.1. The Survey Population

Of the 609 questionnaires despatched to C.S.E. science teachers in 98 schools and colleges in the East Midland region, 461 completed copies were returned for analysis. A further 19 teachers responded to the communication but 8 of them refused and 11 felt unable to participate in the study. By way of explanation, the main reasons put forward included lack of time, inexperience in teaching C.S.E. science, and change in teaching post, role or responsibility within the school/college. Taking such factors into consideration, this represented an overall response rate of 78.8% and an adjusted response rate of 75.7%. As a measure of co-operation, an indicator of teacher interest and a source of concentrated data, this figure was by all accounts encouraging.

6.1.1. Subject Area and the Use of Project Work

Of those finally responding to the questionnaire, 137 (29.7%) were teachers of C.S.E. Biology, 125 (27.1%) taught C.S.E. Physics, 120 (26.0%) were C.S.E. Chemistry teachers and 64 (13.9%) were teachers of General Science at C.S.E. level. The remaining 15 (3.3%) respondents were responsible for a range of additional C.S.E. science subjects (including Engineering Science, Integrated Science and Rural Science) and their replies to the questionnaire were made in relation to these other subjects.

Further analysis revealed that the greatest percentage response (79.5%) came from the teachers of Chemistry whilst the lowest (62.1%) was observed among General Science teachers (see Table 6.1.). It should be stressed, however, that the figures cited do not take into consideration those teachers who responded to the questionnaire under a different subject area from the one initially associated with them following the preliminary enquiries made to the Heads of Science departments (see Chapter 2, Section 2.2.). Nonetheless, the figures serve as a useful guide to the differing degrees of representation in each of the four main subject fields.

Of the 461 science teachers participating in the survey, only 160 (34.7%) claimed to use (or sometimes use) the project approach as part of their C.S.E. teaching programme. An analysis of the replies by subject area (see Table 6.1.) showed that the incidence of project work at this level was highest in General Science (40 out of 64 i.e. 62.5% made use of the method) and lowest in Physics (only 18 out of the 125 respondents i.e. 14.4% claimed to use it).

These observations are interesting on two accounts. Firstly, it may seem surprising that the teachers of General Science, who purported to use project work more frequently than other subject teachers, failed to respond to the questionnaire as fully as they might, considering the relevance of the research document to their own teaching practices. A reduced response of this kind possibly reflects the 'poor relation' image which this subject continues to carry, and gives some support to the initial premise that teachers of General Science may feel less

TABLE 6.1.

THE QUESTIONNAIRE: TEACHER RESPONSE BY SUBJECT AREA AND USE OF PROJECT WORK

C.S.E. Course/ Subject Area	Questionnaires		Respondents	
	Total No.Despatched (% Distribution)	Total No.Returned Usable (% Response) (Total % Sampled)	Teachers Using PW (% Frequency) (% Sampled)	Teachers Not Using PW (% Frequency) (% Sampled)
Biology	190 (31.2)	137 (72.1) (29.7)	61 (44.5) (38.1)	76 (55.5) (25.2)
Chemistry	151 (24.8)	120 (79.5) (26.0)	36 (30.0) (22.5)	84 (70.0) (27.9)
General Science	103 (16.9)	64 (62.1) (13.9)	40 (62.5) (25.0)	24 (37.5) (8.0)
Physics	165 (27.1)	125 (75.8) (27.1)	18 (14.4) (11.3)	107 (85.6) (35.5)
Engineering Science*	n/a	3	2	1
Integrated Science*	n/a	4 (n/a)	1 (35.7)	3 (64.3)
Rural Science*	n/a	2 (3.3)	1 (3.1)	1 (3.0)
Others*	n/a	6	1	5
TOTALS	609 (100%)	461 (75.7%) (100%)	160 (34.7) (100%)	301 (65.3) (100%)
* Some respondents who, at the time of the enquiry, were no longer involved with the teaching of any one of the four main C.S.E. science subjects completed the questionnaire with reference to their own CSE subject.			Always 136 (29.5)	Sometimes 24 (5.2%)

commitment and involvement in their subject. There is a suggestion that General Science, like other combined and integrated forms, is frequently viewed as a second-rate science subject, being tailored mainly for those pupils in the lower ability range. Furthermore, from the additional data collected from the questionnaires, interviews and visits, it would seem that one teacher is seldom given sole responsibility for the General Science teaching in a school or college. Moreover, it appears that if a teacher is assigned the role of General Science tutor, s/he tends to associate it with low or reduced status within the department. More usually, teachers tend to pick up 'tolerable' oddments of the syllabus and teach them, patched together, in scattered periods throughout the course. Thus, it is perhaps not surprising that some teachers should feel little real commitment to the subject compared to the pure sciences with which they, as specialists, can more 'respectably' associate themselves, and bearing in mind the low status of the subject, it could of course be argued that if these teachers had not used project work to the extent charted, then their response to the investigation might have been lower still.

The second point of interest centres on the Physics respondents since although these teachers tended not to implement the project approach with their C.S.E. groups, their response to the enquiry (75.8%) would seem to suggest that they are not disinterested in the method. On the contrary, the data suggest that Physics teachers are only too willing to express their views about project work and to comment critically on its usefulness in a variety

of contexts. From their response to Section B of the questionnaire, it is also clear that many of them have first-hand working knowledge of project work, having used it with pupils on previous occasions⁽¹⁾. In this respect, their willingness to participate in the survey is especially valuable since their judgements about project work represent informed opinion. The views of these teachers and the reasons behind their decision not to implement the project approach at C.S.E. level are discussed more fully in Chapter 8.

6.1.2. Regional Locality and the Use of Project Work

Analysis of the replies by regional locality revealed certain discrepancies. As shown in Table 6.2. the highest percentage response was obtained from teachers in the central Derbyshire district (82.8%) and the lowest from teachers in the south Lincolnshire area (38.9%). In attempts to explain these differences no significant factors could be identified. From informal discussions with examination officials at the start of the enquiry, it had been suggested that proximity to the Regional Examining Centre might encourage more communication between the Board and the teaching staff, more involvement in alternative forms of teaching and assessment and, hence, an increased readiness to respond to enquiries along these lines. However, no evidence was found to suggest that geographical placement might in itself be influential.

TABLE 6.2.

THE QUESTIONNAIRE: TEACHER RESPONSE BY REGIONAL LOCALITY AND USE OF PROJECT WORK

Regional Locality*	Total no. of Questionnaires despatched (%)	Total no. Returned (% Response)	Percentage Sampled in each locality	Number and Percentage in each locality using (or sometimes using) the Project Method
DERBYSHIRE	C 29 (4.8)	24 (82.8)	5.2	11 (45.8)
	N 49 (8.2)	39 (79.6)	8.5	12 (30.8)
	S 61 (10.1)	40 (65.6)	8.7	12 (30.0)
LEICESTERSHIRE	N 70 (11.6)	52 (74.3)	11.3	20 (38.5)
	S 61 (10.1)	45 (73.8)	9.8	13 (28.9)
LINCOLNSHIRE	N 37 (6.2)	27 (73.0)	5.9	11 (40.7)
	S 18 (3.0)	7 (38.9)	1.5	3 (42.9)
	N 52 (8.7)	36 (69.2)	7.8	9 (25.0)
NORTHANTS.	S 60 (10.0)	43 (71.7)	9.3	9 (20.9)
	E 60 (10.0)	32 (53.3)	6.9	18 (56.3)
NOTTINGHAMSHIRE	N 54 (9.0)	33 (61.1)	7.2	21 (63.6)
	W 44 (7.3)	24 (54.5)	5.2	9 (37.5)
GRIMSBY (S.Humber)	14 (2.3)	11 (78.6)	2.4	1 (9.1)
Not identified	N/A	48 (N/A)	10.4	11 (22.9)
Totals	609 (100%)	461	100%	160 (34.7%)

* Divided into areas: Central (C), North (N), South (S), East (E) and West (W).

Among those teachers completing the postal questionnaire in each locality, the highest incidence of project work (63.6%) was observed in the north Nottinghamshire area. Being built on mining and associated industries as well as having strong manufacturing and agricultural connections, north Nottinghamshire might, it was speculated, provide a rich source of topic material to be utilised in the form of project work for science pupils. Again, however, although these topographical explanations are attractive, no firm evidence to support these claims emerged from this study.

6.2. The Teachers: General Characteristics

6.2.1. Previous Studies

During the course of the literature review, an impressive amount of material on teacher characteristics was collected and although, generally speaking, the earlier studies were largely inconclusive, some interesting relationships emerged. It seemed important therefore to investigate more closely the characteristics of the teachers participating in this study in an attempt to establish whether or not their age, sex, qualifications, experiences and attitudes could be related in any way to their modes of teaching, their use of project work and their treatment of pupils of average ability. However, prior to presenting the research findings on these issues, the aim at this point is to provide the reader with a brief summary of the literature that pre-empted the research.

It seems to be generally assumed that young teachers fresh from teacher-training courses are the most likely sources of innovation in the classroom. Their openness, their enthusiasm and their readiness to put into practice the pedagogic theories learned at college are often thought to be important elements behind the introduction of new strategies, styles and new ways of thinking about teaching, pupils and their learning. It is surprising therefore to discover that much of the literature focussing on the young teacher would seem to reject these popular notions and suggest instead that:

... young teachers frequently express anxiety and frustration as regards their innovatory role in schools ... (Maden in 'Teachers for Tomorrow', edited by K.Calthrop, 1971, p.44)

In her study of 246 young teachers on their entry into teaching, Maden went on to make a number of pertinent observations. Starting her investigation in 1965, she recognised that the requirements of schools were changing and that new classes, new types of pupil and new assessment procedures demanded new methodology and ultimately required more skill and intellectual ability from the teacher. With this perspective in mind, Maden began to question whether young teachers really were the agents of change within the schools. Her analyses of the responses of the young teachers to items on a questionnaire very much reflected the problems associated with being a 'young teacher'. Maden explained how many of their attempts to introduce new philosophies seem to fall on barren ground:

... new ideas should be able to be conveyed and communicated in an intelligible, rational and critical manner. Young teachers all too often falter and eventually retract when asked to explain and justify new ideas and practice ... it is not surprising that some young teachers will intellectually collapse when confronted with an apparently successful 'chalk and talk' teacher. The traditional teacher does not have to justify his case, his apparent success does this for him... (Ibid., p. 38 - 9)

In pursuing this theme, many other writers have described the pressures exerted on young teachers to conform to the more traditional, well-established teaching practices. Partridge, on observing life in a secondary modern school in the Midlands, claimed that in terms of relations between staff:

The younger teachers, whether graduates or college-trained men, have a low status; there is a general deference to experience and seniority, though not always so ... Seldom does a junior member initiate conversation or voice strong opinions other than or contrary to those of his seniors. (Partridge 1968, p.35)

Similarly, Grace in a discussion of role conflict and the teacher cited the findings of Spindler (1963) who showed that:

...there was evidence also that some senior teachers in influential positions in the schools favoured a firm reassertion of all traditional values and standards and regarded with hostility younger teachers who sought any modification of them. (Grace 1972, p. 93)

Moreover, the work of Armstead (1975) cited earlier showed that any conflict of opinion between Chemistry teachers in the same department over the value of project work was not conducive to the smooth operation of it.

Morrison and McIntyre (1969) believed that staff relations functioned in two ways. Firstly, they suggested that pressure to conform could markedly influence teaching

behaviours and relationships with pupils. Secondly, they maintained that consensus or conflict among teachers could have serious repercussions in the class. These effects were demonstrated in a study by Shipman (1967) in which the performances of a sample of students in college were compared with their later performances in schools as teachers. He found that those students who had held very progressive views whilst at college moved in the traditional direction in their first teaching post, to hold views compatible with those of the staff of the school in which they were teaching. This transition was observed in new-comers to both primary and secondary school teaching and has been documented by several other workers⁽²⁾. Some clues as to the cause of such swings in attitude were provided by Perry (1969, as cited in Maden 1971) in a discussion of education for teaching in which he contrasted the open, expressive ethos of the Colleges of Education with the closed, instrumental aims of the average school. He suggested that whereas initial training attempts to preserve an open mind, school 're-training' is concerned to ensure that the new teacher subscribes to specific beliefs, putting him or her under pressure to accept the beliefs and attitudes common to the rest of the staff.

Tisher et al. (1972) saw the problem from a slightly different perspective. With particular reference to science education, it was suggested that the nature of teaching has altered very little and that this serves to indicate that some science teachers are transmitting to younger ones procedures, strategies and curricula that have worked well in the past, with little thought for their relevance today.

It can be seen then that on this issue a number of writers are agreed that in the school situation senior members of staff may profoundly influence both the attitudes and activities of junior teachers and that this influence may work against the introduction of more modern, and possibly more appropriate, ideas about teaching theory and practice. The discussion of teacher age and attitude does not however end here; the questions extend further with several authors offering a range of alternative observations and interpretations.

As early as 1953, Peterson began a study of age, teacher role and institutional setting. He based his investigation on personal interviews with a sample of fifty-six white female high school teachers, aged between 30 and 70, in the urban system. Although the time and location of the study is clearly not fully applicable to the East Midland schools of the 1980's, and in spite of the fact that the sample size was relatively small and consisted solely of women teachers, the study is nonetheless impressive because of its exceptional perception and sensitivity. The comments and observations of the respondents reveal some important points about female teachers of differing ages.

The younger teachers in Peterson's study had been trained at a time when progressive education was very much in vogue and it was on this basis that many of the younger respondents criticised their older colleagues for being rigid disciplinarians, and for having lost (or never having had) an understanding of their students. It was argued that:

... old teachers are not interested in children as children ... they have forgotten what it was like to be young ... they do not carry their share of the extra-curricular work ... (Peterson in 'Contemporary Research on Teacher Effectiveness', edit. by B.J. Biddle and W.J. Ellena, 1964, p. 285)

The older teachers however also acknowledged that their methods and attitudes differed from those of their younger counterparts. One such teacher commented:

I think I am of the older generation of teachers ... you know, the traditional old-fashioned way of teaching . I believe in discipline ... (Ibid., p. 285)

It seemed that the important elements contrasting teachers of different ages centred on their contact with pupils and the types of methods they employed. Peterson, on the strength of his interview data, suggested that:

... beginning in the thirties (i.e. age range), there is a decline in intimacy with students. (Ibid., p. 282)

and showed that:

... the 'generational difference' question was invariably interpreted as calling for a stand on differences in teaching methods ... (p. 285)

Ryans (in Biddle and Ellena 1964) also confirmed the occurrence of age-related characteristics in teachers in a lengthy undertaking based on (i) estimates of teacher behaviour observed in the classroom, (ii) an inventory of estimated teacher characteristics, (iii) background and environmental factors and (iv) observed pupil behaviour. By comparing F-test scores, Ryans showed that teachers 55 years or over fared less well than younger teachers except in relation to (a) patterns of classroom behaviour which could be identified as systematic and business-like, and (b) those teacher characteristics labelled as learning-

centred and traditional. However, the conclusions from Ryans' study remain tentative since it is questionable whether the age differences identified were dependent primarily on changes in the individual teacher as s/he grew older or the result of college training and cultural experience encountered at a different period in time. Perhaps, as Ryans suggests, this might only be reliably determined through longitudinal studies. Nonetheless, in support of Ryans' thesis, it would seem tenable to conclude that 'in the absence of definitive answers ... age must be taken into account whenever teacher characteristics are considered' (Ibid., p. 82).

Another interesting finding to emerge from Ryans' study focussed on the sex of the teacher as a possible variable influencing classroom behaviour. On this issue, Ryans found that differences between the sexes - often insignificant at the elementary level - were pronounced among secondary school teachers. In secondary schools, women generally attained significantly higher scores than men on scales measuring understanding and friendliness, and responsible, business-like, stimulating and imaginative classroom behaviour. More favourable attitudes towards pupils, toward democratic classroom practices and permissive educational viewpoints were also recorded. In contrast, men in secondary schools scored significantly higher than women with respect to emotional stability. Interestingly, a breakdown of the results by subject group indicated that maths/science teachers, with few exceptions, fitted these general findings.

The importance of examining teacher characteristics such as age and sex was emphasised by Peterson in the study cited earlier. He pointed to the lack of consideration given to these factors in the more popular research studies but also drew attention to other areas which seemed to have been neglected; among these were commitment, job satisfaction, and the career perspectives of the teachers.

Thus, from the initial review of work on the age and sex of the teacher as important variables influencing teaching behaviour and attitudes, other issues emerged relating to teacher characteristics that required investigation in the C.S.E. research study.

One such issue, namely the academic status of the teacher, is discussed by Waring (1979) in her book Social Pressures and Curriculum Innovation. She questions the practice of assessing teachers by the quality of their university degree, stressing that a 'good Honours' degree may indicate true cognitive perspective but that, equally, it may also represent little more than the possession of a body of factual knowledge. In Waring's view, 'good Honours' in itself can afford little indication of the breadth of that knowledge or the perspective with which it is viewed. She goes on to emphasise that teaching calibre is not easy to assess, being dependent upon 'the possession and discriminating use of wide-ranging pedagogical skills, knowledge and understanding, but also upon personal characteristics, attitudes and values' (Ibid., p. 56). Thus, although it has often been assumed that given good academic qualifications, with a little experience, teaching ability naturally follows⁽³⁾, Waring maintains that intellectual

ability is relevant to teaching only up to a point. In the assessment of teaching calibre, many other factors need to be taken into consideration.

Several earlier writers have similarly rejected qualifications as an indicator of teaching skill. Rosenshine (1971) reviewing the outcome of current studies on teaching behaviour and student achievement reported that no consistent and significant results could be found in areas of teacher experience, amount of training and knowledge. Furthermore, Yager (1966) investigating the controversial issue of teacher effectiveness, found that although professional preparation and stated philosophies may be similar, teachers were individuals with varied abilities to make courses interesting as judged by their students. And along similar lines, Tuppen (1965) concluded that research would seem to suggest that 'a teacher's effectiveness depends at least as much upon his attitude as upon his length of experience or qualifications.'

The discussion of teacher qualifications and effectiveness is not however new to educationalists. In his article on the contribution of Arthur Smithells F.R.S. to education, Flintham (1977) has described how, much earlier, at the turn of the century, the importance of developing appropriate attitudes in those entering science teaching had been recognised, and how the need for more general rather than specialized knowledge among the new science teachers of the period was an important issue to be raised by Smithells. The translation of Smithells' theory lay ultimately in the training of teachers. In his work, he recognised that the graduates from the universities who entered teaching were

a powerful influence on curriculum reform but that the universities' concern at that time was to produce science specialists rather than teachers. As a result, the new science graduates entering schools carried with them the university outlook on science. For this reason, Smithells advocated that the work of universities should be broadened so that school science teachers might be trained to develop methods and techniques more suitable for the education of the majority and cease to operate along narrow university lines.

The influence of the universities on science teaching in schools has been neatly illustrated by Tomley (1980) in a more recent paper tracing the developments in biology courses over the period 1900 - 50. Commenting on the teacher-dominated, transmission model of teaching he concludes that:

School science, then, was strongly subject-focussed and content-orientated. There were strict rules about what constituted science and scientific behaviour. A high premium was placed on academic scholarship involving a deep and systematic concern for the content of the subject. Thus, science reflected the history of the subject and of the people teaching it. It was a socializing of the young into the traditions, thoughts and behaviour patterns of their elders. There was a clear hierarchical, almost linear relationship between pupil, teacher and university tutor. Schoolmasters were scientists first and teachers second.

(Tomley in 'Curriculum Change: The Lessons of a Decade', edit. by M.J. Galton, 1980)

Bringing the issue up to the present day, Tomley also suggests that science teachers of the grammar-public tradition are to a large extent mirror images of scientists in universities. Validated by a university degree, their knowledge and expertise is theoretical rather than practical

and is reflected in the type of curriculum they teach. Teachers of the elementary-secondary modern tradition have, on the other hand, less subject identity and less in common with the pure scientist. In Tomley's view, these teachers tend to place more emphasis on pedagogical skills, the needs of pupils and theories of mental development when justifying the appropriateness of their courses. If this is so, it is perhaps sad that by popular acclaim subject expertise rather than pedagogical skill has remained the main criterion for judging the effectiveness of the science teacher.

Hence, the influence of differing patterns of teacher education and training on teaching styles, methods and effectiveness in the classroom has been viewed from a variety of perspectives and although, in general, additional qualifications may not be directly translatable into more effective teaching strategies, it seems likely that those teachers without any formal training may be handicapped by their rigid, traditional approach to science and by their lack of familiarity with the range of methods and techniques open to them.

The difficulty of communicating new ideas about teaching strategy to teachers in the schools has long been recognised and in relation to the implementation of project work, this issue alone may have important implications. Several writers have considered the problems. Kaye and Rogers, for instance, made the following suggestion in their review of alternative teaching methods cited earlier:

One of the reasons, we suspect, why they are not put to greater use is that there are not readily available in this country suggestions as to how these more informal methods can be implemented in classes used to traditional teacher-directed lessons. (Kaye and Rogers 1968, p.vii)

Disappointingly low levels of communication have been detected in other areas too. The Schools Council, commenting on Mode III examinations, was aware that liaison between teachers and Boards was not as good as initially envisaged. The Mode III type of examination was established alongside the C.S.E. and, as discussed in earlier chapters, it gave teachers the opportunity to develop those aspects of their science teaching which they felt were especially relevant to the needs and abilities of their pupils; it offered them, for the first time, 'effective control' of their national examination syllabuses. Some teachers were clearly eager to take advantage of these new opportunities and were enthusiastic about the prospect of such high levels of involvement in curriculum development. Many were reputed to have worked long hours to produce novel resource materials and to develop alternative assessment strategies. However, as a result of the investigations preempting the publication of the Schools Council Examination Bulletin No.34 (1976), it became clear that not all teachers confronted with the freedom of the Mode III examination felt the same degree of assurance. Some felt remote, lacked confidence in assessment techniques and found it difficult to comprehend the relative functions of themselves, their schools and the Examination Boards. Hence, they were reluctant to take on the new levels of responsibility endowed upon them and as a consequence the new

patterns of innovation encompassed in the Mode III examination scheme were not adopted to the extent initially expected. A large proportion of the teachers implicated in the C.S.E. tended instead towards the security of the Mode I examinations and their more traditional syllabuses and assessment procedures⁽⁴⁾.

Such features of the C.S.E. system were a cause of considerable concern since lack of involvement in any new scheme, whether by accident or design, can have serious consequences on the success of that scheme. Thus, convincing teachers of the value of a new strategy and providing them with the opportunity of participating fully in it (perhaps, by providing appropriate training courses and/or remission from class teaching) would seem to be important prerequisites for success⁽⁵⁾.

It is likely that this line of reasoning would gain the support of Deere (in Macintosh 1978) whose study of the assessment of project work led him to conclude that in most subjects, teachers who had experience of being involved with assessment advocated the consideration of course work (or project work) as complementary to the final examination. From this, it follows that experience - defined in terms of familiarity with the C.S.E. and its associated teaching strategies and assessment procedures - may be an influential factor in determining teachers' use of the project method at this level. Clearly, on the one hand, the novelty aspect of a new strategy may appeal to some teachers but, equally, the strangeness of the new, perhaps through lack of confidence and/or support, may deter others. Hence, whether teachers remain with the well-tried familiar

methods or venture to introduce newer, lesser known formulae are interesting alternatives requiring further investigation.

Teacher experience together with the other topics mentioned earlier were then just some of the more pressing issues to emerge from the review of literature linking teacher characteristics with teaching styles and attitudes. Thus, the need to include on the questionnaire and interview programme items relevant to these issues was recognised early on in this research study and on the basis of information already published, items were subsequently constructed to investigate more fully a range of teacher characteristics including the age, sex, qualifications and training of the respondents as well as their breadth of experience in schools and at C.S.E. level (see Section D of the questionnaire). In this way, it was hoped that any patterns or relationships that might exist between these variables and the respondents' use of the project method could be identified.

The main findings to arise from this area of the investigation are documented in the following sections.

6.2.2. Sex Ratios

In keeping with the national statistics (Statistics of Education, Vol.4, H.M.S.O. 1976), the majority (71.6%) of the science teachers participating in this survey were male although on the questionnaire nine of the respondents failed to state their gender. Thus, in secondary science

it seemed that male teachers outnumbered female by almost three to one and that this was a pattern observable nationally. However, when, in this study, the sex ratio was examined across the separate subject areas certain variations in this general pattern became apparent (see Table 6.3.). In Chemistry and more especially in Physics the proportion of male teachers was higher, 76.7% and 92.0% respectively, but in General Science the ratio was reduced with male teachers making up just 67.2% of the subject sample. In striking contrast, the sex ratio among Biology teachers was far more evenly balanced, women representing 48.9% of the sample population.

A preliminary analysis of the use of project work by male and female teachers revealed no significant difference between the sexes although in the sample studied female teachers were found to use the project method marginally more than their male counterparts (see Table 6.3., Figures (a) and (b)). In some respects this is a surprising finding in that female teachers, according to Ryans' study cited earlier, have been found to hold more permissive, democratic and imaginative educational perspectives, and since these are seen as features characteristic of a project approach, one might have expected a much higher representation of women among the users of the project method.

A second analysis - a breakdown by subject area - showed that only in General Science and Physics did proportionately more female teachers implement the project approach (see Table 6.3., Figures (c)(d) and (e)(f)). This finding is especially interesting in view of the

TABLE 6.3.

THE USE OF PROJECT WORK BY MALE AND FEMALE SCIENCE TEACHERS IN DIFFERENT SUBJECT AREAS

Row % per subject	USERS					NON-USERS					ALL RESPONDENTS							
	B	C	GS	P	O	Tot.	B	C	GS	P	O	Tot.	B	C	GS	P	O	Total
Raw frequency																		
Column %																		
MALE	52.2	32.6	60.5 _d	13.0 _f	36.4 _b	33.6 _b	47.8	67.4	39.5	87.0	63.6	66.4	20.9	27.9	13.0	34.8	3.3	100%
	36	30	26	15	4	111	33	62	17	100	7	219	69	92	43	115	11	330
	59.0	83.3	65.0	83.3	80.0	69.4	43.4	73.8	70.8	93.5	70.0	72.8	50.4	76.7	67.2	92.0	73.3	71.6
FEMALE	37.3	17.4	70.0 _c	37.5 _e	25.0 _g	38.5 _a	62.7	82.6	30.0	62.5	75.0	61.5	54.9	18.9	16.4	6.6	3.3	100%
	25	4	14	3	1	47	42	19	6	5	3	75	67	23	20	8	4	122
	41.0	11.1	35.0	16.7	20.0	29.4	55.3	22.6	25.0	4.7	30.0	24.9	48.9	19.2	31.3	6.4	26.7	26.5%
NON-STATD	-	40.0	-	-	-	22.2	100.0	60.0	100.0	100.0	-	77.8	11.1	55.6	11.1	22.2	-	100%
	-	2	-	-	-	2	1	3	1	2	-	7	1	5	1	2	0	9
	-	5.6	-	-	-	1.2	1.3	3.6	4.2	1.9	-	2.3	0.7	4.2	1.6	1.6	-	2.0%
TOTAL	44.5	30.0	62.5	14.4	33.3	34.7	55.5	70.0	37.5	85.6	63.7	65.3	29.7	26.0	13.9	27.1	3.3	100%
	61	36	40	18	5	160	76	84	24	107	10	301	137	120	64	125	15	461
	-	-	-	-	-	100%	-	-	-	-	-	100%	-	-	-	-	-	100%

KEY: B - Biology; C - Chemistry; G.S. - General Science; P - Physics; O - Other Subjects.

marked dissimilarity between the two subjects. General Science, as discussed earlier, tends to be regarded as a low status subject, associated with pupils of lower ability, and holds a comparatively high representation of female teachers (see Section 6.1.1.). Physics, on the other hand, is seen as a more prestigious science, one with strong university ties and one in which project work is not generally pursued. Pupils of high ability are common, female teachers few. Thus, it could be argued as perhaps Tomley (op.cit. 1980) would argue, that General Science teaching has its roots in the 'elementary-secondary modern' schools whilst Physics follows in the 'grammar-public tradition'. This being so, then any differential use of project work by male and female teachers in these subject areas cannot be easily explained, at least not in terms of teacher sex ratios, subject traditions or pupil ability. It would seem instead that a complex of factors interact to influence teachers in their decisions about project work and that the sex of the teacher as a single variable is not in itself significant.

6.2.3. Age

From earlier studies linking the age of the teacher with teaching styles and practices (see Peterson 1964, Ryans 1964) it was suspected that teachers' age may be an important variable influencing their use of project work, younger teachers favouring the strategy, older ones rejecting it. This was not found to be the case; the data from this

investigation provided little evidence to support such an age trend.

In line with the national statistics (op.cit., 1976) the majority of respondents (62.3%) were found to be under 35 years of age at the time of enquiry, the estimated mean age being 33 years 9 months (see Table 6.4.). No significant difference was observed in the age distribution of teachers using and not using the project method although the 'Users' were found to be slightly younger overall, having an estimated mean age of just 33 years compared to 34 years 3 months for the 'Non-Users'.

An analysis of teacher age by subject area revealed that proportionally more teachers of Physics were over the age of 35 whilst over 70% of the General Science teachers were under 35 years of age. Since project work was undertaken least in Physics but more commonly in General Science (see Section 6.1.1.) it could perhaps be argued that the older Physics teachers followed in the grammar-public tradition described by Tomley (in Galton 1980) and saw themselves as scientists first and teachers second whilst the younger General Science teachers related more typically to the elementary-secondary modern image and its emphasis on pedagogical skills and pupil development. By interpreting age in terms of 'traditions', it becomes an interesting variable and one which might be seen to have an important bearing on the use of project work. However, attractive though this line of explanation may be, age as a single variable influencing teachers' use of the project method was not substantiated by this enquiry. The age differences that were detected failed to show any statistical

TABLE 6.4.

TEACHER AGE : AN ANALYSIS BY SUBJECT AREA AND USE OF PROJECT WORK

C.S.E. RESPONDENTS								
AGE RANGE (Years)	BY SUBJECT AREA					BY USE OF PROJECT WORK		TOTAL and % age Sampled
	Biology	Chemistry	Gen. Sci.	Physics	Others	'USER'	'NON-USERS'	
Less than 25	21 (15.3)	10 (8.3)	13 (29.3)	5 (4.0)	1 (6.7)	20 (12.5)	30 (10.0)	50 (10.8)
25 - 29	44 (32.1)	24 (20.0)	21 (32.8)	33 (26.4)	5 (33.3)	44 (27.5)	83 (27.6)	127 (27.5)
30 - 34	27 (19.1)	38 (31.7)	11 (17.2)	28 (22.4)	6 (40.0)	43(26.9)	67 (22.3)	110 (23.9)
Sub-totals (under 35)	92 (67.1)	72 (60.0)	45 (70.3)	66 (52.8)	12(80.0)	107(66.9)	180(59.8)	298 (62.3)
35 - 39	18 (13.1)	19 (15.8)	6 (9.4)	25 (20.0)	-	23 (14.4)	45 (15.0)	68 (14.8)
40 - 44	15 (10.9)	13 (10.8)	5 (7.8)	13 (10.4)	1 (6.7)	15 (9.4)	32 (10.6)	47 (10.2)
45 - 49	4 (2.9)	8 (6.6)	4 (6.3)	11 (8.8)	1 (6.7)	7 (4.4)	21 (7.0)	28 (6.1)
50 - 54	5 (3.6)	3 (2.5)	1 (1.6)	4 (3.2)	1 (6.7)	4 (2.5)	10 (3.3)	14 (3.0)
55 - 59	1 (0.7)	1 (0.8)	2 (3.1)	4 (3.2)	-	2 (1.3)	6 (2.0)	8 (1.7)
60 or over	-	-	-	-	-	-	-	-
Sub-totals (over 35)	43 (31.4)	44 (36.5)	18 (28.1)	57 (45.6)	3 (20.0)	51 (31.9)	114(37.9)	165 (35.8)
Age not stated	2 (1.5)	4 (3.3)	1 (1.6)	2 (1.6)	-	2 (1.3)	7 (2.3)	9 (2.0)
n =	137(100%)	120)100%)	64(100%)	125(100%)	15(100%)	160(100%)	301(100%)	461 (100%)

Estimated mean age = 33 yr. = 34 yr. 3m. = 33 yr. 9m.

significance and in view of the distribution of teachers across the separate science disciplines, it would seem that subject area and a complex of other associated variables may account for these differences at least as much as teacher age.

6.2.4. Qualifications and Training

The initial analysis of the qualifications and training of the teachers participating in this enquiry revealed some interesting features.

74.8% of the respondents were graduates (see figures (a) and (b) of Table 6.5.) and assuming the definition of 'Good Honours' to be that used in the Burnham recommendations on pay awards, then 47.1% of them had, in addition, gained their degrees with second class honours or above (see figures (c) and (d)). Set against the national statistics available for comparison, both these sets of figures seem high since in 1976 the total percentage of all graduates in secondary establishments stood at just 42.6% (Statistics of Education, Vol.4, H.M.S.O. 1976). Hence, if these figures are representative of the secondary teaching population, it would appear that the sciences hold a much higher proportion of graduate teachers than other subject areas and that this gives some support to earlier suggestions that school science teaching has strong university links and follows in the academic rather than the pedagogic tradition.

In this study, Chemistry and Physics held the greatest proportion of graduates (83.4% and 75.2% respectively) whilst

TABLE 6.5.

QUALIFICATIONS AND TRAINING OF TEACHERS OF C.S.E. SCIENCE:
AN ANALYSIS BY SUBJECT AREA AND USE OF PROJECT WORK

QUALIFICATIONS AND TRAINING	FREQUENCY OF RESPONSE (% age)							
	BY SUBJECT AREA				BY USE OF PROJECT WORK			ALL RESPONDENTS
	Biology	Chemistry	Gen.Sci.	Physics	'USERS'	'NON-USERS'		
Teacher-trained graduate with good Honours	58 ^e (42.3)	54 (45.0)	25 ^g (39.1)	39 (31.2)	69 (43.1)	114 (37.9)	183 ^c (39.7)	
Teacher-trained graduate without good Honours	33 (24.1)	32 (26.7)	11 (17.2)	41 (32.8)	35 (21.9)	85 (28.2)	120 (26.0)	
Total Teacher-trained graduates	91 (66.4)	86 (71.7)	36 (56.3)	80 (64.0)	104 (65.0)	199 (66.1)	303 ^a (65.7)	
Teacher-trained non-graduate	37 ^f (27.0)	17 (14.2)	23 ^h (35.9)	30 (24.0)	43 (26.9)	65 (21.6)	108 (23.4)	
Good Honours graduate without teacher-training	8 (5.8)	11 (9.2)	2 (3.1)	10 (8.0)	10 (6.3)	24 (8.0)	34 ^d (7.4)	
Graduate without good Honours and no teacher training	0 (-)	3 (2.5)	1 (1.6)	4 (3.2)	2 (1.3)	6 (2.0)	8 (1.7)	
Total untrained graduates	8 (5.8)	14 (11.7)	3 (4.7)	14 (11.2)	12 (7.6)	30 (10.0)	42 ^b (9.1)	
Untrained non-graduates	0 (-)	1 (0.8)	0 (-)	0 (-)	1 (0.6)	0 (-)	1 (0.2)	
Qualifications and training not stated	1 (0.7)	2 (1.7)	2 (3.1)	1 (0.8)	0 (-)	7 (2.3)	7 (1.5)	
n =	137	120	64	125	160	301	461	

General Science had the lowest (61.0%), a finding which perhaps reflects the low status of this subject compared to the pure sciences.

The data from this study also showed that 89.1% of the respondents had gained some form of professional teacher-training. Although no direct comparisons can be made with the statistics published by H.M.S.O., this figure seems exceptionally high⁽⁶⁾ and one cannot exclude the possibility that such a high percentage of trained respondents in this enquiry may not be truly representative of the whole secondary science teaching population; it might simply indicate that trained teachers are more likely to respond to investigations of this kind. In other words, by not taking into account those untrained staff who may have felt insufficiently qualified and/or motivated to respond to the questionnaire, the proportion of trained teachers involved in this study may be artificially high.

A breakdown of the qualifications and training of those teachers using and not using the project method in C.S.E. science teaching revealed no significant differences between the two groups of teachers (see Table 6.5.). A slightly higher percentage of trained, good Honours graduates used project work than did not, and a similar observation was made in respect of trained, non-graduate teachers. However, since 69.3% of Biology teachers (figures (e) and (f)) and 75.0% of General Science teachers may be grouped within these two categories, compared to only 59.2% and 55.2% of Chemistry and Physics teachers, the incidence of project work here would seem to reflect subject differences rather than teacher credentials. Overall, then, comparing

untrained graduates and trained non-graduates, no differential use of project work was observed.

These findings are interesting in that they run contra to what one might expect on the basis of arguments put forward in the literature. In science teaching, the good Honours graduate without formal teacher-training has been associated with 'a deep and systematic concern for the content of the subject' rather than the pupil; his knowledge and expertise has been labelled 'theoretical' and he has been attacked for his lack of pedagogical skills. In contrast, the trained teacher by vocation has concerned himself with the needs of his pupils and, whilst lacking subject identity, has familiarized himself with the range of teaching methods and techniques open to him. Hence, one might expect the trained teacher to be more willing and able to pursue a course of project work than the untrained graduate who would seem more inclined to stick with traditional, didactic teaching methods. However, although these stereotypes may have been shrewd in the past, such divisions among teachers on the basis of their qualifications and training are not substantiated by this more recent enquiry. From the data presented here, it seems fair to conclude that there is no general tendency for teachers with a particular pattern of qualifications and training to use project work significantly more (or less) than teachers with alternative educational backgrounds.

6.2.5. Higher Degrees

Of the 461 teachers participating in this investigation, 43 (9.3%) of them possessed some form of higher degree (see Table 6.6.). Among the higher qualifications, the Doctorate (Ph.D.) was found to be most common (3.5%), followed by the Master of Science (M.Sc., 2.4%). Eight respondents held either the Master of Arts or Philosophy (M.A. or M.Phil.) although the importance/relevance of the former qualification to science teaching was difficult to ascertain since it was appreciated that an M.A. might be more indicative of the Oxbridge tradition than a true Arts Honour. Only 4 respondents were in possession of the Master of Education (M.Ed.).

Professional qualifications (such as those in pharmacy, biochemistry, agriculture) were for ease of analysis included in the category 'Other Higher Degrees'.

Further analysis of degrees held was difficult because of the small numbers of respondents involved in each category. However, a breakdown of higher qualifications by use of project work was useful in demonstrating the slightly greater proportion of higher degrees (notably M.A., M.Phil., M.Ed., Ph.D.) held by those teachers not using the project method (see columns (1) and (2) of Table 6.6.). It is stressed though that, unsupported by any statistical tests, this finding can only be interpreted as a slight tendency. Whether the data could be applied in reverse remains dubious for although it might be attractive to suggest that those teachers with more advanced academic qualifications are slower to adopt a more contemporary

TABLE 6.6.

THE INCIDENCE OF HIGHER DEGREES AMONG THE TEACHERS OF C.S.E. SCIENCE

Teachers Type of Degree	(1)Users of Project Work (n=160)	(2)Non-Users of Project Work (n=301)	(3) All Respondents (n=461)
Master of Arts/Philosophy	2 (1.3%)	6 (2.0%)	8 (1.7%)
Master of Education	1 (0.6%)	3 (1.0%)	4 (0.9%)
Master of Science	4 (2.5%)	7 (2.3%)	11 (2.4%)
Doctorate	5 (3.1%)	11 (3.7%)	16 (3.5%)
Others	1 (0.6%)	4 (1.3%)	5 (1.1%)
Not specified	2 (1.3%)	-	2 (0.4%)
Total No. of Respondents possessing Higher Degree(s)	15 (9.4%)	28*(9.3%)	43*(9.3%)

N.B.

*Three respondents in this category held more than one Higher Degree e.g. M.Sc. and Ph.D.

teaching strategy such as a project approach, the data presented here offers no support for this suggestion.

This is demonstrated as follows:

Number of 'Users' with Higher Degree(s)	= 15
Number of 'Non-Users' with Higher Degree(s)	= 28
Ratio of 'Users' to 'Non-Users'	= 15 : 28
	= 1 : 1.9

Similarly,

Number of all 'Users'	= 160
Number of all 'Non-Users'	= 301
Ratio of 'Users' to 'Non-Users'	= 160 : 301
	= 1 : 1.9

Hence, there is no evidence to suggest that teachers with higher degrees use project work to any lesser extent than those not in possession of such degrees. In addition, it should be stressed that in the 'Non-Users' category, (Column 2, Table 6.6.) some respondents held more than one higher degree. Accordingly, the slight tendency for 'Non-Users' to possess a greater proportion of higher degrees is eroded when the proportions of respondents themselves are examined.

6.2.6. Experience⁽⁷⁾

(i) Years in Teaching

Section D, item 4 of the questionnaire sought to investigate the number of years each respondent had been teaching (a) in their present school/college, and (b) since the start of their teaching career. It was anticipated that the period of time spent in a single establishment and the total duration of the teachers' career may well have an influence on their use of project work as a teaching/learning

strategy and as an assessment procedure, and it was hoped that this section of the enquiry would highlight any relationships of this kind. For simplicity, both lines of investigation utilised grouped year periods (e.g. 1+ to 3 years) where the respondents were required to indicate the time range applicable in each case. The findings are summarised in Tables 6.7a and 6.7b and charted in histogram form in Figures 6(i) and 6(ii).

As shown in Table 6.7a., 63.4% of the respondents had been teaching in their present school/college just five years or less, the 'newcomers' (i.e. those in their first year) making up 14.8% of the total. Little difference was found between the 'Users' and 'Non-Users' of project work in the survey population. This was surprising since it did not lend support to earlier and more common findings that older established teachers revert to traditional methods and adopt a more learning-centred didactic approach (see Shipman 1967, Grace 1972, Peterson in Biddle and Ellena 1964). Among the 'Users' slightly more were found to be within the 1 to 5 year category but no significant differences were detected, and those teachers who were 'long-standers' (i.e. 9+ to 15 years) in their establishments used project work just as frequently as the newer members of staff⁽⁸⁾.

Concerning the total number of years spent in teaching, 296 (64.2%) of the respondents were found to have been teaching just 10 years or less and 36 (7.8%) of them were at the time of the enquiry in their first (probationary) year of teaching (see Table 6.7b). 155 (33.6%) of the respondents had been teaching in excess of 10 years.

TABLE 6.7a.

THE TEACHERS: YEARS SPENT IN CURRENT ESTABLISHMENT

YEARS	FREQUENCY OF RESPONSE (% age)		
	'Users' of Project Work	'Non-Users' of Project Work	All Respondents
1 year or less	23 (14.4)	45 (15.0)	68 (14.8)
1+ to 3	48 (30.0)	77 (25.6)	125 (27.1)
3+ to 5	39 (24.4)	60 (19.9)	99 (21.5)
5+ to 7	19 (11.9)	42 (14.0)	61 (13.2)
7+ to 9	14 (8.8)	23 (7.6)	37 (8.0)
9+ to 11	5 (3.1)	7 (2.3)	12 (2.6)
11+ to 13	4 (2.5)	10 (3.3)	14 (3.0)
13+ to 15	5 (3.1)	8 (2.7)	13 (2.8)
Over 15 years	3 (1.9)*	22 (7.3)	25 (5.4)
Not stated	-	7 (2.3)	7 (1.5)

n = 160 (100%) =301 (100%) =461 (100%)

* see Note (8)

FIGURE 6(i)

YEARS SPENT IN CURRENT ESTABLISHMENT

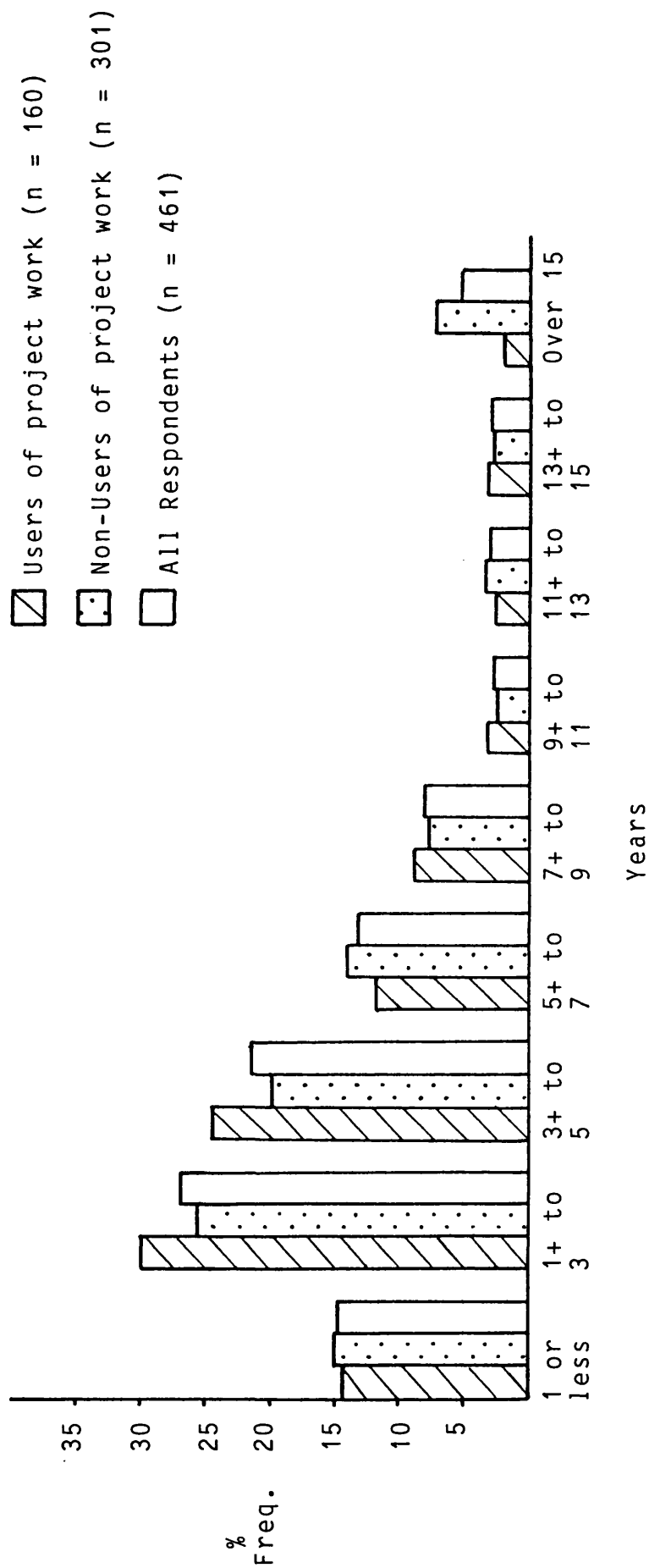


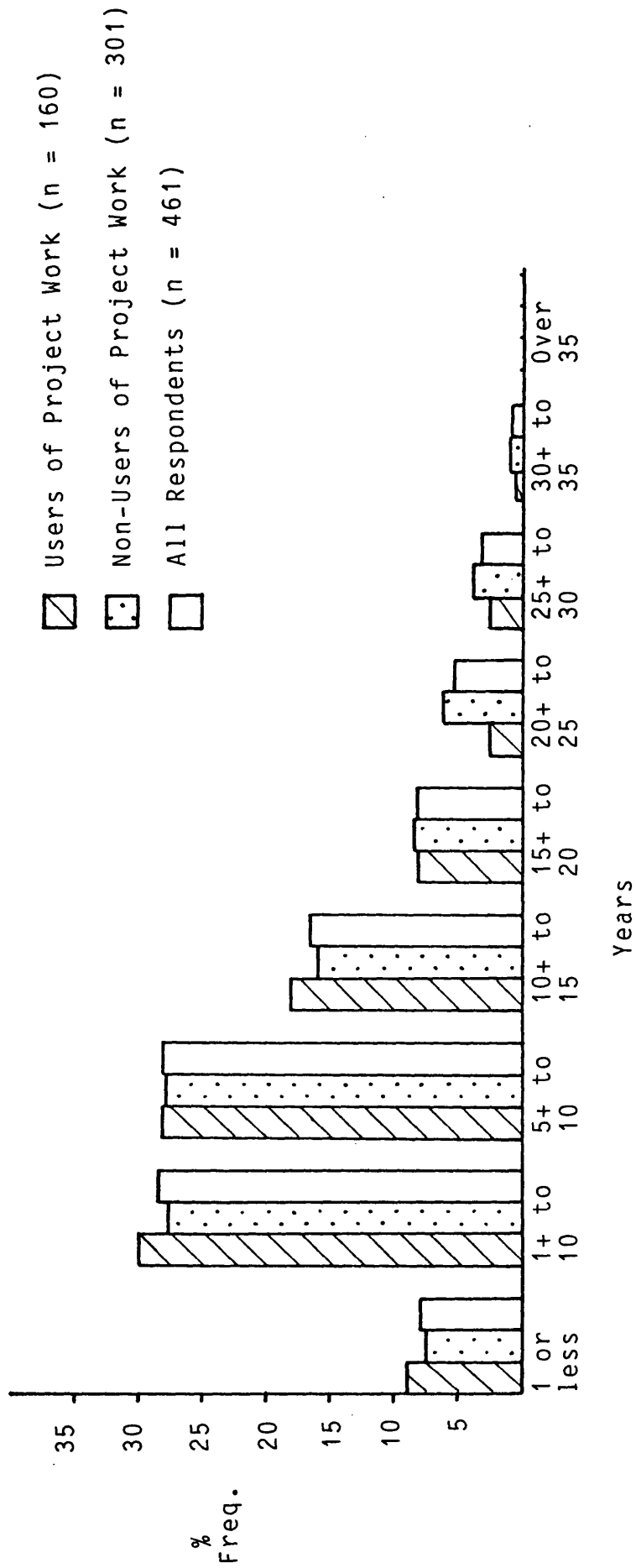
TABLE 6.7b.

THE TEACHERS: YEARS SPENT IN TEACHING

YEARS	FREQUENCY OF RESPONSE (% age)		
	'Users' of Project Work	'Non-Users' of Project Work	All Respondents
1 or less	14 (8.8)	22 (7.3)	36 (7.8)
1+ to 5	48 (30.0)	83 (27.6)	131 (28.4)
5+ to 10	45 (28.1)	84 (27.9)	129 (28.0)
10+ to 15	29 (18.1)	48 (15.9)	77 (16.7)
15+ to 20	13 (8.1)	25 (8.3)	38 (8.2)
20+ to 25	4 (2.5)	18 (6.0)	22 (4.8)
25+ to 30	4 (2.5)	10 (3.3)	14 (3.0)
30+ to 35	1 (0.6)	3 (1.0)	4 (0.9)
Over 35	- -	- -	- -
Not stated	2 (1.3)	8 (2.7)	10 (2.2)

n = 160 (100%) =301 (100%) =461 (100%)

FIGURE 6(ii)
YEARS SPENT IN TEACHING



When viewed alongside the age distribution of the teachers, these findings open up several issues worthy of comment.

Those teachers in the profession for longer than 10 years, assuming the minimum qualifying age to be 20 to 22 years (depending on the route of entry), must by requirement be over 30 years of age. However, as shown in Table 6.4. (given earlier) the number of respondents in the 'over 30' category totalled 275 (59.7%) which means that 120 (26.0%) teachers in this group had less than 10 years experience i.e. less than might be expected given their age. This discrepancy between the possible number of years in teaching and the actual perhaps reflects some important features of teachers' career patterns over the last two decades.

The main elements of teacher shortage outlined in the Ninth Report of the National Advisory Council on the Training and Supply of Teachers (1965) and a later report produced by a Committee of Inquiry on Teacher Education and Training (James Report 1971) have highlighted certain key factors influencing career patterns, and a study by Kob (in Halsey et al 1965) defining the teachers' role in German respondents during the years 1956 - 7 has provided further observations relevant to this issue. On the basis of these research studies, several explanations would seem likely.

Firstly, it seems probable that for some respondents teaching may not have been their first choice of career and in this event they may have been late entrants into the profession.

Secondly, against a background of specific legislation authorizing National Service up until 1961, some respondents aged 35 or over may through force of circumstances have been late entering the profession or, alternatively, had their teaching careers interrupted.

Thirdly, some of the science teachers may have deliberately chosen to delay or interrupt their period in teaching to gain experience in other fields (see Section 6.2.6.(iv)).

And fourthly, the position of women in teaching cannot be ignored since their unique patterns of employment will affect, not least, the data presented here. Clearly, the special circumstances brought about by the ascribed role of child-bearing and the prescribed task of family-rearing, exert specific pressures on women, forcing them in many cases to leave teaching. The retreat from teaching may come early or late in a woman's career; it may represent the final curtain, an ill-timed break or a short, strategically-planned intermission in their teaching career. Eitherway, it has to be accepted that the figures quoted here must reflect to some extent these premature departures from teaching by women.

Returning to the original data on the total number of years spent in teaching, a second breakdown of the replies into 'Users' and 'Non-Users' of project work was implemented in an attempt to determine whether any associations between the variables existed. (It was suspected, for instance, that the teachers of long-standing might be more inclined to persist with the 'tried and tested' traditional teaching methods and thus show reluctance to attempt a project-type

approach with their C.S.E. pupils.) The results of this analysis are given in Table 6.7b. and displayed graphically in Figure 6(ii), pages 292 and 293.

For the total period spent in teaching, a slightly greater percentage of 'Users' was found in every category under 15 years and, as expected, a slightly greater percentage of 'Non-Users' was found in all categories over 15 years. However, it must be emphasised that these tendencies were detected only in terms of percentage observations; the findings were not found to be statistically significant and thus the data can provide no strong evidence to support the suggestion that for teachers, the longer their period in teaching, the less likelihood there is of them implementing the more modern teaching strategies.

(ii) Previous Teaching Positions in Secondary Education

In response to item 4(c) Section D of the questionnaire, "Prior to your present position, did you hold any other full-time teaching posts in secondary education?", the following data were received:

TABLE 6.8a.

THE INCIDENCE OF EXPERIENCE IN OTHER
FULL-TIME SECONDARY TEACHING POSTS

	FREQUENCY OF RESPONSE (% age)		
	'Users' of PW	'Non-Users' of PW	All Respondents
YES	78 (48.8%)	164 (54.5%)	242 (52.5%)
NO	81 (50.6%)	128 (42.5%)	209 (45.3%)
NOT ANS	1 (0.6%)	9 (3.0%)	10 (2.2%)
n =	160 (100%)	301 (100%)	461 (100%)

As shown in Table 6.8a., over 50% of the respondents had held other full-time teaching positions in secondary education, prior to their current appointment. A breakdown of the responses into 'Users' and 'Non-Users' of project work showed that the latter group (i.e. the 'Non-Users') had slightly more experience of teaching in other secondary establishments than the 'Users' (54.5% compared to 48.8%). These findings were not however found to be statistically significant although the increased tendency not to use project work by those respondents with previous full-time secondary teaching experience might realistically be linked to other related factors such as teachers' age, qualifications and the number of years spent in teaching in total.

A subsequent enquiry into the types of teaching experience gained by the 242 respondents cited above produced the data given in Table 6.8b. which follows.

Table 6.8b. reflects the range of secondary teaching experience gained by the respondents. Over one third of the teachers (34.7%) had taught in comprehensive establishments (all types: 11 - 14, 11 - 16, 11 - 18 years); 18% had Grammar school experience and an almost equal proportion had first-hand teaching knowledge of Secondary Modern schools. A further 68 respondents (14.8%, see column 3) had taught in other, less common, secondary institutions such as technical schools, special schools, British Forces schools, Commonwealth and missionary schools, and the like.

In the second instance, a breakdown of the type of secondary teaching experience gained by the 'Users' and 'Non-Users' of project work was undertaken on the understanding that certain kinds of establishment may have

TABLE 6.8b.

PRIOR TEACHING EXPERIENCE IN SECONDARY EDUCATION:
TYPES OF ESTABLISHMENT

Type of Establishment	FREQUENCY OF RESPONSE*(% age)		
	1. 'Users'	2. 'Non-Users'	3. All Respondents
Comprehensive	49 (30.6)	111 (36.9)	160 (34.7)
Grammar	27 (16.9)	56 (18.6)	83 (18.0)
Sub-totals	76 (47.5)	167 (55.5)	243 (52.7)
Secondary	28 (17.5)	52 (17.3)	80 (17.4)
Modern	6 (3.8)	4 (1.3)	10 (2.2)
Technical			
Sub-totals	34 (21.3)	56 (18.6)	90 (19.5)
Special	2 (1.3)	1 (0.3)	3 (0.7)
Other types	19 (11.9)	36 (12.0)	55 (11.9)
where n =	78*	164*	242*
out of total	160 (100%)	301 (100%)	461 (100%)

*It should be stressed that many respondents had teaching experience in more than one type of institution and therefore made more than one response. Such multiple responses explain the high frequency of experience observed under this questionnaire item, and necessitate the presentation of data as a percentage of the total number of respondents in each category.

encouraged a project approach whilst others may have not. (It was suspected, for example, that certain characteristic features of a school, such as pupil intake, examination-orientation, teacher/pupil expectations, might perhaps be conducive to the implementation of project work with science pupils and thus helpful in the development of opportunities for its use.)

The results of this analysis are recorded in Columns 1 and 2 of Table 6.8b.

The data showed no significant differences in teaching experience between the 'Users' and 'Non-Users' of project work although the findings did suggest some interesting tendencies. For instance, a slightly greater proportion of those teachers using the project method had previous experience in Secondary Modern and Technical schools (21.3% compared to 18.6%), and of those teachers not using project work with C.S.E. pupils at the time of the enquiry, a slightly greater percentage had taught in Comprehensive and Grammar schools (55.5% compared to 47.5%). Developing these results further, it is of course attractive to suppose that Secondary Modern and Technical schools, each with pupils of similar abilities and aptitudes, and with curricula that were largely non-academic and practical in bias, may have made ideal settings for the development of a project approach to learning. Conversely, in the Grammar and Comprehensive schools - because of tradition in the former case and logistics in the latter - project work may have been difficult to implement. It might be argued, for instance, that the Grammar School with its academic record, its examination-orientation and its classical traditions,

was hardly likely to be a hot-bed for project innovation. Similarly, the view could be upheld that the Comprehensive school with its 'new' mixed ability intake, its involvement with a range of examination Boards, syllabuses and modes, may have produced in its early days too many managerial and organisational problems to permit the introduction of effective project work. Perhaps, as some suggest, it is only now after a period of settling and familiarisation that the project method can be successfully implemented in these establishments.

Thus, from the data on previous teaching posts, a number of interesting comparisons between establishments may be made and attractive theories about their role in project innovation can be formulated. However, it has to be stressed finally that the issues raised under this topic remain speculative in that the findings emerging from this aspect of the enquiry failed to show any statistical significance.

(iii) Prior Experience of C.S.E. Science Teaching

In the introduction to this section (6.2.1.), it was suggested that lack of confidence in the techniques of examining and familiarity with the Board structure and the administration of examinations might, in part, explain teachers' failure to develop to the full Mode III examinations in science. Moreover, it was speculated that familiarity with the different aspects of the C.S.E., its various modes, syllabuses and assessment procedures might give teachers the confidence needed to attempt alternative strategies and to develop new techniques in their science

teaching. Hence, for the purposes of this enquiry, it was considered important to establish the extent of C.S.E. science teaching experience acquired by the respondents and to investigate whether or not such experience influenced teachers and encouraged them to engage more readily in less conventional teaching methods such as project work.

Item 6, Section D, the last formal item to be included on the questionnaire, was an attempt to determine the incidence and nature of C.S.E. science teaching experience held by the respondents. The results are summarised in Tables 6.9a. and 6.9b.

TABLE 6.9a.

THE INCIDENCE OF PRIOR C.S.E. SCIENCE TEACHING EXPERIENCE
AMONG THE USERS AND NON-USERS OF PROJECT WORK

EXPERIENCE	FREQUENCY OF RESPONSE (% age)		
	'USERS'	'NON-USERS'	ALL RESPONDENTS
YES	63 (39.4)	121 (40.2)	184 (39.9)
NO	95 (59.4)	168 (55.8)	263 (57.0)
NOT. ANS.	2 (1.3)	12 (4.0)	14 (3.0)
n =	160	301	461

As shown in Table 6.9a., 39.9% of the respondents had gained some experience of C.S.E. science teaching prior to their present position. In this respect, no significant difference was found between the 'Users' and 'Non-Users' of project work: 39.4% of the 'Users' compared to 40.2% of the 'Non-Users' had some previous experience of science teaching at C.S.E. level.

TABLE 6.9b.

THE RANGE OF C.S.E. TEACHING EXPERIENCE GAINED BY
SCIENCE RESPONDENTS

E.M.R.E.B. C.S.E.** SYLLABUS	FREQUENCY OF RESPONSE FROM CSE SUBJECT TEACHERS*										
	BIOLOGY		CHEMISTRY		GEN.SCI.		PHYSICS		ALL SUBJECTS		
	U	NU	U	NU	U	NU	U	NU	U	NU	Total
BIOLOGY											
Mode I	11	16	1	4	4	3	1	2	17	25	42
II	-	-	-	-	-	-	-	-	-	-	-
III	1	1	-	-	1	-	-	-	2	1	3
Mixed	3	2	-	-	-	-	-	1	3	3	6
TOTAL	15	19	1	4	5	3	1	3	22	29	51
CHEMISTRY											
Mode I	1	2	5	15	5	3	1	5	12	25	37
II	-	-	1	2	-	-	-	-	1	2	3
III	1	-	-	-	-	-	-	-	1	-	1
Mixed	1	-	-	2	-	-	-	-	1	2	3
TOTAL	3	2	6	19	5	3	1	5	15	29	44
GEN.SCIENCE											
Mode I	6	6	1	10	2	3	-	4	9	23	32
II	-	-	1	-	-	-	-	-	1	-	1
III	1	1	2	1	1	-	-	-	4	2	6
Mixed	2	-	-	1	-	-	-	2	2	3	5
TOTAL	9	7	4	12	3	3	0	6	16	28	44
PHYSICS											
Mode I	3	2	1	11	3	2	4	18	11	33	44
II	-	-	-	-	-	-	-	-	-	-	-
III	-	-	-	1	-	-	-	-	-	1	1
Mixed	-	-	-	-	-	-	-	4	-	4	4
TOTAL	3	2	1	12	3	2	4	22	11	38	49
Other Boards											
- Biology	7	8	1	1	2	3	-	1	10	13	23
- Chemistry	2	-	9	8	5	-	-	8	16	16	32
- Gen.Sci.	5	1	3	4	2	1	1	6	11	12	23
- Physics	1	-	1	2	1	2	2	14	5	18	23
- Others	9	19	2	15	5	3	4	19	20	56	76
TOTAL	24	28	16	30	15	9	7	48	62	115	177
n=									63	121	184
out of total=									160	301	461

* Subject teachers defined according to their main C.S.E. science subject as stated on their questionnaires
(N.B. U = Users of project work, NU = Non-Users of project work).

** East Midland Regional Examinations Board unless otherwise stated.

Concerning the range of experience gained (see Table 6.9b.), it can be seen that, between them, the respondents had acquired a wide variety of C.S.E. teaching experience in different subjects, in different modes and under different Examinations Boards⁽⁹⁾. It was clear that a number of teachers participating in the study had taught C.S.E. science in subjects other than the one with which they were currently associated. This was especially detectable among those teachers of General Science for whom C.S.E. experience in the teaching of Biology, Chemistry and Physics was also recorded⁽¹⁰⁾. However, it was interesting to note that this tendency was less marked amongst the teachers of Physics. For this group of respondents, the incidence of teaching experience in other C.S.E. science subjects was reduced, reflecting perhaps both the high status of the subject and the shortage of staff available to teach it, issues which were at the centre of heated discussions on recruitment to specialist science teaching at the time of this study⁽¹¹⁾.

The suggestion that experience with Mode III examinations may promote teachers' use of project work by allowing them opportunity to familiarise themselves with alternative teaching strategies and assessment procedures receives some support from this enquiry. Among the users of project work, seven instances of previous Mode III experience were recorded compared to only four among the non-users. Although the numbers are clearly too low to be put to any statistical test, the lack of Mode III experience in all rows of the table is possibly the most interesting feature to emerge from this part of the

enquiry and perhaps explains the low incidence of project work (of all types) observed in this study.

(iv) Employment Outside the Field of Education

Investigation of the types of work experience possessed by the respondents in this study was extended in an attempt to establish whether the nature/field of the work experience could be related in anyway to the kinds of teaching strategies (notably project work) later employed. It had been suggested, for instance, that variety in career pattern might encourage teachers to extend their repertoire of teaching methods and consequently encourage them to implement with more confidence and competence a project approach to secondary science teaching. Item 5, Section D of the questionnaire was an attempt to acquire the information necessary to support or refute this suggestion.

In the item, the teachers were asked to state if they had "ever had full-time employment of longer than six months duration outside the field of education". If so, they were then asked to give brief details of the type(s) of occupation in which they had been engaged. Using the information provided by the respondents, five categories of employment were derived which were considered to be relevant to the enquiry in hand. The categories are summarised as follows:

- (1) Science-practising; industry-based
- (2) Non-science-practising; industry-based
- (3) Science-practising; non-industrial
- (4) Non-science-practising; non-industrial
- and (5) Fully varied, wide-ranging.

For the purposes of this study, science-practising was distinguished from science-related. Jobs were categorized

according to the former label only if they required the practice of scientific skills (see Chapter 5) as in chemical analysis, experimentation and testing procedures. Science-related occupations (e.g. Distribution Manager for scientific equipment) were differentiated since although they may have required some specialist scientific knowledge, they made no demands on scientific skills as such.

In most cases, each stated occupation could, without too much difficulty, be assigned to a specific category, but where the job description was too vague, the case was recorded under 'Not specified'.

The findings are summarised in Tables 6.10a. to d. which follow.

TABLE 6.10a.

THE INCIDENCE OF FULL-TIME EMPLOYMENT OUTSIDE THE FIELD OF EDUCATION AMONG THE TEACHERS OF C.S.E. SCIENCE

Employment Outside Education	FREQUENCY OF RESPONSE (% age)		
	'USERS'	'NON-USERS'	ALL RESPONDENTS
YES	55 (34.4)	119 (39.5)	174 (37.7)
NO	101 (63.1)	172 (57.1)	273 (59.2)
NOT ANS.	4 (2.5)	10 (3.3)	14 (3.0)

n = 160 301 461

From Table 6.10a., it can be seen that 59.2% of the science respondents had no experience of full-time employment, of longer than six months duration, outside the field of education. This relatively simple finding, however, would seem to imply a number of possible

alternatives for these teachers. Firstly, the data suggests that these respondents may have entered teaching immediately after the completion of their own higher education. Alternatively, the teachers may have had only short periods of employment (temporary or otherwise) outside education. Thirdly, they may have held only part-time occupations in fields other than education or fourthly, they may have undergone periods of unemployment prior to taking up teaching. Nevertheless, regardless of which of these categories might aptly describe the teachers' experience (or lack of it), the implications are clear; the data collected demonstrate with little doubt that over half of the secondary science teachers participating in this study had only limited work experience in fields other than education.

In the initial analysis, it was also interesting to note that there were no significant differences in the extent of work experience acquired by those teachers using the project method and those not, although it was noted that among the 'Non-Users' a slightly greater proportion had actually worked full-time outside education. Thus, it would seem from the preliminary analysis that work experience and knowledge of occupations outside teaching do not necessarily encourage teachers to implement a project approach in their science teaching.

The nature of the experience gained by 174 of the respondents raise other points of interest. As shown in Table 6.10b., 79 teachers (17.1%) had acquired work experience of a scientific nature in industrial fields and a further 34 respondents (7.4%) had been involved in

TABLE 6.10b.

THE NATURE OF EMPLOYMENT OUTSIDE EDUCATION

Approximate Nature of Employment	FREQUENCY OF RESPONSE* (% age)			Typical Examples taken from the Questionnaires
	1. USERS	2. NON-USERS	3. ALL RESPONDENTS	
1. Science-practising; Industry-based.	15 (9.4)	64 (21.3)	79 (17.1)	Development Engineer Analytical Chemist Research and Production Chemist
2. Non-science-practising;	6 (3.8)	8 (2.7)	14 (3.0)	Haulage Contractor Industrial Sales Representative Unskilled Factory Worker
3. Science-practising;	14 (8.8)	20 (6.6)	34 (7.4)	Min. of Agriculture Research Assistant National Service Kidney Unit Biochemist Medical Laboratory Technician
4. Non-science-practising;	11 (6.9)	32 (10.6)	43 (9.3)	Local Authority Care Assistant Trainee Manager, Electrical Goods Civil Servant
5. Fully-varied; wide-ranging**	9 (5.6)	9 (3.0)	18 (3.9)	Varied
Not answered/ Not specified***	107(66.9)	182 (60.5)	289 (62.7)	N/A
(1-5)n= 55 119 174 out of total= 160 301 461				

* Some respondents had been engaged in more than one form of employment outside education.

** Each type of occupation, where specified, is included in these data.

*** This category includes those respondents with experience in 3 or more different occupational fields.

*** This category includes (i) those respondents with no full-time employment experience outside education, and
(ii) those respondents who failed to specify in sufficient detail the nature of their employment outside education.

scientific occupations in the non-industrial sectors. Thus, in total, 113 respondents (24.5%) had used their scientific knowledge and skills in occupational fields outside education, and from the examples given for these categories of employment, it can be seen that the respondents had a wide variety of experience behind them. Furthermore, one might imagine that the occupations quoted would provide these teachers with those kinds of 'up-to-date and relevant practical applications of the concepts and principles being studied' in secondary science, and permit them, in some instances, by reference to their first-hand knowledge of industrial processes and practices, 'to enrich the science teaching and enhance its relevance to pupils' (12).

Fifty-seven respondents (12.4%) had acquired work experience in non-scientific fields i.e. in areas unrelated to their specific teaching subject although 14 of these teachers had gained industrial experience of some sort. A further 18 respondents had apparently undertaken a range of different occupations prior to taking up their present teaching position; fully-varied, their employment record included both scientific and non-scientific posts, in industry and the non-industrial sectors.

In considering the differing natures of the employment undertaken by the science teachers involved in this study, their responses were categorized further on the basis of their current use of project work with C.S.E. pupils. The results of this second analysis are recorded in Columns 1 and 2 of Table 6.10b.

Comparing the two sets of findings for the 'Users' and 'Non-Users', it was again interesting to note that those teachers in the 'Non-User' group had proportionately more industrial experience of a scientific nature than those in the 'User' category (21.3% compared to only 9.4%). In addition, the 'Non-Users' appeared to have slightly more experience of the non-scientific, non-industrial occupations e.g. positions in the Civil Service. In contrast, the 'Users' of project work had the slight edge with respect to (i) industrial work of a non-scientific nature, and (ii) scientific work of a non-industrial nature.

Given these perspectives, it became clear that any association that might exist between the nature of the employment outside education and the use of project work in science was, in this first instance, confused by the segmented nature of the job categories. By regrouping and combining the categories, as shown in Table 6.10c., the findings were simplified.

Displayed in this way, the data indicate that 24.5% of the respondents had gained experience of a scientific nature outside education and that approximately one fifth of them had for a time worked in industry in various capacities, both scientific and non-scientific. Again, 18 of the respondents had pursued a range of jobs varying in nature and employment area. Also of interest, the analyses show that of the respondents participating in the study, those who classed themselves as 'Non-Users' of project work in C.S.E. science had in each case proportionately more (i) scientific work experience outside education (i.e. 27.9% compared to 18.1% of the 'Users') and

TABLE 6.10c.

THE INCIDENCE OF SCIENTIFIC AND INDUSTRIAL WORK
EXPERIENCE AMONG THE USERS AND NON-USERS OF PROJECT WORK

EMPLOYMENT FIELD	INCIDENCE OF EXPERIENCE* (% age)		
	'USERS'	'NON-USERS'	ALL RESPONDENTS
Scientific	29 (18.1)	84 (27.9)	113 (24.5)
Non-scientific	17 (10.7)	40 (13.3)	57 (12.3)
Industrial	21 (13.1)	72 (23.9)	93 (20.2)
Non-industrial	25 (15.6)	52 (17.3)	77 (16.7)
Fully varied (as before)	9 (5.6)	9 (3.0)	18 (3.9)
	n=160	=301	=461

*N.B. Again, it must be emphasised that the categories used in the above table are not mutually exclusive; respondents with more than one occupation behind them may be included, in each case, in either category 1 or 2, or both. Those respondents with experience in 3 or more different occupational fields/areas are included in category 3 ('Fully varied'). Hence, the data cannot be treated as discrete.

(ii) industrial work experience (i.e. 23.9% compared to 13.1% of the 'Users').

A third analysis - an investigation of the duration of employment outside the field of education (see item 5, Section D of the questionnaire) - revealed further points of interest. These findings are summarised in Table 6.10d., and illustrated graphically in Figure 6(iii).

TABLE 6.10d.

THE DURATION OF EMPLOYMENT OUTSIDE EDUCATION

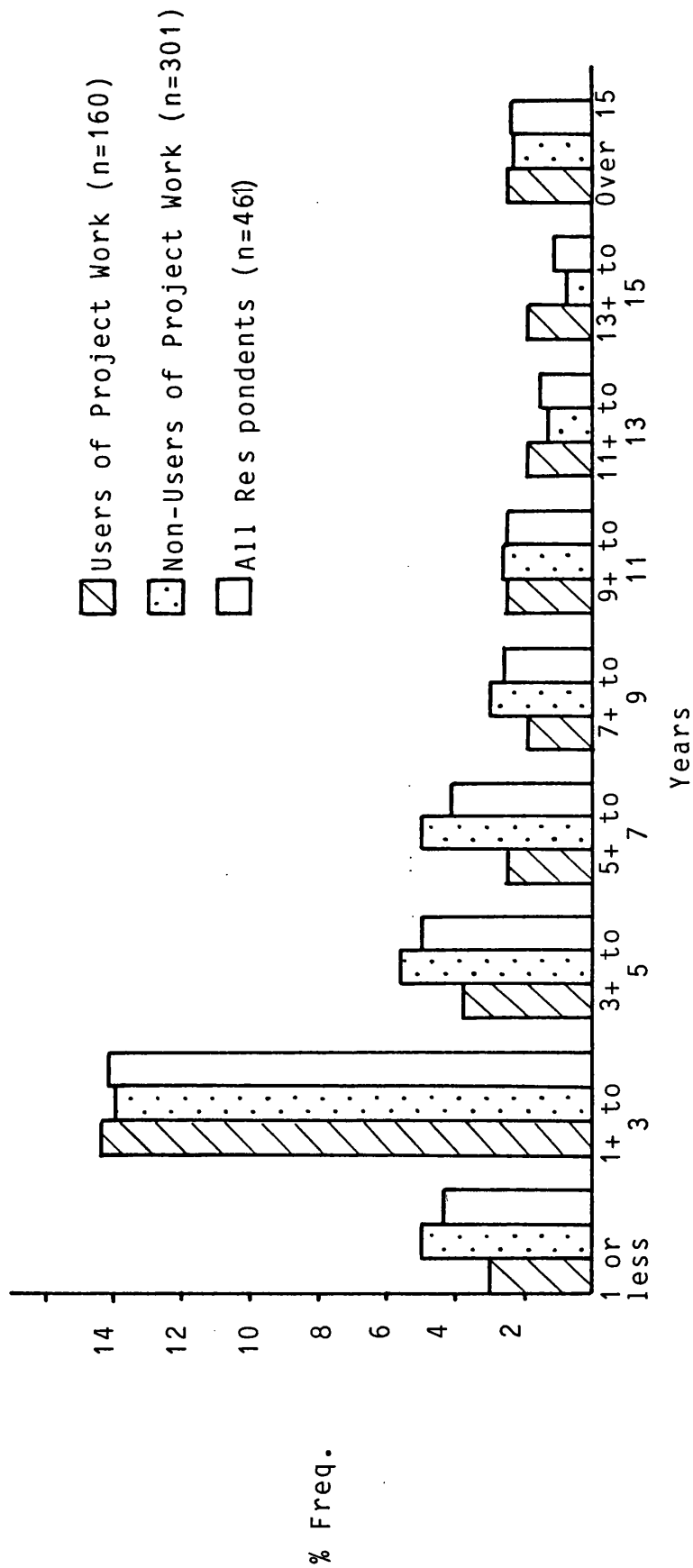
DURATION	FREQUENCY OF RESPONSE (% age)		
	'USERS'	'NON-USERS'	ALL RESPONDENTS
1 year or less	5 (3.1)	15 (5.0)	20 (4.3)
1+ to 3	23 (14.4)	42 (14.0)	65 (14.1)
3+ to 5	6 (3.8)	17 (5.6)	23 (5.0)
5+ to 7	4 (2.5)	15 (5.0)	19 (4.1)
7+ to 9	3 (1.9)	9 (3.0)	12 (2.6)
9+ to 11	4 (2.5)	8 (2.7)	12 (2.6)
11+ to 13	3 (1.9)	4 (1.3)	7 (1.5)
13+ to 15	3 (1.9)	2 (0.7)	5 (1.1)
Over 15 years	4 (2.5)	7 (2.3)	11 (2.4)
Not ans.*	105 (65.6)	182 (60.5)	287 (62.3)
n =	160	301	461

*These figures include those respondents who were never employed outside the field of education for any period longer than six months.

As shown in Table 6.10d. and Figure 6(iii), relatively more 'Non-Users' of project work were found to have had work experience outside the field of education in all categories between 3 and 11 years duration. The differences observed between the 'Users' and 'Non-Users' across these categories were however only slight and showed no

FIGURE 6 (iii)

THE DURATION OF EMPLOYMENT OUTSIDE EDUCATION



statistical significance. Slightly more 'Users' than 'Non-Users' were found to have held employment outside education for periods of between 1 and 3 years and in excess of 11 years, but again these findings were not statistically significant⁽¹³⁾.

Thus, in conclusion, it would seem that the initial hypothesis that work experience outside education, in fields related either directly or indirectly to subject teaching areas, might encourage teachers to adopt a project approach with their pupils receives no support from this study of C.S.E. science teaching. Moreover, among the 'Users' and 'Non-Users' of project work, no characteristic patterns of employment experience were discernible with respect to the duration of work periods outside education. For these two groups of teachers, the time periods spent working outside education were largely comparable, revealing no significant differences or trends. However, the value of work experience cannot be easily dismissed since the numbers involved in this study are small and the suggestion that work experience might help teachers to relate their subject to the everyday life of pupils, by allowing them the opportunity to call upon their own experiences to illustrate the importance of scientific principles and processes, might still be upheld even though such strategies would not, from this brief study, seem to manifest themselves in the application of the project method at C.S.E. level.

6.2.7. Summary

Three hundred and thirty (71.6%) of the science teachers participating in the study were male although a breakdown by subject area revealed that the sex ratio was more evenly balanced among Biology teachers, 48.9% of whom were women, and more one-sided in Physics where only 6.4% of the teachers were female. An analysis of the use of project work by male and female teachers revealed no significant difference between the two sexes although in the sample studied project work was used marginally more by female teachers in C.S.E. General Science and Physics. Although not statistically important, this was an interesting finding in view of the marked dissimilarity of the two subjects in terms of the sex ratios of the teachers, the subject status and the ability range of the pupils usually involved. From this, it was concluded that a complex of factors other than sex influence teachers in their decisions about project work.

Two hundred and eighty-seven (62.3%) of the respondents were found to be under the age of thirty-five although an analysis by subject area showed that the teachers of General Science and the other fringe subjects⁽¹⁴⁾ were on average slightly younger than the total population whilst the Physics teachers were slightly older. Using the grouped data that were available, the mean age of the teachers participating in the study was estimated to be 33 years 9 months. An analysis of the use of project work by teachers of differing ages revealed no significant differences although the 'Non-Users' of project work did

tend to be slightly older. However, since Physics teachers were found to be in the older age ranges and to use project work to a much lesser extent, it was suggested that any relationship between teacher age and use of project work that might exist was more likely, in this study, to be a product of subject area and associated variables rather than age itself.

An analysis of the qualifications and training of the respondents showed that four hundred and eleven (89.2%) of them had successfully completed a formal course of teacher training and three hundred and forty-five (74.8%) of them were graduates. Hence, the majority of the teachers participating in the study were teacher-trained graduates. Further analysis of their qualifications also revealed that 39.7% of them were trained graduates with Class II Honours or above. Forty-three teachers (9.3% of the total sampled) claimed some form of higher degree, the Doctorate and M.Sc. being the most common awards gained in this category. With respect to their qualifications and training, no significant differences were found between those teachers using project work and those not. Similarly, there was no evidence to suggest that teachers with higher degrees used the project method to any lesser (or greater) extent than those without such qualifications.

The majority (63.4%) of the respondents had been in their present teaching post just five years or less. Twenty-five teachers (5.4%) had however been in the same establishment for over fifteen years whilst thirty-six respondents (7.8%) were in their first probationary year of teaching.

Pursuing the question of teaching experience, the majority (56.4%) of the respondents had spent in total between 1 and 10 years in teaching. Eighteen teachers (3.9%) had been teaching for over 25 years. Their range of experience was wide and varied. Two hundred and forty-two (52.5%) teachers had held other full-time teaching appointments in secondary education. Over one third of them had taught in comprehensive establishments previously, 18% had grammar school experience and almost an equal proportion had worked in secondary modern schools. Some teachers had acquired further teaching experience in technical, special and other secondary institutions.

Considering teaching experience in relation to the use of project work, it appeared that the number of years in a particular establishment did not noticeably affect teachers' use of the project method. From the data, it could be seen that teachers who were 'long-standers' in a school used project work just as frequently as the newer members of staff, the only important exception to this finding being those teachers in the 'over 15 years' category. Only three out of the twenty-five teachers in this group used the project approach. In terms of the total number of years spent in teaching, no significant differences were found between the users and non-users of project work. There was therefore no support for the suggestion that the longer a teacher's period in teaching, the greater his/her reluctance to move away from the more traditional approaches and implement more progressive teaching strategies.

In connection with the type of teaching experience acquired by the respondents, no relationships of any

statistical importance were apparent although a slightly greater proportion of those teachers using the project method had taught in secondary modern and technical schools. It was suggested that these types of school, because of the calibre of their pupils and their non-academic curricula biassed towards the practical approach, might have encouraged teachers to use (or at least to think about using) the project method. In contrast, of those teachers not using the project method a greater proportion had seemingly gained some or all of their teaching experience in grammar or comprehensive schools. Again, it was tempting to interpret such findings in terms of pupil ability, academic ethos and exam-orientation but these explanations remained cautionary. The data were scant and although differences were detected, it has to be stressed that the results were not statistically significant. Thus, the interpretations can only be speculative.

Concerning teachers' experience of the C.S.E., one hundred and eighty-four (39.9%) of the respondents had some previous knowledge of the examination. This experience covered a variety of subject areas and a number of different Examination Boards. It was clear that some of the teachers participating in the study had taught C.S.E. science subjects other than the one with which they were currently associated. This was found to be especially true of General Science teachers who had experience of C.S.E. teaching in Biology, Chemistry and Physics. The same was not however true for the teachers of Physics; for this group of respondents the incidence of teaching experience in other C.S.E. disciplines was markedly

reduced. It was suggested that this perhaps reflected the high status of Physics as a teaching subject and pointed to the shortage of staff available to teach it. There was no evidence to suggest a relationship between teachers' experience of the C.S.E. and their use of project work although the lack of first-hand knowledge of Mode III examining in all subject areas was thought to explain in part the low incidence of project work observed in this study.

In examining the range of experience held by the respondents, the question of employment outside teaching was considered. On this issue, one-hundred and seventy-four (37.7%) of the teachers indicated that they had previously been engaged in full-time work outside the field of education for periods of six months or more. A variety of occupations were recorded although the greatest proportion of respondents in this category had, on earlier occasions, worked in industry, in occupations which were classed as science-practising. (Examples cited included analytical chemistry and industrial research.) Forty-three teachers had on the other hand undertaken jobs of a clerical/administrative nature. In this class, occupations such as social work, the Civil Service and managerial appointments were quoted. Several other forms of employment were stated but their incidence was less marked. The duration of employment outside education varied from six months to over fifteen years although the greatest proportion of the respondents had been employed for just three years or less. The employment data for the users and non-users of project work were largely comparable in terms of the

nature, duration and variety of outside work. The 'Non-Users' were found to have engaged in a slightly wider range of jobs overall but the findings in this respect were not statistically significant.

Thus, in concluding this summary, it may be said that teacher characteristics (defined in terms of age, sex, qualifications, training and work experience) have little bearing on teachers' use of the project method. Although clearly interesting from the sociological perspective, the age distribution, the sex ratio and the patterns of education and employment as single variables appear to have little direct influence on teachers' decisions about project work. More probably, it is a complex of these factors and others that interact to affect teachers' attitudes about project work and influence their practices in this respect.

6.3. The Teachers : General Attitudes

6.3.1. Attitudes Towards Teaching

As discussed earlier (see Chapter 2.2.) the period of the enquiry was perceived by many as a time of disenchantment for those in teaching. In the press, much frustration had been documented; working conditions, salaries, career prospects and reduced expenditure in education had all been under attack. Steadily, the concept of teaching as a high status profession was challenged and eroded, and comparability studies with industry revealed clear

differentials in terms of salaries and benefits for those with similar qualifications and training. It was on the basis of these studies that the leading teachers' unions and associations demonstrated that the teachers were the disadvantaged group⁽¹⁵⁾.

The degree of dissatisfaction among teachers was thought to be especially pertinent to this enquiry given that C.S.E. science teaching is often regarded as low-status compared to, say, G.C.E. O- and A-level work. In addition, because science specialists have had greater opportunities to enter those more profitable occupations in industry, it was felt that the science teachers involved with the C.S.E. might feel cheated in their ambitions and aspirations. To assess this particular aspect of frustration among teachers, a tentative test of teacher satisfaction was included in Section D of the questionnaire.

After careful consideration, Item 3(d) was phrased thus:

Do you consider your present teaching commitments to be appropriate to your specific qualifications and training?

The teachers' response to this question is given in Table 6.11.

In view of the claims put forward through the media, it was a little surprising to find that almost three-quarters of the respondents (74.4%) considered their teaching commitments to be appropriate to their qualifications and training. Hence, in terms of teaching responsibilities, this study offered little support for the notion of job frustration. The type of course and the category of pupil taught did not appear to be a major source of dissatisfaction among the respondents. Clearly, dissatisfaction, if it does

exist, would seem to be rooted in other realms of education (e.g. salaries, promotion, cuts in public expenditure, etc.) and on the basis of ad hoc comments made during the interviews, subjectively this would seem to be true.

TABLE 6.11.

TEACHING COMMITMENTS IN RELATION QUALIFICATIONS
AND TRAINING

	FREQUENCY OF RESPONSE (% age)		
	'Users' of Project Work	'Non-Users' of Project Work	All Respondents
Yes, teaching commitments are appropriate to qualifications and training	113 (70.6)	230 (76.4)	343 (74.4)
Uncertain	19 (11.9)	20 (6.6)	39 (8.5)
No, teaching commitments are not appropriate to qualifications and training	26 (16.3)	40 (13.3)	66 (14.3)
Not Answered	2 (1.3)	11 (3.7)	13 (2.8)
n =	160	301	461

The high level of agreement observed in response to the questionnaire item was of additional interest in that it perhaps reflected two entirely different standpoints.

From the first perspective, the degree of satisfaction recorded may have indicated that those teachers responsible for the low level, less academic courses (such as those C.S.E. sciences courses under investigation) saw their task as especially challenging because they were required to evoke interest and learning in pupils who may not have been inherently science-oriented. In this way, their

teaching commitments, rather than being simplistic and frustrating, were seen as continually stimulating and demanding.

Alternatively, from another perspective, the level of satisfaction observed may have reflected the wide range of courses and pupils for which the science teachers were responsible. Hence, the respondents as well as teaching C.S.E. subjects may have had sufficient variety of other courses included in their teaching programme to fulfil their own personal and intellectual aspirations, and to alleviate the feelings of despondency which they might have experienced when only low level work in science was being undertaken.

Thus, it may be that teachers from essentially opposing positions are able to agree that their teaching commitments are appropriate to their qualifications and training. Each teacher may be able to acknowledge the specialist expertise required of him (i.e. either the skill required to teach non-academic pupils or the skill needed to teach science courses at a variety of levels) and so achieve that level of satisfaction reflected in the response to this questionnaire item.

6.3.2. Attitudes Towards Project Work

In the discussion of teacher characteristics at the start of this chapter, certain references were made to the changing attitudes of teachers. It was suggested that although teachers may subscribe to different sets of

beliefs about procedures, strategies and curricula and hold varying perspectives of their pupils' needs and abilities, in the school context they are often put under pressure to accept those beliefs and attitudes common to the rest of the staff so that in reality pressure to conform may markedly influence their teaching practices and relationships with pupils (Morrison and McIntyre 1969, Shipman 1967, Perry 1969).

With these issues in mind, Section C of the questionnaire was constructed in an attempt to investigate teachers' own attitudes towards project work and its role as a teaching/learning strategy, and to examine in more detail the differences in perspective held by those teachers using the method and those not.

Section C comprised twenty random statements about project work; ten of these statements could be regarded as favourable (e.g. 'Project work increases pupils' interest in the subject') and ten unfavourable (e.g. 'Many pupils waste time during class periods allocated to project work'). The teachers involved in the study were asked to respond to each of these statements in turn, indicating either agreement, uncertainty or disagreement. Their responses are summarised in Table 6.12.

In the first analysis, a range of attitudes was discernible, many of which centred on those less desirable aspects of the project method. In general, the respondents were agreed that at C.S.E. level project work had a number of drawbacks especially in relation to the 'average' pupil. Time-wasting and plagiarism (items 2 and 8) on the part of the pupils were identified as important disadvantages and

TABLE 6.12.

ATTITUDES TOWARDS PROJECT WORK

	STATEMENT ABOUT PROJECT WORK	FREQUENCY OF RESPONSE (% age)										Significance					
		ALL RESPONDENTS (n=461)					'USERS' (n=160)						'NON-USERS' (n=301)				
		Agree	Uncertain	Disagree	Agree	Uncertain	Disagree	Agree	Uncertain	Disagree	Agree		Uncertain	Disagree			
1.	Project work increases pupils' interest in the subject	36.7	46.0	15.2	49.7	39.7	10.0	29.9	49.5	17.9							
2.	Many pupils waste time during class periods allocated to project work	71.4	15.4	11.7	67.5	14.4	17.5	73.4	15.9	8.6							
3.	Project work of any real value to the pupil is beyond the scope of an average C.S.E. candidate	35.4	19.7	43.6	29.4	13.8	56.9	38.5	22.9	36.5							
4.	An ability to apply previous understanding of fundamental concepts to new situations is derived from project work	27.3	40.3	31.2	30.0	40.6	28.8	25.9	40.2	32.6							
5.	A large measure of subjectivity is involved in the assessment of project work	69.4	18.2	10.6	70.6	18.8	9.4	68.8	17.9	11.3							
6.	Communication skills are developed through project work	45.1	37.7	15.4	50.0	36.3	12.5	42.5	38.5	16.9							
7.	Pupils gain self-confidence through project work	37.1	39.5	21.5	46.3	30.6	21.9	32.2	44.2	21.3							
8.	Project work results in large volumes of material being copied directly from books and journals	76.8	12.8	8.7	75.6	10.6	12.5	77.4	14.0	6.6							
9.	Project work makes excessive demands on the free time of the teacher	42.1	23.6	32.5	33.8	16.3	48.8	46.5	27.6	23.9							
10.	Project work ensures pupils take care over the presentation of their work	29.1	28.0	41.6	36.3	27.5	35.6	25.2	28.2	44.9							
11.	Project work cannot be reliably standardized; a pupil may be severely handicapped by his/her choice of topic	64.4	20.2	14.3	61.9	15.6	21.9	65.8	22.6	10.3							
12.	Project work is too time-consuming to be done well within the confines of a school/college timetable	51.2	25.6	21.9	45.0	21.3	33.8	54.5	27.9	15.6							
13.	Enquiry skills are developed through project work	56.4	31.5	11.1	65.6	24.4	10.0	51.5	35.2	11.6							
14.	Pupils learn self-discipline through project work	26.9	46.2	25.4	44.4	36.9	17.5	17.6	51.2	29.6							
15.	Some pupils are placed at a serious disadvantage when they have several projects to do in different subjects	71.1	19.1	8.7	71.9	16.9	11.3	70.8	20.3	7.3							
16.	Pupils' powers of deduction are developed through project work	18.4	46.4	33.2	22.5	48.1	26.9	16.9	45.5	36.5							
17.	Skill in the planning and organisation of scientific investigations is acquired through project work	35.1	36.0	27.8	37.5	39.4	23.1	33.9	34.2	30.2							
18.	Project work is too costly in resources to be catered for adequately by the standard school/college	37.3	26.0	35.1	24.4	25.0	50.0	44.2	26.6	27.2							
19.	Project work favours the child from the resourceful home	76.6	14.8	7.8	76.3	13.1	10.6	76.7	15.6	6.3							
20.	Skill in the handling and interpretation of data is acquired through project work	37.7	44.0	17.1	49.4	37.5	13.1	31.6	47.5	19.3							

from a managerial perspective additional problems were recognised. The majority of teachers (64.4%) felt that project work could not be reliably standardized and that certain pupils could be severely handicapped by an unwise choice of topic (item 11). 71.1% of the respondents envisaged further difficulties when pupils following a C.S.E. programme were required to undertake several projects in other subjects areas (item 15), the general feeling being that pupils under these circumstances were likely to have demands placed upon them that were in total quite beyond their capabilities. In addition, over half of the respondents (51.2%) agreed that given the existing constraints of time-table allocations, project work was too time-consuming to be done well (item 12). Several teachers added that the products/outcomes of project work rarely seemed to justify the time and effort expended on it. And finally, in terms of the assessment of pupils, over three quarters of the teachers thought that project work favoured the child from the resourceful home (item 19) and a further 69.4% acknowledged that the assessment of pupils' project work involved a large measure of subjectivity (item 5).

In the second analysis - the breakdown of responses made by the 'Users' and 'Non-Users' of project work - a number of significant differences between the two groups of teachers were found. The 'Users', as might be expected, viewed project work rather more favourably than the 'Non-Users'. They supported the idea that project work was effective in promoting the acquisition of certain skills e.g. enquiry skills (item 13) and skill in the handling

and interpretation of data (item 20), and valuable to the development of certain attitudes to learning e.g. interest in the subject (item 1), self-confidence (item 7) and self-discipline (item 14). The 'Non-Users', in contrast, showed a greater tendency to see project work as a costly, demanding, time-consuming exercise, difficult to standardize and possibly beyond the scope of the 'average' C.S.E. pupil (items 3, 9, 11 and 12). They envisaged more managerial problems and displayed less confidence in project work as anything more than an exercise in plagiarism (item 8).

The level of agreement observed among the 'Users' and 'Non-Users' of the project method towards the ten favourable and the ten unfavourable statements about project work is illustrated graphically in Figures 6(iv) and 6(v).

From the histograms, it can be seen that those teachers using the project method showed a higher level of agreement with the favourable (i.e. positive) statements (items 1, 4, 6, 7, 10, 13, 14, 16, 17 and 20) whilst those respondents not using the project approach tended to give more support to the negative aspects of the method. However, several important exceptions to this overall trend were observed. For instance, for items 5 and 15, which identified (i) subjectivity in assessment and (ii) the disadvantages of too many projects in other subjects as negative features of the project strategy, a slightly higher percentage of agreement was found among those teachers actually using the method although in both cases some 70% of all respondents ('Users' and Non-Users') confirmed these views. Thus, the assessment of project work

FIGURE 6(iv)

AGREEMENT WITH FAVOURABLE STATEMENTS ABOUT PROJECT WORK

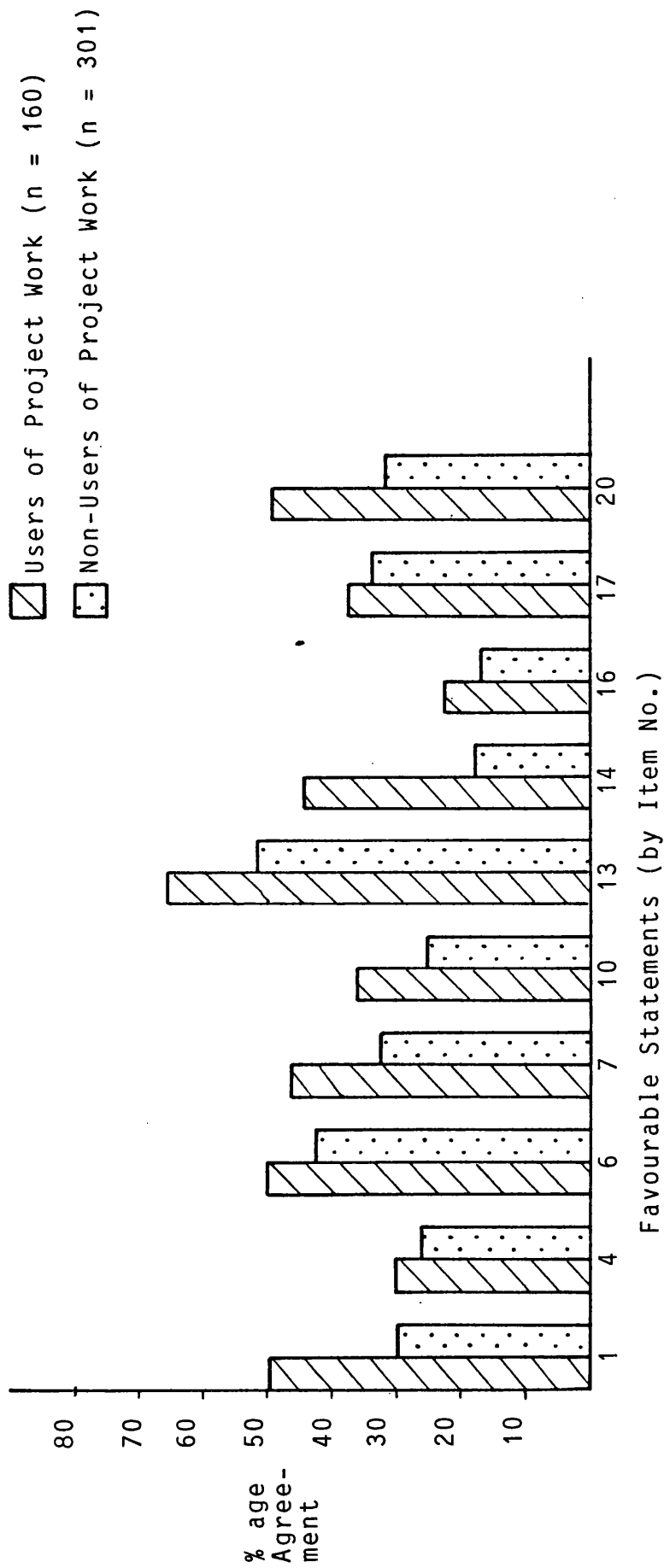
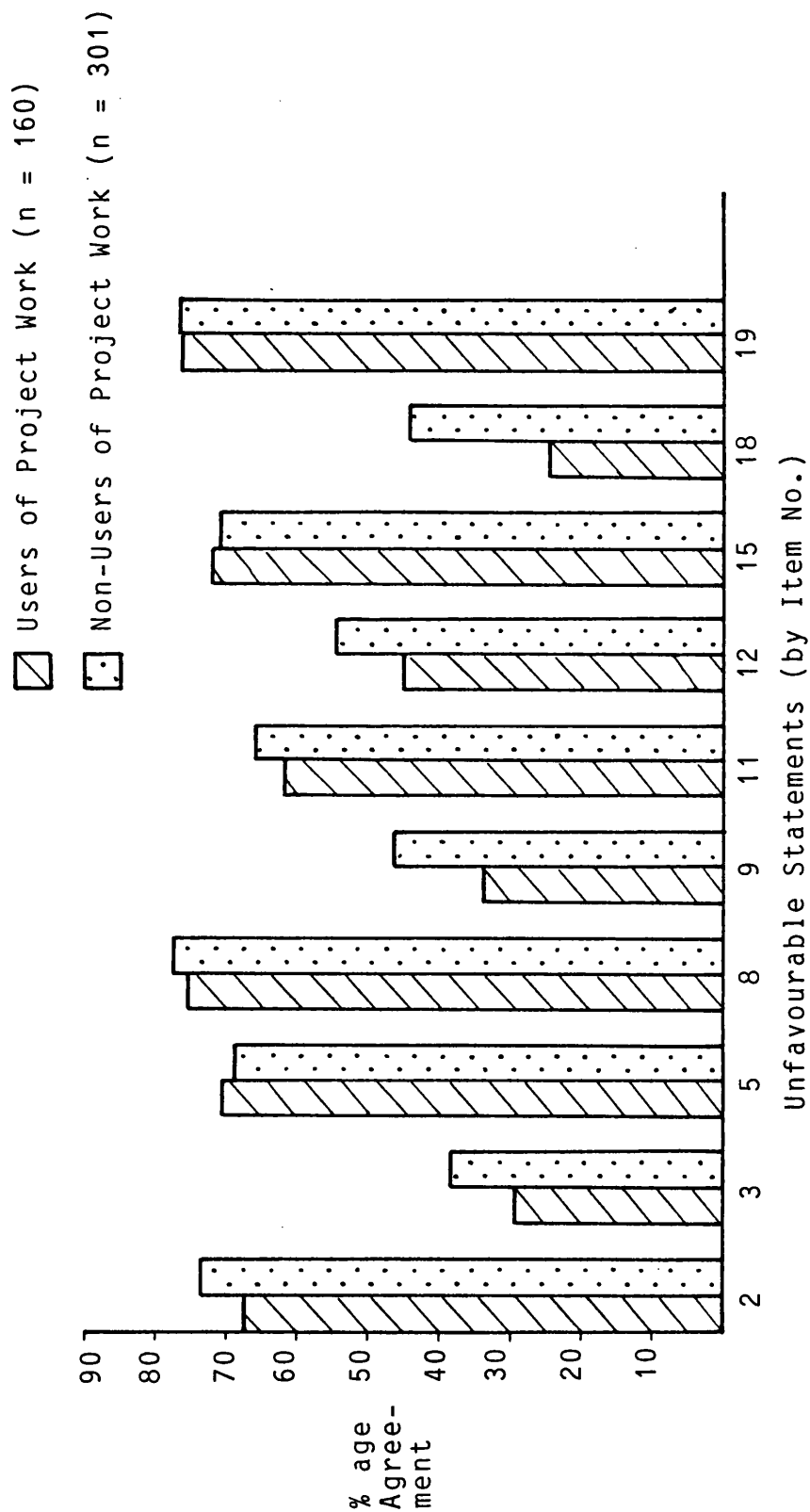


FIGURE 6(v)

AGREEMENT WITH UNFAVOURABLE STATEMENTS ABOUT PROJECT WORK



and its incorporation into the school curriculum alongside other subjects were seen as important considerations by those science teachers undertaking this type of approach with C.S.E. pupils. Interestingly, the 'Users' also acknowledged the problems of standardization and were particularly sensitive to the idea that project work favours the child from the resourceful home. In contrast, whilst maintaining that project work had a number of unfavourable features, over half of the 'Non-Users' (51.5%) agreed that 'enquiry skills are developed through project work' (item 13).

In a third analysis, the 'weight' of teachers' views was assessed in an effort to gain an overall picture of teachers' leanings towards project work. In this analysis, teachers' responses were combined so that agreement with positive statements and disagreement with negative statements were interpreted as favourable attitudes towards project work, and agreement with negative statements and disagreement with positive statements were interpreted as unfavourable. The teachers' responses to these positive and negative statements were then weighted according to the number of responses - out of a possible ten - that were recorded in each case. The findings are summarised in Table 6.13. and represented graphically in Figure 6(vi), where a(i) and a(ii) indicate favourable leanings and b(i) and b(ii) unfavourable. The greater the mean value in each case, the greater the weight of attitude.

By grouping the responses of the two sets of teachers in this way, several points of interest were highlighted.

TABLE 6.13.

THE RANGE OF ATTITUDES HELD BY THE USERS AND NON-USERS OF PROJECT WORK

Number of Responses (x/10)	a) Favourable Attitudes										b) Unfavourable Attitudes									
	i. Agreement with positive					ii. Disagreement with negative					i. Agreement with negative					ii. Disagreement with positive				
	'USERS'		'NON-USERS'			'USERS'		'NON-USERS'			'USERS'		'NON-USERS'			'USERS'		'NON-USERS'		
	Raw	%	Raw	%		Raw	%	Raw	%		Raw	%	Raw	%		Raw	%	Raw	%	
0	23	14.4	63	20.9		23	14.4	95	31.6		2	1.3	6	2.0		57	35.6	70	23.3	
1	14	8.8	44	14.6		27	16.9	82	27.2		4	2.5	5	1.7		34	21.3	62	20.6	
2	9	5.6	46	15.3		28	17.5	52	17.3		10	6.3	17	5.6		17	10.6	40	13.3	
3	17	10.6	30	10.0		27	16.9	35	11.6		14	8.8	13	4.3		12	7.5	39	13.0	
4	28	17.5	37	12.3		28	17.5	22	7.3		15	9.4	29	9.6		15	9.4	29	9.6	
5	12	7.5	25	8.3		12	7.5	10	3.3		30	18.8	42	14.0		7	4.4	19	6.3	
6	12	7.5	19	6.3		9	5.6	2	0.7		29	18.1	34	11.3		9	5.6	11	3.7	
7	14	8.8	11	3.7		3	1.9	2	0.7		24	15.0	62	20.6		6	3.8	13	4.3	
8	17	10.6	9	3.0		2	1.3	1	0.3		21	13.1	39	13.0		3	1.9	7	2.3	
9	11	6.9	9	3.0		1	0.6	-	-		6	3.8	38	12.6		-	-	8	2.7	
10	3	1.9	8	2.7		-	-	-	-		5	3.1	16	5.3		-	-	3	1.0	
Total ($\sum fx$)	690		923			436		463			890		1856			319		785		
MEAN (\bar{x})	690 - 160 = 4.31		923 - 301 = 3.07			436 - 160 = 2.73		463 - 301 = 1.54			890 - 160 = 5.56		1856 - 301 = 6.17			319 - 160 = 1.99		785 - 301 = 2.61		

Difference between means = 1.24

= 1.19

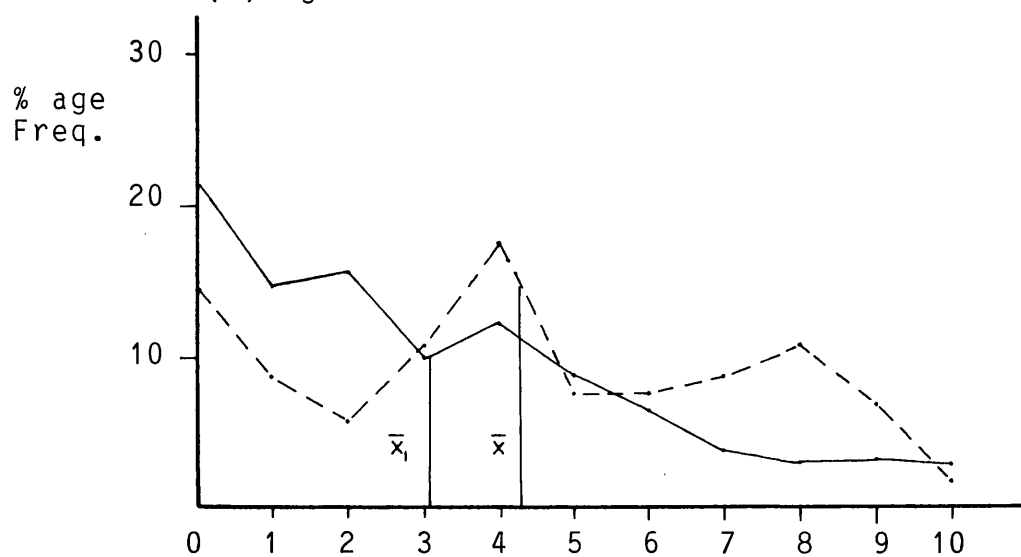
= 0.61

= 0.62

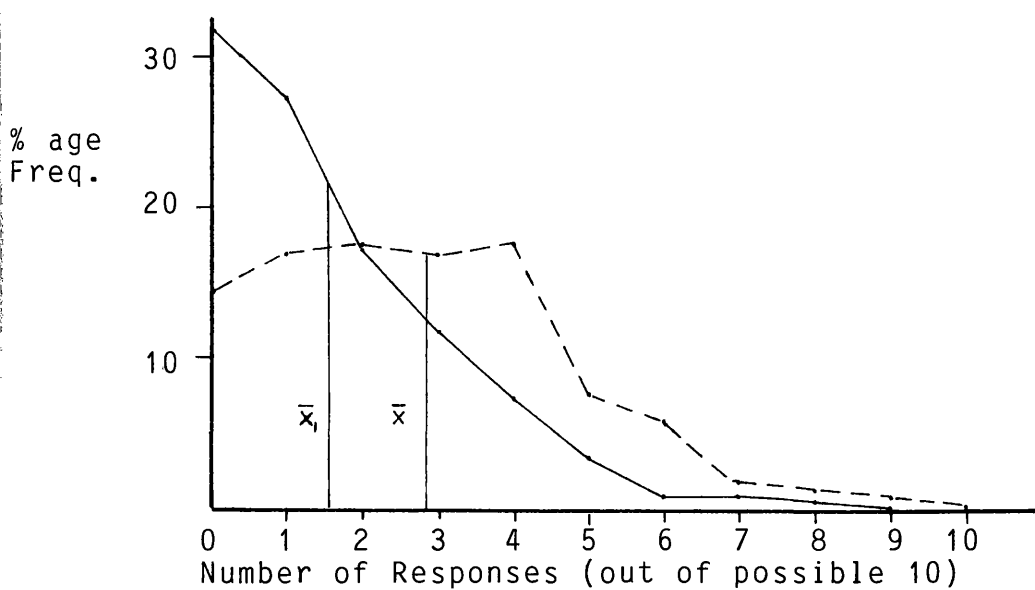
FIGURE 6(vi) (cont.overleaf)

(a) FAVOURABLE ATTITUDES TOWARDS PROJECT WORK AMONG
'USERS' AND 'NON-USERS'

(i) Agreement with Positive Statements



(ii) Disagreement with Negative Statements



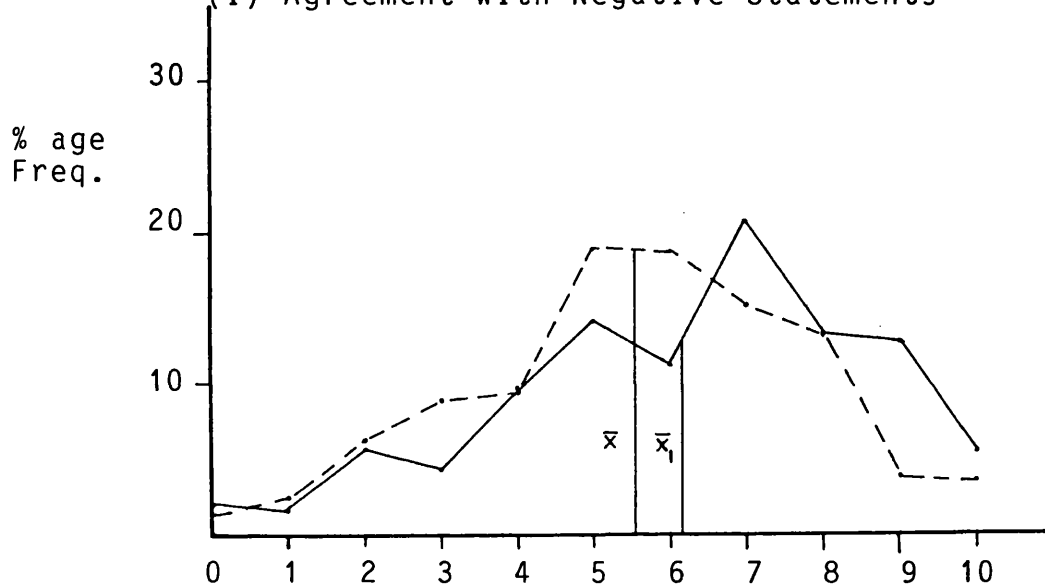
▨ Users of Project Work (n = 160)

▨ Non-Users of Project Work (n = 301)

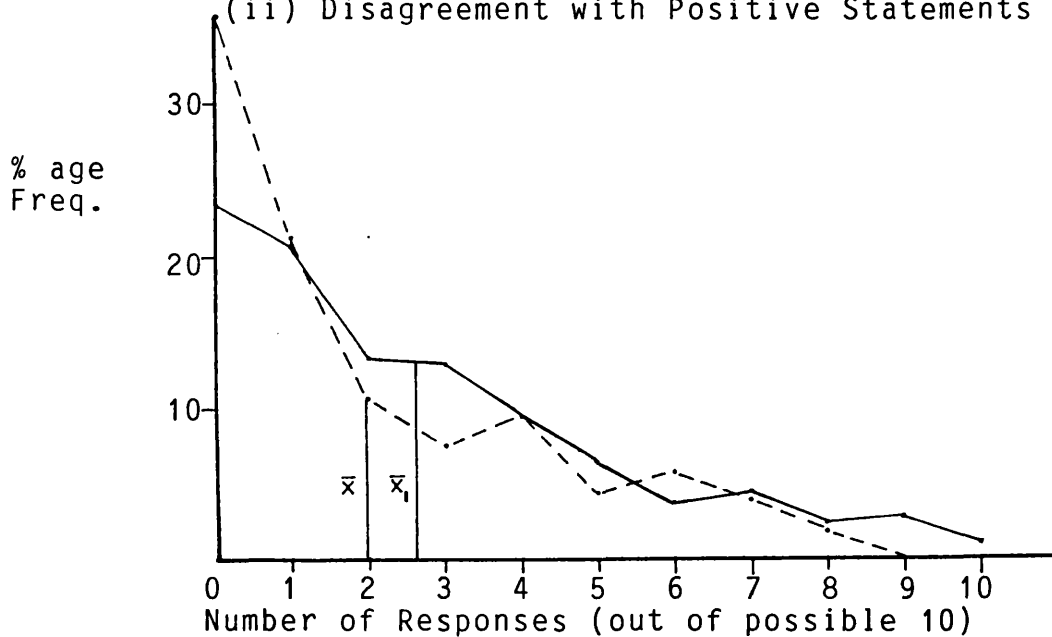
FIGURE 6(vi) (continued)

(b) UNFAVOURABLE ATTITUDES TOWARDS PROJECT WORK AMONG
'USERS' AND 'NON-USERS'

(i) Agreement with Negative Statements



(ii) Disagreement with Positive Statements



☒ Users of Project Work (n = 160)

☒ Non-Users of Project Work (n = 301)

In their responses, the users of the project method showed a greater tendency to agree with the positive statements ($\bar{x} = 4.31$) than the 'Non-Users' who, in contrast, showed stronger agreement with the negative statements ($\bar{x}_1 = 6.17$). Low scores were recorded for b(ii) 'disagreement with positive statements' by the 'Users' and for 'disagreement with negative statements' by the Non-Users' ($\bar{x} = 1.99$, $\bar{x}_1 = 1.54$) although of more importance was the high level of 'agreement with negative statements' observed in both the 'Users' and 'Non-Users' ($\bar{x} = 5.56$ and $\bar{x}_1 = 6.17$ respectively). Hence, the more marked difference in response (as measured by the differences in means) between the two groups of teachers was found in respect of their favourable attitudes to project work rather than their less favourable ones. [This finding is demonstrable graphically by comparing figures a(i) and (ii) with b(i) and (ii) of Figure 6(vi).]

Thus, it seems reasonable to conclude that all the teachers, irrespective of their current teaching practices, appreciated to some extent the problems of the project approach and the difficulties of implementing it successfully. The differences of opinion centred, it would appear, mainly on the benefits of project work. Those teachers actually using project work with C.S.E. pupils were, at the time of the enquiry, more able/inclined to recognise the favourable aspects of the project approach. They identified the positive features more readily and for them the favourable outcomes of project work (e.g. the development of communication and enquiry skills, the increase in pupils' interest and the acquisition of skill

in the handling and interpretation of data) outweighed its difficulties. Hence, on balance, these teachers accepted that the project approach was a worthwhile strategy.

In contrast, the 'Non-Users' of project work could concede to some of the beneficial aspects of the method (e.g. the development of enquiry skills) but could not accept that these over-ruled the problems of standardization, subjectivity, cost, time-wasting and plagiarism.

6.4. Science Teachers: A Typology based on Cluster Analysis

Cluster analysis is a useful and important processing method that permits the examination of relationships between individuals involved in a study as distinct from the variables used in that study. It is a complex statistical procedure comprising a large number of classification techniques rather than a single analytical method. Through cluster analysis, groups (or clusters) are formed on the basis of similarity of individuals within one group and the contrast or distinction of individuals between groups, the aim being to increase the within-group similarity whilst increasing that group's distance from other groups.

For this particular study, C.A.R.M. (Cluster Analysis by Relocation Methods), a computer program available through the P.M.M.D. package at the University of Nottingham, (see Youngman 1976) was employed. This program utilises the centroid relocation procedure which differs from the hierarchical grouping methods by repeatedly

comparing individual cases with existing groups (or clusters) and not with every other case. It commences with the random allocation of individual cases to a pre-set number of groups (usually set at between 10 and 20). Then, on the basis of cluster centroids (i.e. the mean scores for all the cluster members on each variable) individuals are relocated into the group with which they show greatest similarity. The two most similar groups are then fused. Computationally, the process is much faster than the hierarchical methods and as a consequence larger samples may be analysed.

The combined process of centroid computation, relocation and fusion is repeated (reiterated) until a single group composed of the entire sample remains. By plotting a distance graph of the error or similarity associated with successive fusions, poor fusions can be identified. Any large increases in the distance measure shows that relatively dissimilar groups have been combined. Hence, scrutiny of the groups preceding that fusion are more valid. A detailed picture of the classification structure is also provided by a dendrogram showing the successive fusions making up the complete analysis. The length of each horizontal arm of the dendrogram is proportional to the increase in error associated with the subsequent fusion. Hence, long branches again suggest that classifications before the increase are more valid. By using these two facilities, the appropriate number of clusters for further study can be decided upon and the diagnosis of the characteristics of each cluster can begin.

The four hundred and sixty-one teachers involved in this enquiry were clustered according to their grades of response (agree, uncertain, disagree) to the twenty statements on project work given in Section C of the questionnaire. The C.A.R.M. program was set up as shown in Table 6.14., commencing with the random allocation of teachers to 15 groups and a maximum of 10 iterations per relocation cycle. The patterns of group merger were displayed in the form of a dendrogram (Figure 6(vii)) and a fusion plot (Figure 6(viii)). Visual inspection of these plots indicated that analysis of group membership at the 3-cluster stage might be worthwhile.

The three clusters were analysed in the first instance with reference to the mean scores (cluster centroids) obtained for the twenty variables used in the classification. The teachers' response to these items had been standardized and were coded as follows: agree = 1, uncertain = 2, disagree = 3. Therefore, for each item in the analysis a mean score or centroid value of between 1.00 and 1.67 indicated agreement, between 1.67+ and 2.33 uncertainty, and between 2.33+ and 3.00 disagreement. Thus, the overall level of agreement for members of each of the three clusters could be interpreted on the basis of the mean scores given in the computer diagnosis. These findings are presented in Table 6.15; the levels of significance, where applicable, are also given. The interpretation is simplified in Table 6.16, which relates the findings directly to items 1 to 20 on the questionnaire. This table charts the teachers' general attitudes towards each statement in terms of agreement, uncertainty and

TABLE 6.14

THE C.A.R.M. PROGRAM

CLUSTER SCIENCE

PARAMETERS FOR THIS RELOCATION ANALYSIS ARE AS FOLLOWS

NUMBER OF VARIABLES	20	
DATA TYPE IS	2	1=BINARY / 2=NUMERIC / 3=STANDARDISFD
DATA CHECKING MODE	0	0=NONE / 1=CHECK BINARY DATA
COEFFICIENT SELECTED	24	
MAXIMUM NO OF ITERATIONS	10	10 RECOMMENDED
INITIAL NO OF CLUSTERS	15	0=ARRAY SUPPLIED
FINAL NO OF CLUSTERS	1	
MINIMUM CLUSTER SIZE	0	0 RECOMMENDED
REMOVAL WANTED	0	0=YFS(RECOMMENDED) / 1=NO
THRESHOLD TEST WANTED	0	0=NO(RECOMMENDED) / 1=YES
THRESHOLD VALUE	0.0000	ONLY IF COL 18=1
PUNCH ARRAYS	0	0=NO / 1=YES
PRINT SIMILARITIES	0	0=NO / 1=YES
PUNCH SIMILARITIES	0	0=NO / 1=YES

SELECT DISSIMILARITY COEFFICIENT 24
 MAX NO. OF ITERATIONS PER RELOCATION CYCLE = 10
 OBJECTS ARE REMOVED FROM PARENT CLUSTERS FOR RELOCATION TEST
 NO THRESHOLD TEST SELECTED
 MINIMUM CLUSTER SIZE = 0
 NO. OF TERMINAL CLUSTERS = 1

ALLOCATE CASES TO 15 RANDOM CLUSTERS INITIALLY

FIGURE 6(vii)
PATTERNS OF GROUP MERGER
 CLUSTER SCIENCE

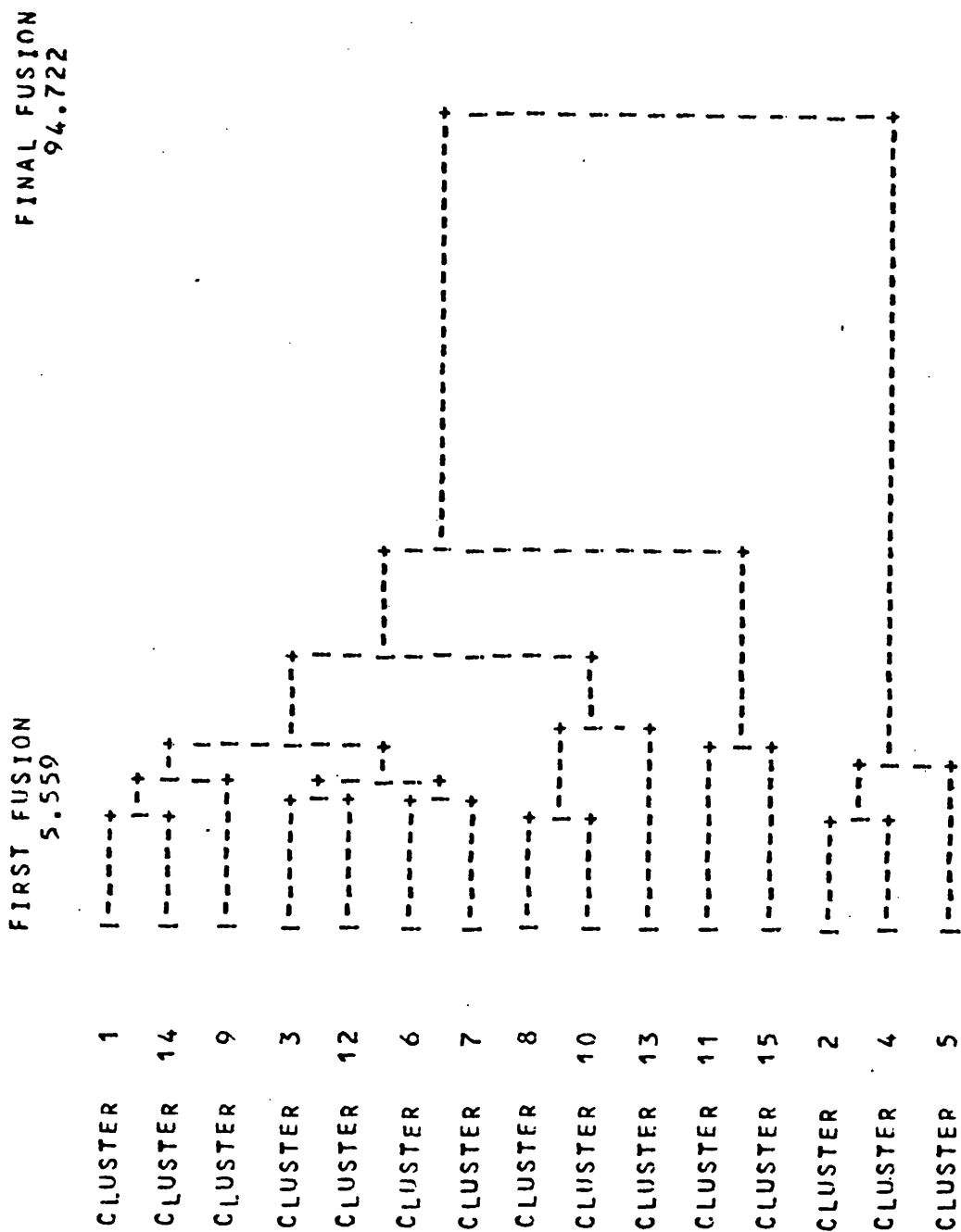


FIGURE 6(viii)
 THE FUSION PLOT, SHOWING REFLEXION AT CLUSTER
 STAGE 3

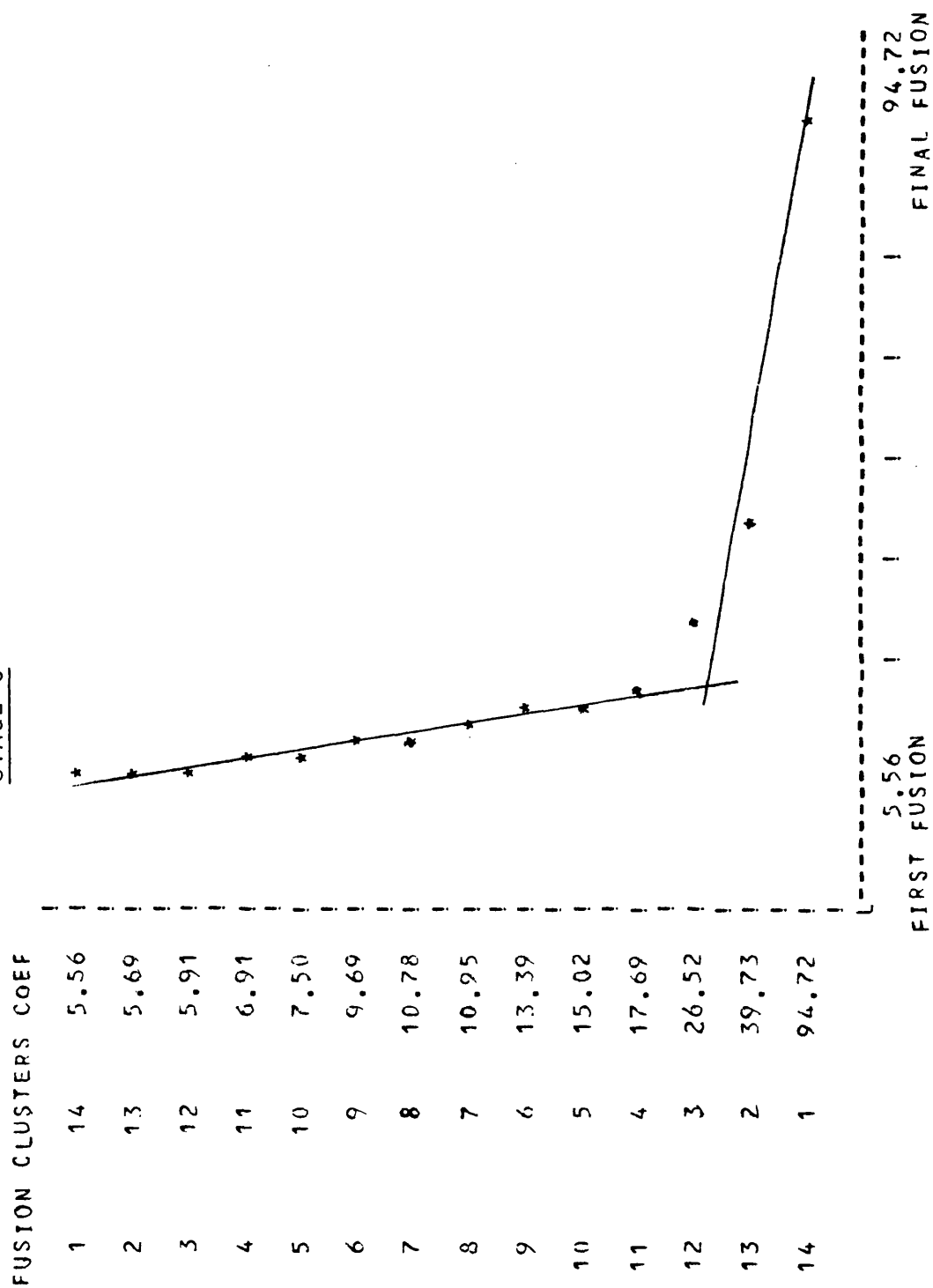


TABLE 6.15
DIAGNOSIS OF THREE CLUSTERS

DEGREES OF FREEDOM = BETWEEN				2.	/	WITHIN	458.
CLUSTER CODES		1/ 2		2/ 1		3/ 11	
CLUSTER SIZES		142		191		128	
VARIABLE F OR M=MASKED CHIZ PROR		CLUSTER CENTROIDS (MEANS)					
1	97.90	0.000**	2.27**	1.82		1.20**	
2	26.97	0.000**	1.32	1.21**		1.77**	
3	131.00	0.000**	1.40**	2.08		2.84**	
4	59.21	0.000**	2.48**	2.04		1.54**	
5	6.21	0.003**	1.30?	1.38		1.59**	
6	84.89	0.000**	2.30**	1.54**		1.32**	
7	126.29	0.000**	2.53**	1.69**		1.33**	
8	46.11	0.000**	1.12**	1.17**		1.77**	
9	7.58	0.001**	1.80	1.83		2.17**	
10	44.65	0.000**	2.58**	2.06		1.68**	
11	25.25	0.000**	1.27**	1.41		1.87**	
12	93.92	0.000**	1.37**	1.48**		2.43**	
13	125.70	0.000**	2.16**	1.36**		1.12**	
14	123.19	0.000**	2.62**	1.81**		1.40**	
15	16.38	0.000**	1.25*	1.28*		1.65**	
16	105.35	0.000**	2.66**	2.14		1.55**	
17	124.43	0.000**	2.57**	1.82*		1.32**	
18	37.09	0.000**	1.70**	1.83**		2.50**	
19	21.65	0.000**	1.21	1.16**		1.59**	
20	129.10	0.000**	2.40**	1.66**		1.27**	

* Significant at .05 level

** Significant at .01 level

TABLE 6.16.

CLUSTER GROUP ATTITUDES TOWARDS PROJECT WORK

STATEMENTS ABOUT PROJECT WORK	PERCENTAGE AGREEMENT/GENERAL ATTITUDE*					
	CLUSTER 1		CLUSTER 2		CLUSTER 3	
	% age	G.A.	% age	G.A.	% age	G.A.
1. Project work increases pupils' interest in the subject	12.0		25.7	NS	80.5	✓
2. Many pupils waste time during class periods allocated to project work	81.7	NS	81.7	✓	44.5	
3. Project work of any real value to the pupil is beyond the scope of an average C.S.E. candidate	70.4	✓	30.9	NS	3.1	
4. An ability to apply previous understanding of fundamental concepts to new situations is derived from project work	9.2		23.0	NS	53.9	✓
5. A large measure of subjectivity is involved in the assessment of project work	78.2	NS	70.2	NS	58.6	✓
6. Communication skills are developed through project work	12.7		50.3	✓	73.4	✓
7. Pupils gain self-confidence through project work	5.6		38.7		69.5	✓
8. Project work results in large volumes of material being copied directly from books and journals	93.0	✓	83.2	✓	49.2	
9. Project work makes excessive demands on the free time of the teacher	49.3	NS	45.0	NS	29.7	
10. Project work ensures pupils take care over the presentation of their work	7.7		20.0	NS	53.1	
11. Project work cannot be reliably standardized; a pupil may be severely handicapped by his/her choice of topic	81.0	✓	67.5	NS	41.5	
12. Project work is too time-consuming to be done well within the confines of a school/college timetable	73.2	✓	59.7	✓	14.1	
13. Enquiry skills are developed through project work	17.6		63.4	✓	89.4	✓
14. Pupils learn self-discipline through project work	2.8		26.7		53.9	✓
15. Some pupils are placed at a serious disadvantage when they have several projects to do in different subjects	82.4	✓	75.9	✓	51.6	✓
16. Pupils' powers of deduction are developed through project work	0.7		12.0	NS	47.7	✓
17. Skill in the planning and organisation of scientific investigations is acquired through project work	5.6		32.5		71.9	✓
18. Project work is too costly in resources to be catered for adequately by the standard school/college	53.5		42.4		11.7	
19. Project work favours the child from the resourceful home	82.4	NS	82.2	✓	61.7	✓
20. Skill in the handling and interpretation of data is acquired through project work	7.0		34.6	✓	76.6	✓

* GENERAL ATTITUDE (G.A.)



Agreement
Uncertainty
Disagreement
Not Significant

TABLE 6.17

THE USE OF PROJECT WORK
BY CLUSTER GROUP MEMBERS

Raw Frequency Raw Percentage Column Percentage	CLUSTER GROUP			TOTALS
	1	2	3	
Using/sometimes using project work	41 25.6 28.9	55 34.4 28.8	64 40.0 50.0	160 100 34.7
Not using project work	101 33.6 71.1	136 45.2 71.2	64 21.3 50.0	301 100 65.3
Cluster size	142	191	128	461

disagreement and also indicates the percentage agreement of members within each cluster to each of the statements.

To complete the picture, an analysis of the use of project work by cluster group members was also undertaken. The results of this analysis are given in Table 6.17.

From these findings certain beliefs and attitudes characteristic of each cluster emerged. These are summarised below.

TYPE 1 (Cluster group 1) The 'Opposers'

These teachers were generally opposed to the use of project work at C.S.E. level. They agreed by majority with all the negative items included on the list and failed to recognise any of the more favourable features of the method. The teachers in this group believed that project work was too costly (item 18) and time-consuming (item 12) to be catered for adequately by the standard school or college. They rejected the approach for its lack of standardization maintaining that pupils could be severely handicapped by their choice of topic (item 11), and as a teaching/learning strategy it was thought to be beyond the scope of 'average' C.S.E. pupils (item 3), resulting in excessive plagiarism (item 8) rather than effective learning. At the time of the enquiry, 28.9% of the teachers in this group used project work as part of their teaching programme although from their responses it seems unlikely that they implemented it out of personal choice.

TYPE 2 (Cluster Group 2) The 'Waverers'

These teachers held mixed views about project work; they regarded it from two perspectives. In agreement with the group 1 respondents, they felt that projects were all too often time-consuming (item 12), plagiaristic (item 8) exercises that resulted in pupils wasting time during formal class periods (item 2). They also recognised the difficulties for pupils undertaking project work in different subjects (item 15) and the problems of standardization arising out of variations in home background (item 19). However, whilst acknowledging these drawbacks, they held out some support for the suggestion that project work enhances pupils' self-confidence (item 7), assists in the development of enquiry and communication skills (items 6 and 13) and promotes skill in the handling and interpretation of data (item 20). Hence, the teachers in this group were not so dismissive of the project approach as those in group 1 although, in view of the fact that only 28.8% of them used project work, it seemed that on balance they still felt unable to give it the benefit of the doubt.

TYPE 3 (Cluster Group 3) The 'Supporters'

These teachers were very favourable in their appraisal of project work. The majority of them were agreed that a project approach helped pupils to develop a number of important skills such as the application of knowledge (item 4), communication (item 6), enquiry (item 13), planning and organisation (item 17) and skill in the handling and

interpretation of data (item 20). They also accepted claims that project work increased pupils' interest in the subject (item 1), added to their self-confidence (item 7), improved their self-discipline (item 14) and encouraged them to take care over the presentation of their work (item 10).

In their overall support of the project method, they did not however dismiss some of its less favourable aspects. They recognised, for instance, that the assessment of project work involved a large measure of subjectivity (item 5) although two of the teachers interviewed from this group (131, Biology and 063, Biology) maintained that this in itself was not necessarily undesirable nor indeed unreliable. The Type 3 teachers also accepted that some pupils may be placed at a serious disadvantage when they have several projects to do in other subjects (item 15) and when they are from homes which lack the types of resources beneficial to the production of projects (item 19). These were clearly serious concerns but the responses of the teachers in this group suggest that, for them, the advantages of project work greatly outweighed its disadvantages. Fifty per cent of these teachers used project work as part of their C.S.E. teaching programme.

Thus, the three types of teacher to emerge from the cluster analysis were quite distinct. Type 1 teachers, the 'Opposers', were clearly against the use of project work at C.S.E. level. Their opposition centred mainly on the managerial/organisational problems attending the exercise. Type 2 teachers, the 'Waverers', acknowledged the benefits that can arise from project work but remained

reluctant to participate because of the difficulties of implementing it successfully. Type 3 teachers, in contrast, were widespread 'Supporters' of the project approach. They appreciated all its benefits and advocated its use from a variety of perspectives. The pupils' personal development seemed to be their most important consideration.

Having grouped teachers in this way according to their attitudes and beliefs about project work as set out in Section C of the questionnaire, further analyses were performed in an attempt to identify any additional features characteristic of each cluster group. The final stage of the investigation utilised data from Sections A, B and D of the questionnaire and produced the following sets of results.

Analysis of the cluster groups by subject area, examination mode and entry revealed no significant differences between the three groups. Similarly, no significant variation in the age, sex and qualifications of the respondents was detected although group 3, the 'Supporters' did contain a higher proportion of young (46.9% were under 30), well-qualified (45.3% were teacher-trained good Honours graduates), female (31.3% were women) teachers which gives some support to earlier findings linking teacher characteristics with attitudes and beliefs (see, for example, Ryans in Biddle and Ellena 1964). Teaching experience varied significantly across the three groups. Group 3 (the 'Supporters' had overall less teaching experience than the other two groups; 50.7% of them had been in teaching for less than five years in total (significant at $<.01$ level)

and 58.6% had held no other full-time secondary teaching appointment prior to their present post (significant at $<.01$ level). Although statistically significant, it may be argued that the reduced experience of group 3 teachers relates more to differences in age across the groups rather than differences in attitudes and beliefs, but this line of reasoning fails to account for the higher (though not significantly so) incidence of employment experience outside education observed among the younger group 3 teachers, neither does it explain why C.S.E. teaching experience varied very little across the three groups.

Analysis of teachers' reasons for not using the project approach with C.S.E. pupils revealed some interesting differences between the 'Non-Users' in each of the three cluster groups. Group 1 teachers (the 'Opposers') named pupil ability and existing examination/syllabus restrictions as the chief factors influencing their decision not to implement the project approach. Project work to be effective required high level cognitive skills which, they argued, were beyond the scope of average C.S.E. pupils. In addition, the content of the syllabuses and the structure of the examinations were, they felt, largely incompatible with a project approach. The teachers in groups 2 and 3 (the 'Waverers' and the 'Supporters') saw things from a different perspective; it was organisational and managerial difficulties that caused them to reject the project strategy. Unfavourable staff-pupil ratios, mixed ability classes and inappropriate timetabling were just some of the factors involved.

Hence, in the final analysis, it seems unlikely that attitudes and beliefs about project work stem from teacher characteristics such as age, sex, qualifications, training and experience. Instead, they seem to be based on teachers' perceptions of the usefulness and success of project work in a variety of contexts so that a number of factors (ranging from pupil ability, syllabus constraints, examination procedures to class size, composition and organisation) are influential. These factors are discussed in more detail in Chapter 8.

NOTES

1. Additional findings relating to the teaching experience of those C.S.E. science teachers not implementing the project approach at the time of the enquiry are given in Appendix IX.
2. See, for example, Brookover (1955), Finlayson and Cohen (1967) and Banks (1971) as cited in Banks O. (1971) The Sociology of Education, Batsford Ltd., pp. 207 - 208.
3. This assumption is aptly illustrated by the fact that until quite recently England and Wales waived any requirement of professional teacher-training for graduates in maintained secondary schools. Science and mathematics graduate teachers because of continuing shortages remain exempt.
4. This tendency is reflected in part in the early examination statistics produced by E.M.R.E.B.

5. Issues relating to teachers' ability to implement new teaching strategies are discussed further in Chapters Eight and Nine.
6. It should be remembered that in the sixties and early seventies, to alleviate the problems of staff shortage and to promote recruitment to the profession, science specialists graduating before 1970 were (and are still) not required to gain formal training prior to seeking teaching appointments in the state-maintained secondary sector. Furthermore, in this study 59.7% of the teachers were over 30 years of age (see Section 6.2.3.). Thus, it follows that a substantial number of them may have graduated early enough to warrant exemption from professional teacher-training.
7. See note (1).
8. The only important exception to this finding was the 'over 15 years' group where only 3 out of 25 teachers used the project approach with C.S.E. pupils. This result, when compared with those teachers who had been in their current establishment for less than 15 years, was significant at the .05 level.
9. That is, Examination Boards other than the East Midland Regional Examinations Board on which this study is focussed.
10. The possible reasons for this are discussed in Section 6.1.1. alongside other issues relating to the low status of the subject and the reduced commitment shown towards it.
11. See for example,
 - (i) MacInness, I. (1980) 'Shortage of Physics Teachers', School Science Review, Vol. 61, No. 217, pp. 783 - 786.
 - (ii) 'The Supply of Science Teachers', Symposium of the Annual Meeting of the Association for Science Education, University of Warwick, January 1981.

- (iii) D.E.S. (1979) Aspects of Secondary Education in England: A survey by H.M. Inspectors of Schools, H.M.S.O., 8.7.1./2. pp. 179 - 180.
- (iv) Kirkham, W.J. (1979) 'Science Teachers for the 1980's', Education in Science, No. 83, pp. 16 - 17.
- (v) 'Retraining in the Physical Science - A Possible Solution to the Shortage' (1979) Report produced by the College of Ripon and York St. John, cited in Education in Science, No. 83, p. 22.

12. Teaching practices which attempted, as described, to relate science teaching to the everyday life of the pupils, industry and the biological environment was welcomed by H.M. Inspectorate. See D.E.S. (1979) Aspects of Secondary Education in England, H.M.S.O. 8.3.5., 3.6. p. 171.

13. Recalculation of the percentages with reference only to those 174 teachers with work experience outside education, to whom this questionnaire item directly applied (55 teachers among the 'Users' and 119 among the 'Non-Users') revealed that more of the respondents with experience of a scientific nature failed to use project work as part of their C.S.E. teaching programme. Similarly, of those teachers who had gained some or all of the work experience in industry, less tended to use the project approach at C.S.E. level.

Concerning the duration of employment in fields other than education, the majority of respondents (both 'Users' and 'Non-Users') had less than five years full-time work experience although 11 (6.3%) of the teachers in the survey had spent over fifteen years outside teaching.

14. That is, subjects other than the four main ones under investigation. Included in this category were Engineering

Science, Integrated Science and Rural Science as well as other less well-known Mode III science subjects.

15. See evidence presented to the Standing Commission on Pay Comparability, Report No. 7 (1979 - 80) Cmnd.7880 (Chairman: Professor H.A. Clegg).

CHAPTER SEVEN

PROJECT WORK IN PROGRESS: THE OBSERVATIONAL STUDY

- 7.1. Early Considerations
 - 7.2. The Project Lessons: A Brief Description
 - 7.2.1. The S-Band Class
 - 7.2.2. The G-Band Class
 - 7.3. The Findings
 - 7.3.1. Pupil Talking
 - 7.3.2. Pupil Reading
 - 7.3.3. Pupil Writing
 - 7.3.4. Pupil Practical Work
 - 7.4. Summary and Conclusions
 - 7.5. The Limitations of the Pilot Study
 - (i) The Observation Schedule
 - (ii) The Teachers
 - (iii) The Topics
 - (iv) The Project Strategy
- Notes

7. PROJECT WORK IN PROGRESS: THE OBSERVATIONAL STUDY*

7.1. Early Considerations

It appears that at times educational research has become preoccupied with the fundamental problem of identifying a form or strategy of teaching which reflects the intentions and ensures that the material content and the methods are compatible with the pupils and the learning objectives. This may be a highly commendable preoccupation when every classroom is a continuous, teetering experiment in which the ingredients of 'good' teaching still escape consensus.

Morrison and McIntyre (1969) have, however, questioned the value of even searching for some generally superior form of teaching; they claim that it would prove more worthwhile to attempt to specify more clearly the methods which are most appropriate for fostering specific abilities, and to understand more fully the effects of the interactions of the needs and abilities of the pupils and the teacher upon the working relations in the classroom. According to Morrison and McIntyre, a priority of the research specialist should be to establish organised systems of relationships among the events and the variables in the teaching/learning situation.

Attempts to identify these relationships have a long history; early approaches involved the nostalgic recollections of individuals in response to cues like 'the

* A full account of the Observational Study, the planning and method of enquiry is given in Chapter Two.

best teacher I ever had ...' These subjective appraisals of 'good' and 'bad' teachers were superseded by accounts of the opinions and ratings of the so-called educational experts on what they (the Inspectorate and the teachers) considered to be the important elements of effective teaching. From exhaustive analyses of rating scales, the research then moved towards the more objective observation of classroom activity based around specific observation schedules.

The main impetus for this type of research arose from the publication of the Flanders' Interaction Analysis Categories (F.I.A.C.) in 1970. The application of this schedule, in common with the innumerable observation schedules which superseded it, involved the presence of a trained observer in the classroom to observe, analyse and record, in a systematic way, aspects of classroom behaviour as and when they occurred, using a predetermined set of behaviour categories. Systematic observation procedures of this kind made it possible to identify particular types of learning experiences which might constitute a teaching style and then to examine possible relationships between different styles and outcomes such as the attitudes and attainments of the pupils.

Those who support observational techniques see them as a less subjective method of documenting exchanges between teachers and their pupils during the course of a lesson. The method was employed in the Schools Council Project for the Evaluation of Science Teaching Methods in England and Wales (Eggleston et al. 1976) at a time when the first impetus of Nuffield science curriculum

development reached the schools.

Using the Science Teachers Observation Schedule (S.T.O.S.) trained observers collected data on the methods of teaching used by almost one hundred science teachers. Using the technique of cluster analysis, three distinct styles of teaching emerged. These were then related to the measured attainments and attitudes of pupils, all of whom were of above-average ability in the penultimate year of a G.C.E. O - Level course. Some interesting findings and contradictions emerged with respect to teachers' perceptions of their teaching style and the reality of it based on the observation data.

Systematic observation as a means of investigating the teaching/learning situation has not however been without its critics and before attempting to utilise the method it was clearly important at the outset to examine the validity of the arguments levelled against it and to assess, in the light of the debate, the circumstances in which and the purposes for which systematic observation may be usefully employed.

The opinions of the sceptics range from mild criticism of the method to harsh condemnation of the underlying concepts.

Nuthall and Snook (1973) have argued that the current emphasis on observational studies has produced an absurd proliferation of different observation systems and frequency counts of minutiae of teacher and student behaviours in specific situations, and Walker and Adelman (1975) commenting on the Flanders' system have questioned the validity of predetermining (in the form of

prescribed categories of behaviour) what is educationally 'most significant'. However, insofar as the Flanders' scheme aimed not at solving educational problems, but at identifying instances of pupil initiation in 'classroom talk', then the observational system fulfilled its objectives and in this respect the criticism would seem unjustified. Moreover, every research undertaking holds certain ideological assumptions in that the researcher concentrates on some aspects and neglects others. Systematic observation by its very nature is dependent on the values and concepts inherent in the system and clearly, by using prescribed categories, one risks inaccuracy through omission. However, although the descriptions and explanations put forward by systematic observation can be only partial, McIntyre and Macleod (1978) have argued that the issue is not whether certain aspects are neglected but rather how it is decided what should be neglected. Furthermore, they suggest that systematic observation holds the merit in that it makes quite explicit those aspects on which the research is focussing and the commitment that is being made.

Observational schedule systems have also been severely attacked with regard to the sampling procedures they involve. It is argued that sample populations, as a result of economy in time and finances, tend to be small and restricted and, as such, may be unrepresentative. Given the nature of systematic observation, this would seem a fair criticism and, in accepting the validity of the argument, it follows that descriptions and explanations arising out of the procedure should be treated with caution.

In addition, generalisations derived from the system should only be regarded as statistical, being based on precise yet specific quantitative data. (On this point, quantification in systematic observation would not in itself appear problematic since most other research strategies draw their conclusions from quantitative data of some kind.)

Systematic observation has also been challenged on the grounds that it is too mechanistic. Those who support this view also maintain that the schedules focus on specific describable behaviours and tell us nothing about the critical interplay of personalities in the classroom e.g. the charisma, the dislike, the fear. It is also argued that straight observational techniques contribute little of any significance to our understanding of the less overt aspects of classroom interaction such as interpretations, expectations, impressions. In reply, it must be accepted that systematic observation does not provide any direct evidence on the mental activities of the participants nor the meaning which the participants attach to their actions, but observational procedures do not prohibit the use of other techniques for obtaining data of this kind and, in this respect, therefore, systematic observation is seen here as enhancing rather than conflicting with the other research strategies (the questionnaire and interview methods) employed in this study.

Adams (1972) has stressed the importance of the observer on the situation being observed. Not only do those under observation know (or suspect) they are part of an investigation and react to the situation, but the

observer himself goes to the situation with preconceived ideas and expectations about the roles of the teacher and the pupil. Adams investigated his theory of observer expectations by asking trained observers to select from a list of teacher behaviour items those which they thought related closely to the teacher's role. The most popular items selected were: directs, informs, praises, manages, lectures, evaluates, supports, clarifies, questions, controls. These were derived from the replies of one hundred and fifty observers. By examining these selections, Adams arrived at an overall view of a teacher's role implicit in their approaches. It emerged that teaching behaviour was seen as highly complex, that management issues were salient and that in some form or other teacher dominance was anticipated.

If, as Adams' research study suggests, observer expectations do influence what they actually observe, serious questions must be raised about the usefulness of such observational techniques. Clearly, in the light of Adams' findings, it would be unwise to interpret observational data without some consideration of this possible effect.

The influence of the presence of an observer on the actual behaviour of those being observed (the so-called 'halo' effect) seems, in contrast, less problematic. In the early stages of an observation programme, the participants are almost certainly affected by the presence of the researcher but, by all accounts, this effect soon wanes. McIntyre and Macleod (1978), having examined the validity of this claim, have inclined to the view that with careful planning, the influence of the observer's presence is 'not generally of major practical importance'.

Thus, in concluding this critique, it is clear that systematic observation as a research technique should not be entered into lightly. Although valuable in providing a relatively objective profile of classroom behaviours, its use and interpretation is subject to certain restrictions. Moreover, there exists a number of limitations which need to be considered carefully in the period of preliminary planning leading up to the observation study, as well as in the intermediate and final stages of it.

Firstly, systematic observation is less subjective than many alternative methods but as a consequence it is also more mechanistic in that it focusses on a relatively narrow range of specific observable behaviours and, in doing so, provides only a statistical framework against which interpretations and explanations must be lodged. Secondly, in developing an appropriate schedule, certain selections about activities relevant to the study have to be made. Hence, when interpreting the results, care must be taken not to introduce distortion by attributing significance to those items included whilst failing to consider the importance, if any, of activities absent from the schedule. Thirdly, the presence of the observer cannot be disregarded. Some degree of influence can be expected to affect both the situation being observed and the data being recorded. And fourthly, data based on observable behaviours can provide no information on internalised behaviour i.e. the mental activities surrounding each action. These aspects therefore have to be investigated by techniques other than systematic observation (e.g. reasoning and personality tests).

Thus, having examined these restrictions on the use of systematic observation and assessed its limitations, it seemed reasonable to conclude that when used with care and interpreted with caution, the method could provide a useful means of investigating pupil activity during project work. It was felt that given specific hypotheses to test, the method could make a valuable contribution to the overall understanding of project work in progress by providing precise descriptions of the exchanges taking place between pupil and peer, and pupil and teacher. In this respect, systematic observation was seen as complementing rather than opposing the other research strategies employed in this study.

7.2. The Project Lessons: A Brief Description

The reader is provided with a general description of each project lessons, drawn up from informal notes taken during the investigative period. These early accounts are largely impressionistic but it is hoped that they will help, in each case, to set the scene and make the interpretation of the observational data that follows more meaningful.

7.2.1. The S-Band Class

(Pupils rated as above-average ability⁽¹⁾)

During the first part of the observation period, the pupils were asked to complete their work on the topic 'electricity'. The project booklet on this topic (see Chapter 2, Section 2.5.) included the following items:-

- (i) a theoretical and practical study of different kinds of cells
- (ii) an investigation into electrical conductors
- (iii) a study of the electric bell
- (iv) a theoretical account of the transmission of electricity
- (v) a study of electricity in the home: fuses, earthing, plugs and meters.

In a previous lesson, practical work had been undertaken by the pupils in accordance with the procedures set out in the booklet, and the teacher had demonstrated to the class certain aspects relating to the topic. The pupils had collected data from these exercises and were now required to write up the work.

The pupils in this band worked at different rates and some of the more able completed the topic well in advance of other members of the class. As the pupils finished, they were permitted to begin the next topic in the series and, at one point during the observation period, three different topics ('electricity', 'bacteria' and 'reproduction') were being undertaken. The more able pupils were clearly accustomed to starting new projects first and towards the end of the observation programme, some of the pupils in this category, having completed the theoretical preamble, were observed beginning the practical investigation of bacterial growth. In this way,

the more able pupils gained the advantage of experiencing first-hand the novelty and discovery elements of a new topic. As a consequence, they seemed to find the project lessons more rewarding (a general impression gained by the observer and supported by the class teacher).

In contrast, the other pupils in the group seemed to plod on with topics which became stale in the light of the new 'discoveries' being made by the more advanced members of the class. By the time they were ready to begin a new topic, most of the exercises had already been completed by others. Thus, for these slower pupils, it seemed that the project exercises became a routine following of instructions to obtain the 'right answer', rather than a practical exercise to pursue a line of enquiry. Perhaps the best example of this occurred during the project work on 'bacteria'. As part of a practical investigation into bacterial growth, pupils were required to inoculate agar plates with swabs taken from various items throughout the school (tea towels from the cookery room, soap dishes from the wash basins in the cloakrooms etc.). The first pupils to attempt this exercise dashed off to collect their samples, enthusiastic about the investigation, and returned keen to know the results. The remaining pupils were distracted by this excitement in their peers, but being unfamiliar with the exercise, were unable to share their enthusiasm.

In addition to the problems arising out of pupils' differential rates of working, further difficulties were encountered as a result of career interviews. During the observation of this group, selected male pupils were

required to attend R.A.F. interviews with a view to recruitment after leaving school. As they departed and returned, interruptions in the class work were inevitable; the pupils were asked questions about their interviews and, in response, readily related their experiences to their peers. These activities disturbed some pupils and their pace of work slowed down noticeably.

Towards the end of the observation period, the teacher returned completed project booklets to the pupils, having assessed their work and effort, and made comments and amendments as necessary. During this time there was heightened interaction between the pupils, peers and teacher. Many pupils were clearly eager to discuss and compare their work on these earlier projects. Amidst this buzz of conversation, as the lesson drew to a close, two of the girls being observed were allowed to leave the class five minutes early in order to return equipment to the main store, since the lessons were held in a general, ill-equipped laboratory remote from the main science block. There were a few humorous comments about favouritism, followed by pleas to be allowed to leave early too.

Communications between pupil and teacher appeared good; exchanges of a teasing, witty nature were common. On the whole, the atmosphere was friendly but firm.

7.2.2. The G-Band Class

(Pupils rated as below-average ability⁽²⁾)

Compared to the S-Band class, the pace of working within this group was considerably slower and during the observation period, only one project topic was attempted. This was a study of 'fibres' which, again, was undertaken with the aid of a project booklet and included the following items:-

- (i) a study of natural and man-made fibres
- (ii) a theoretical account of the production of cotton
- (iii) practical investigations into:
 - a) tensile strength of fibres
 - b) shrinkage, insulation and water repellent properties of fabrics
 - c) permanent creasing
- (iv) a review of the uses of different fabrics at home and in industry

At the time of the observation study, two practical investigations were undertaken by the pupils. The first was an experiment to compare the water repellent properties of different fabrics before and after the application of a silicone spray. The second was an investigation into the effect of boiling on a range of fabrics.

Before commencing the practical work, the teacher asked the pupils to make a few minor amendments to the procedure set out in the project booklet (e.g. they were asked to alter the dimensions of the fabric to be used in the investigation and to increase the number of drops of water placed on each piece of cloth). These slight adjustments to the original schedule caused some concern and uncertainty among the pupils, many of whom appeared reluctant to pursue the revised scheme without some personal consultation with the

teacher. The majority of pupils in this group seemed tentative about the practical work; they read through the procedures hurriedly, tending instead to refer to the teacher for information rather than the project booklet.

In contrast, a few pupils - whilst neither reading the instructions carefully nor referring to the teacher - rushed into the practical exercises. Blundering through the investigations, these pupils shrugged off their mistakes and looked on while the other, more conscientious, pupils completed the work correctly.

Differences in the rates of completion of project exercises by class members were not so marked as in the S-Band. On the whole, the pupils in the lower ability G-Band were much slower workers, taking considerable time to organise themselves before and during the project lessons (e.g. to find lost pencils, to set up apparatus, to measure out quantities etc.). Generally speaking, the pupils who finished first tended to be those who had been attended by the teacher early on.

During the observation period, the teacher spent much of her time going around the class, checking, supervising and directing work as well as giving encouragement and reassurance. In the G-Band, it seemed that the teacher directed and controlled the class to a much greater extent than was apparent in the S-Band. She was the decision-maker about most aspects of the project work. It seemed too that the pupils sought this kind of structure and guidance. The lessons were kept formal in the sense that the teacher was regarded as the sole authority on projects. There was little evidence of personal and informal repartee between the pupils and the teacher.

Pupil concentration was limited in duration. The lessons, being practical in orientation, lent themselves to minor distractions, manifest in window-gazing and aimless wandering around the laboratory.

Towards the end of each lesson, the teacher asked the pupils to conclude their investigations and to begin gathering up their materials and dismantling the apparatus. Compared to the lack of organisation seen earlier in the lessons, the pupils were efficient at this task, sharing with the S-Band the same eagerness to depart from the science class. The teacher supervised the clearing-up operation, counted pieces of equipment and ensured that the benches and sink were left in a reasonable state. Such strict supervision was not resented by the pupils but seen as part of the usual bargain, struck as a means of allowing pupils to leave the lesson a few minutes early. Those pupils who did not conform to the expected levels of tidiness were delayed until the required standards were achieved.

7.3. The Findings

Full data on each pupil's activity during project work, expressed as frequency counts of each activity itemised on the schedule and observed during the period of the study, are given in Appendix VIIIf. The data are presented in tabular form under four separate headings covering the main pupil activities: talking, reading, writing and practical work.

From the total number of observations recorded during the four observation periods, the pupils in the S-Band, those rated as 'above-average' by their teacher, were found to be much more active during project lessons than those in the G-Band who had been rated as 'below-average' by their teacher. During the investigation, the pupils in the S-Band were seen to talk, read and write more frequently than their counterparts in the G-Band who, in some cases, spent a large portion of the observation time in a relatively inactive mode (e.g. staring out of the window, apparently day-dreaming). Thus, in all, 279 observations were recorded for the above-average pupils compared to only 136 for those of below-average ability (see Table 7.1.). These findings are discussed in detail in the following sections.

7.3.1. Pupil Talking

For both groups of pupils talking appeared the most popular activity, 170 observations being recorded for the higher ability group and 90 for the below-average group. Further analysis of the data revealed that in each case most of the talking occurred between the pupils and their peers although some intergroup variation in the nature and frequency of these contacts was detected.

In the above-average group (the S-Band) 81.8% of the talking (139 observations) was between peers compared to 68.9% (62 observations) in the below-average group. Among the higher ability pupils, much of the conversation (41.7%)

TABLE 7.1.

PUPIL ACTIVITY DURING PROJECT WORK

<u>Pupil Activity</u> (Related and Non-Related to Topic)	TOTAL NUMBER OF OBSERVATIONS RECORDED	
	Pupils of Above Average Ability (ID 01-04)	Pupils of Below Average Ability (ID 05-08)
Talking - to Peers	139	62
- to Teacher	31	28
Reading	31	5
Writing	59	3
Practical Work	19	38
	279	136
	(S-Band)	(G-Band)

that was relevant centred on the 'facts and principles' behind the project topics and it was mainly on these points that the pupils asked questions, gave replies and made comments and observations to their peers (see Table 7.2.a.).

In contrast, among the pupils of below-average ability (G-Band), most of the conversation (44.2%) focussed on project procedures (see Table 7.2b.). The pupils in this category attempted several practical investigations during the course of the enquiry and much of their commentary related to the difficulty/ease of this work:

'This is hard'
'It's dead easy!'

and the timing/progress of the exercises:

'Mine won't be dry in time; I'm leaving it 'til last'
'This takes ages'
'I've almost finished'

From the pupil/peer observation record of exchanges relating to the project topic (see Tables 7.2a. and b.) it was particularly interesting to discover that in the S-Band, communication between pupils was on more of an equal footing in that there was a two-way exchange of ideas, which was balanced in the sense that the pupils asked questions (34.0%), replied to questions (34.0%) and offered a range of comments and observations about the project topic (32.0% of the pupil/peer conversation). In the G-Band, however, conversation between pupil and peer was not so well-balanced. There was a marked reduction in the number of observations recorded in the 'replies to question' category (16.3%) which would seem to suggest that these pupils (being below-average ability) were rarely referred to by their peers for information relating to the project topics. Furthermore, out of this general observation, there arises the

TABLE 7.2.

THE INCIDENCE OF 'TALKING TO PEER(S)' AMONG PUPILS ENGAGED
IN PROJECT WORK

a. Pupils of Above-Average Ability (S-Band)

Nature of Communication - Related to Topic	Observed Pupil Activity			Total No. of Observations
	Questions	Replies	Comments	
Facts/principles	10	17	16	43 (41.7%)
Application of facts/principles	7	4	3	14 (13.6%)
Hypothesis/problem	8	4	3	15 (14.6%)
Procedure	5	7	6	18 (17.5%)
Results/data/recordings	5	3	5	13 (12.6%)
Total No. of Observations	35 (34.0%)	35 (34.0%)	33 (32.0%)	103 (100%)

b. Pupils of Below-Average Ability (G-Band)

Nature of Communication - Related to Topic	Observed Pupil Activity			Total No. of Observations
	Questions	Replies	Comments	
Facts/principles	2	3	8	13 (30.2%)
Application of facts/principles	3	0	0	3 (7.0%)
Hypothesis/problem	4	0	0	4 (9.3%)
Procedure	4	4	11	19 (44.2%)
Results/data/recordings	0	0	4	4 (9 .3%)
Total No. of Observations	13 (30.2%)	7 (16.3%)	23 (53.5%)	43 (100%)

suspicion that the peers had low expectations of these pupils and their capabilities.

Continuing the analysis of pupil talking, it was found that in both groups verbal exchanges between pupil and teacher were less common than between pupil and peer, although the incidence of pupil-to-teacher talking (expressed as a proportion of the total) was higher among the G-Band pupils (31.1% compared to 18.2% in the S-Band; from Table 7.1.).

In both groups, questions formed a large part of the conversation with the teacher (60.0% in the S-Band; 52.0% in the G-Band; see Tables 7.3a. and b.) but some variation in the nature of questions being asked was observed. The higher ability pupils asked questions on all aspects of the project work (the facts and principles, the applications, the hypotheses, the procedures and the results) whereas in the lower ability group the pupils' questions tended to focus on project procedures. Finding out how things should be done first-hand from the teacher seemed an important pre-occupation of these pupils. Moreover, from notes taken at the end of each observational period, it was felt that in this class questions served not only as a means of finding out procedural details but also as a way of gaining re-assurance and approval from the teacher. In this context, questions such as 'Am I doing this right, miss?' were typical.

TABLE 7.3

THE INCIDENCE OF 'TALKING TO TEACHER' AMONG PUPILS ENGAGED
IN PROJECT WORK

a. Pupils of Above-Average Ability (S-Band)

Nature of Communication - Related to Topic	Observed Pupil Activity			Total No. of Observations
	Questions	Replies	Comments	
Facts/principles	4	2	5	11 (36.7%)
Application of facts/principles	6	0	0	6 (20.0%)
Hypothesis/ Problem	3	1	1	5 (16.7%)
Procedure	5	3	0	8 (26.7%)
Results/data/ recordings	0	0	0	0 (-)
Total No. of Observations	18 (60.0%)	6 (20.0%)	6 (20.0%)	30 (100%)

b. Pupils of Below-Average Ability (G-Band)

Nature of Communication - Related to Topic	Observed Pupil Activity			Total No. of Observations
	Questions	Replies	Comments	
Facts/principles	3	0	2	5 (20.0%)
Application of facts/principles	1	0	0	1 (4.0%)
Hypothesis/ problem	1	0	0	1 (4.0%)
Procedure	8	5	3	16 (64.0%)
Results/data/ recordings	0	2	0	2 (8.0%)
Total no. of Observations	13 (52.0%)	7 (28.0%)	5 (20.0%)	25 (100%)

7.3.2. Pupil Reading

Reading as a pupil activity in project work was observed more frequently in the pupils of above-average ability than in those of below-average ability, a total of 31 observations of reading being recorded for the S-Band compared to only 5 for the G-Band (see Table 7.1.). In the S-Band, all four of the higher ability pupils under investigation (ID 01-04) were seen reading at some time during the observation period but in the lower ability G-Band only two of the pupils (ID 05 and 06) were similarly observed (see Appendix VII Ib.).

Applying the principle formulated in the Observation Strategy (see Chapter 2, Section 2.5.2.) that each separate observation lasted up to five seconds, it was found that the maximum time spent on reading during the period of the investigation was approximately 2.6. minutes (equivalent to 4% of the total time) in the higher ability group⁽³⁾ compared to only 0.4 minutes (0.6% of the total time) in the lower ability group⁽⁴⁾.

Thus, the observation record showed that in the lower ability group (the G-Band) fewer pupils read, and that much less time was spent on reading overall.

In addition to providing a guide as to the quantity of reading undertaken in the two groups, the observation data also gave some clues about the nature of the activity. In the below-average group, some reading with the teacher was recorded for both pupils but in the above-average group no such pupil/teacher activity was observed (see Table 7.4a and b. and Appendix VII Ib.). This finding

TABLE 7.4.

THE INCIDENCE OF READING AND WRITING AMONG PUPILS ENGAGED
IN PROJECT WORK

a. Pupils of Above-Average Ability (S-Band)

	Nature of Activity	
	Reading	Writing
Alone	23 (74.2%)	49 (83.1%)
With Peer(s)	8 (25.8%)	10 (16.9%)
With Teacher	0 (-)	0 (-)
Total No. of Observations	31 (100%)	59 (100%)

b. Pupils of Below-Average Ability (G-Band)

	Nature of Activity	
	Reading	Writing
Alone	2 (40.0%)	1 (33.3%)
With Peer(s)	0 (-)	1 (33.3%)
With Teacher	3 (60.0%)	1 (33.3%)
Total No. of Observations	5 (100%)	3 (100%)

might be explained by the fact that during the observation period the less able pupils in the G-Band were engaged in practical rather than theoretical exercises so that they tended to spend more time on the 'activity' aspects of project work. The pupils in this group read through practical worksheets with their teacher, often checking that they were reading and interpreting the procedural details correctly. This observation was especially interesting as again it pointed to the pupils' need for reassurance that they were 'doing things right'. The more able pupils were, on the other hand, seemingly confident in their ability to handle the written word. This was evidenced by the emphasis placed on theoretical perspectives and the relative ease with which the pupils in this group read about these aspects of project work, either alone or with other members of the class.

7.3.3. Pupil Writing

In maintaining the required anonymity in the classroom, data on writing as a pupil activity were not easy to collect since it was often not possible for the observer to see and record the nature of the written work, and to make a judgement as to its relevance to the project topic. Thus, the observation data on pupil writing are limited and should be treated with caution rather than elaborated. However, whilst acknowledging these limitations, some general patterns did emerge from the data which it would seem justifiable to report.

In general, the pupils rated as above-average ability spent more time writing than those of below-average ability, a total of 59 observations being recorded for the S-Band compared to only 3 for the G-Band (see Table 7.1.).

In the S-Band, all four of the pupils under investigation (ID 01-04) were seen writing at some time during the observation period but in the G-Band only one pupil (ID 05) was similarly observed (see Appendix VII Ib.).

Applying once again the principle that each separate observation lasted up to five seconds, it was found that the maximum time spent on writing during the period of investigation was approximately 4.9 minutes (equivalent to 7.7% of the total time) in the higher ability group compared to only 0.25 minutes (0.4% of the total time) in the lower ability group.

In the S-Band, most (83.1%) of the writing was undertaken alone although consultation with peers was observed on ten occasions (see Table 7.4a.). The pupils in this group made some use of appropriate texts when writing, but in the main they worked without the aid of such references (see Appendix VII Ib.).

The same pattern of activity was not apparent in the G-Band. The one pupil who was seen writing during the observation period worked alone, with peers and with the teacher, and on all occasions made use of a relevant text i.e. the project booklet and resources literature compiled by the science staff (see Table 7.4b.; Appendix VII Ib.).

Comparing then these two pictures of pupil activity during project work, it may be tempting to conclude that pupils rated as 'above-average' have the ability and

confidence to pursue the writing-up element of project work independently whilst pupils of lower ability (through lack of ability or confidence or both) are reluctant to work alone in this area, seeking instead guidance and support in the form of prepared texts and teacher/peer collaboration.

Unfortunately, attractive though this conclusion may be, given the restricted sampling and the limitations of the research instrument, it can at this stage only be regarded as tentative speculation. Nonetheless, the emergent issues are interesting and clearly warrant further investigation.

7.3.4. Pupil Practical Work

As discussed earlier (see Section 7.2.), the project work undertaken in the two groups differed in emphasis during the observation period. The higher ability S-Band concentrated on the theoretical aspects of their topics whilst the lower ability G-Band carried out a series of practical exercises. Given these differing emphases, it is not surprising that project-related activities of a practical nature were observed more frequently in the G-Band, 37 observations⁽⁵⁾ being recorded compared to just 19 in the S-Band (see Table 7.1. and Appendix VII Ib.). For the pupils of below-average ability, practical work took the form of small scale investigations as set out in the project booklets prepared by the science staff. Simple experiments were performed during this observation period

and these included practical tasks such as the preparation of material and the setting up of apparatus as well as managerial and observational activities associated with the investigations (see Table 7.5.).

The higher ability pupils in the S-Band spent much less time on these practical aspects. Instead, as earlier analyses have shown, they engaged in more talking, reading and writing about the project topics. However, it would be wrong to assume that these findings necessarily represent the general patterns of project work for the two ability levels. Interestingly, the higher ability pupils spent proportionately more time on 'recording the results/data' than the lower ability pupils which is a clear indication that the practical aspects of the project work had been undertaken previously by this group during a period when the observer was not present. Additional discussions with the Tutor Organiser responsible for the class provided further proof that this was indeed the case. (For the topic 'Electricity' it was acknowledged that the pupils had performed a number of practical exercises and recorded the data in rough note books. During the observation period, some of the pupils were seen transcribing their results in full into their formal project booklets).

In both groups, recording of results usually involved completing charts and tables and giving short answers to questions posed in the project booklets. Unfortunately, attempts at more elaborate analysis of practical activities during project work presented a number of difficulties. The scantness of the data alongside deficiencies in the construction of the observation schedule meant that it was

TABLE 7.5.

THE INCIDENCE OF PRACTICAL ACTIVITY AMONG
PUPILS OF VARYING ABILITY ENGAGED IN
PROJECT WORK

Pupil Activity: Practical Work	Pupil Ability Level	
	Above-Average (S-Band)	Below-Average (G-Band)
<u>Related to Topic:</u>		
(i) Preparing material/ setting up apparatus		
- alone	4	10
- with peer(s)	2	9
- with teacher	0	2
(ii) Managing/observing the investigation	4	12
(iii) Recording the results /data	9	4
<u>Non-related to Topic</u>	(0)	(1)
Total No. of Observations	19	37 (38)

not possible to draw any firm conclusions about pupil/peer and pupil/teacher interaction during practical work. Co-operative activity in the preparatory stages of practical work (i.e. preparing materials, setting up apparatus) had been predicted and was itemised accordingly on the observation schedule (items 44-46). By comparison, it had been anticipated that certain practical activities (managing, observing, recording - items 47 and 48 on the schedule) would be performed individually and that any interaction between pupils and teacher in these areas would manifest itself in 'pupil talk' (see Section 7.3.1.). Regrettably, in practice pupil activities were not so easily categorised and it became apparent that pupils were able to work together at these tasks without verbalising their thoughts and ideas. Thus, the observation schedule proved inadequate in that it provided only a very crude description of practical work and failed to differentiate fully between those managerial, observational and recording practices carried out alone and those undertaken in collaboration with others. Whilst acknowledging these limitations, some of the more general observations in this area do, however, raise some interesting speculation.

Firstly, the data revealed that although both groups of pupils questioned, responded and commented on the practical and procedural aspects of project work, only a very small proportion of the class project time was seemingly spent on practical 'activity' tasks such as preparing, managing, observing and recording. Indeed, using the same criteria as before, in the above-average group only 2.5% of the observation time was spent on practical tasks and

in the below-average group just 4.8%*. One possible reason for the reduced incidence of practical activity in the higher ability group may be that much of the practical/investigative work (as discussed earlier) was pursued at times outside the observation period. This, however, fails to account for the low incidence of practical tasks among the pupils of lower ability whose lessons were described by their teacher as largely practical-based. Clearly, some of the practical work may have been undertaken out of class time but since many of the respondents to the questionnaire had commented on the problems encountered by pupils attempting practical exercises outside class periods, and the unfairness of such enterprises to those for whom parental support was not forthcoming, this explanation would seem of doubtful significance. Hence, the lack of 'doing' in science - an element so much encouraged by the respondents yet so infrequently practiced by the C.S.E. pupils - is an aspect of project work which holds some conflict and contradiction and which must, in this respect, be open to further comment and investigation.

A second point of interest arises out of the data on pupil interaction during practical project work. In the G-Band, the pupils (rated as below-average ability) worked alone and with their peers for the preparatory stages of the practical work, and during the observation of this group two instances of teacher/pupil interaction in practical work were also observed (see Table 7.5.). On these

*N.B. The figures quoted represent maximum estimates of the time spent on practical tasks in each group.

occasions, teacher involvement took the form of practical assistance/intervention in that the pupil concerned (ID 07) having experienced difficulty in setting up his apparatus, stood back and watched while his teacher completed the task for him. In contrast, in the above-average group (the S-Band) no teacher/pupil interaction of a practical kind was recorded although some contact with peers was observed. Comparisons are inevitably difficult in view of the low incidence of practical work overall and the differing nature of the lessons observed, but given these two sets of observations, there is again some evidence to suggest that 'working together' is more characteristic of low ability pupils than of high.

7.4. Summary and Conclusions

The initial impetus for this observational study arose out of the teachers' concern about the usefulness and practicalities of project work for the 'average' child and the varying levels of support for it as a teaching/learning strategy.

At the outset, certain assertions had been made about the project method and a number of conflicting ideas emerged (see Chapter 2, Section 2.5.). Four main issues were seen as especially crucial. It is now time to take up each of these points and to re-examine the claims in the light of the findings to come out of the observational data on project work in progress.

Issue 1: Pupils vary in their ability to benefit from project work

The observational data revealed a number of possible variations in pupils' ability to benefit from project work although the differences were not so clearcut as those posed in Chapter Two.

Overall, the data showed that the below-average pupils spent a large portion of their time in a relatively inactive mode with respect to the project topic. They worked at a much slower pace than their contemporaries in the higher ability group, pausing for much longer periods between each activity. In this way, they tended to achieve less during a project lesson than the above-average pupils who were seen to work more continuously.

Further clues relating to pupils' ability to profit from a project approach emerged from the data on pupil talking which for both groups was the most popular activity. In the higher ability group, most pupil/peer conversation centred on the facts and principles underlying the project exercise. They asked questions, gave replies and made a range of comments and observations about the topic. It may be that such exchanges indicate a degree of commitment and enthusiasm for the work in hand which, in turn, suggests that these pupils may have found the exercise more fruitful and rewarding. In contrast, conversations with peers in the below-average group was confined mainly to questions and comments about project procedure and it appeared that the pupils were concerned not so much with the inherent potential of the topic but rather with 'doing things right'. Moreover, it seemed that their peers may

have had low expectations of them and their capabilities, so that they were rarely challenged by questions from others.

Verbal exchanges between pupils and teacher highlighted further differences. In both groups, questions formed a large part of the conversation with the teacher but again the below-average group sought the answers to how things should be done rather than any deeper understanding of the project topic. The above-average pupils, on the other hand, questioned the teacher on a whole range of issues. They appeared to be concerned not just with the basic facts and procedural details but also the applications and hypotheses surrounding the project exercise. On their part, this again may indicate a greater degree of involvement and an enhanced understanding of the task in hand.

Some variation was also found in pupils' ability to pursue the literary component of project work. The more able pupils seemed generally more confident in their handling of the written word. This was evidenced by the emphasis placed on theoretical perspectives and the relative ease with which the pupils in the S-Group read about these aspects and wrote up their findings. The lower ability pupils appeared more intimidated by this element of project work. Reading was confined to the procedural details of their practical investigations and their writing confined to the results emerging from them. The pupils in this group seemed reluctant to work alone and, although there was no evidence of direct plagiarism, in both reading and writing the pupils sought guidance and support in the form of prepared sets of instructions and teacher/peer collaboration.

Additional differences in pupils' ability to benefit from a project approach emerged from the data on practical work. The above-average pupils worked at a faster rate and achieved results quickly whereas the pupils of below-average ability were slower getting started and required more strict supervision; they experienced delays in achieving results so that any rewards they were to obtain from the exercise were less immediate. These problems were amplified when pupils of mixed ability were found in one class. Under these circumstances, the less able pupils were required to plod through the practical exercises even though the results had already been achieved by the more able members of the class. Thus, it seemed that work for these pupils became a routine following of instructions rather than a process of discovery. The more able pupils therefore tended to gain the advantage of experiencing first hand the excitement of a new topic whilst it seems unlikely that the slower, less able pupils - in the shadow of such leaders - could attain the same level of enthusiasm and motivation.

In conclusion, there would seem to be strong grounds for supporting the notion that pupils vary in what they can hope to achieve from project work. Differences in potential as well as confidence, enthusiasm and motivation have been indicated so that different degrees of guidance and supervision and different balances of theoretical and practical work would seem necessary if project work is to be a viable proposition. From this it follows that any thought of implementing a project approach needs careful prior consideration of these variables if a form which is most suited to the needs and abilities of the pupils is to be adopted.

Issue 2: Many pupils waste time during class periods
allocated to project work

From the observation data, it was clear that some pupils wasted time during class periods allocated to project work. This was especially true of the lower ability pupils who, on a number of occasions, were observed day-dreaming or passively staring out of the window. Such observations do not in themselves indicate time-wasting since the pupils may have been contemplating the work in hand during these 'inactive' periods. However, on the basis that these pupils worked at a much slower pace, took longer breaks between activities, were easily distracted and attempted only one project topic during the observation period, it would seem that time, if not actively wasted, was not efficiently used. In the below-average group, some time-wasting seemed to arise out of pupils' lack of confidence and ability; they were seemingly reluctant to commence a topic section without first consulting with the teacher to check details and, perhaps, to gain some reassurance. In addition, they took noticeably longer to organise themselves at the start of and during each lesson.

In the above-average group, instances of time-wasting were less obvious. On the occasions when it was apparent, the pupils were not always at fault. Some interruptions to the flow of the class work were unavoidable when, for instance, pupils were called out of the lesson to attend career interviews.

Both classes experienced delays at the start and end of each lesson as a consequence of the organisation of laboratory work, the issue and return of laboratory stock

and general tidying up procedures. A great deal of time may be written off in this way and it follows that the shorter the class period, the greater the proportion of time lost on these routine procedures. Moreover, some pupils, irrespective of their ability, almost certainly abuse the freedom allowed them in project work and extend the time delegated for such activities. Hence, in attempts to minimize these effects and reduce the time available for idling, there are strong grounds for supporting the adoption of block lesson schemes in which pupils have longer periods to work on their projects, and for encouraging prompt, efficient starts to each lesson. Clearly, if teachers can be allowed adequate time for lesson preparation, to organise work schedules and apparatus beforehand, then delays and subsequent time-wasting will be reduced.

Issue 3: Project work encourages co-operation and communication between pupils and teacher

The notion that project work encourages co-operation and communication between pupils and teacher received good support from the observational data although some variation in the nature of the contacts and the type of interactions was observed across the two groups of pupils.

A high incidence of pupil talking was apparent in both groups, most of the exchanges taking place between pupils and their peers. In the above-average group the conversation centred on the 'facts and principles' underlying the project topic whilst in the lower ability group, project procedure was the more dominant issue.

It was interesting that among the higher ability pupils, communication was seen to be more balanced in the sense

that they asked questions, gave replies and volunteered comments on a range of issues whilst among the lower-ability pupils, conversation was confined to questions and comments. Their peers rarely referred to them for information/opinions and on no occasion were lower ability pupils asked to reply to questions relating to the application of facts, the hypothesis or the results. Thus, it seemed that pupil/peer conversation in the below-average group was more one-sided, almost as if the lower ability pupils had little to contribute to their peers' understanding of the project work.

The incidence of 'talking to teacher' was higher in the below-average group. In these pupil/teacher exchanges, most of the pupils' conversation again consisted of questions about project procedure. In the above-average group questions also formed a large part of the conversation with the teacher but on these occasions the enquiries centred on all aspects (excepting the final results) of project work.

Concerning the role of project work in promoting co-operation between pupils, the observation data suggested that working together was more characteristic of below-average pupils especially in practical activities where a relatively high incidence of working-with-peer(s) was observed. In the lower ability group, some co-operation was also observed during other activities such as writing, although in reading, 'working-with-teacher' was more common. In the above-average group, some reading and writing in collaboration with peers was recorded although, in contrast to the lower ability group, no direct teacher

contact was observed during these activities.

From the collective data on pupil contact during project work, two important points emerged concerning the purpose of the interactions among pupils of above-average ability and those of below-average ability. Firstly, in assessing the nature and incidence of the transactions taking place within the two groups of pupils, it seemed that the communication between pupils of higher ability was more likely to be a two-way exchange of ideas which, by focussing on aspects such as the application of facts and the hypotheses, perhaps operated at a high conceptual level. Secondly, by comparison, conversation among pupils of below-average ability suggested a need for information and reassurance rather than a desire or ability to contribute to the overall understanding of the project work. Hence, although 'working-together' may be more characteristic of project work with lower-ability pupils, there is a suggestion here that by asking certain questions, seeking guidance and support, they adopt a 'passenger' role (as discussed in Chapters 4 and 5) rather than a true co-operative spirit. Thus, there would seem to be strong grounds for investigating further the elements of communication and co-operation in project work.

Issue 4: Enquiry skills are developed through project work

Little evidence of the development of enquiry skills through project work emerged from the observational study. Some of the data on pupil talking (for example, those conversations focussing on the application of facts and principles, the hypotheses and problems) lent a degree of support to the suggestion, although it was interesting that

pupils' discussions about project procedure were not concerned with issues such as scientific method and experimental control (which might have indicated an element of understanding of some of the problems of scientific enquiry) but concentrated instead on how things should be done in the practical/manipulative sense.

The project lessons, as described earlier, were largely teacher-directed and tightly controlled; pupils were assigned specific topics and provided with project booklets which set out in detail those procedures, theoretical and practical, that had to be undertaken and supplied instructions on writing up the exercises. This type of project approach gave the pupils experience in following through a logical sequence of study items but presented little opportunity for them to develop their own lines of enquiry, to pursue their own investigations, to experience their own methodological mistakes. Viewed in this way, it might be argued that the pupils were simply playing out science rather than actively pursuing it, and that their experience of enquiry skills was not first hand.

Hence, project work according to this strategy would seem lacking since it is likely that this type of project approach may be too restrictive to allow pupils to develop skills of enquiry to the full. However, having acknowledged the limiting effects of the strategy, this is not to say that other types of project approach would not be more fruitful in drawing out discussion about the scientific method and the testing of hypotheses and, thus, provide evidence of the development of enquiry skills.

7.5. The Limitations of the Pilot Study

Whilst recognising some of the interesting findings to emerge from the observational data, it is perhaps wise at this point to also acknowledge some of the limitations of the pilot scheme, with a hope of improving future lines of enquiry in this area.

(i) The Observation Schedule

As a research tool, the observation schedule presented several problems. Some of its inadequacies have already been explained but, as a direct outcome of the pilot scheme, other important points have also to be considered.

Firstly, to ensure a comprehensive coverage of pupil activity and to reduce ambiguity, it was found necessary to include over forty categories of pupil behaviour on the final version of the Science Pupil Observation Schedule (S.P.O.S.). Fortunately, in this study the observer was also the researcher and innovator of S.P.O.S. and was therefore well familiar with its form and content. Application of the schedule by future investigators of pupil activity in science could, however, be an onerous task since without adequate training in observation, analysis and recording of pupil behaviour by this method, reliability would be a serious problem. Furthermore, in implementing the schedule the procedures (observing, analysing and recording) have to be performed rapidly, as and when an activity occurs. Even with an experienced observer it should be appreciated that these tasks are a likely source of error in respect of both the intellectual decisions behind the assignment of observed pupil activity to a specific category on the

schedule, and the practical task of recording information accurately on the data sheet.

Secondly, some activities although relevant to the project topic were especially difficult to classify according to the categories set out on the schedule. For instance, pupil transactions relating to the project 'procedure' were not always concerned directly with the methodology of the project exercise (e.g. "Do I mix these together now?" "Do we use ten drops?") but also focussed on such aspects as the nature, timing and ordering of the project procedures (e.g. "Shall we do part 4(b) first?" "Will we finish it by twelve o'clock?" "This is an easy experiment"). Hence, the context of the transactions varied but the schedule in its existing form failed to differentiate fully between these different types of exchanges.

On a similar point, statements in the form of verbal commands made by the pupils presented further problems in that no direct provision was made for them on the schedule. Thus, in order to overcome this difficulty and to record these types of transactions, a degree of flexibility had to be introduced. In these instances, some account of pupil behaviour prior to and directly following the transactions had to be used to assess their context and, hence, their category. For example, commands which could be interpreted as definite orders and which were preceded or followed by some form of comment, were recorded under the 'pupil comments' category (e.g. I'll take a swab from the sink first ... you do the teatowel" "Do that part first, it's easy"). In contrast, commands which were more tentative, implying a form of questioning and calling for

a reply, were categorised under 'pupil questions' (e.g. "You'll mark up the plates" ... "Yes, alright").

Finally, in addition to the problems arising out of the category listing, a third complication arose with the recording of separate pupil behaviours. In an attempt to record both qualitative and quantitative aspects of pupil activity during project work, the schedule utilised two types of scoring system (activity-based for pupil talk, and time-based for other pupil activities; see Chapter 2, Section 2.5.). This dual system proved especially difficult to implement in the classroom setting and placed unfortunate restrictions on the interpretation of the final observation data. (It was, for example, not possible to express a specific activity as a proportion of the total project time). Hence, the information that could be validly drawn from the data was limited and, on reflection, it would seem that a single method of scoring based on time sampling units (e.g. three-minute units as used by Eggleston et. al. 1976 in the operation of S.T.O.S.) may have been, in some respects, more useful.

(ii) The Teachers

The two groups of pupils used in the observation study were taught by two different members of staff. The above-average ability group was taught by a male teacher who was also the Course Organiser for the Mode III C.S.E. Combined Science course. The below-average group was taught by a younger, female science teacher. Both teachers followed the same formal scheme of work for the course but, quite naturally, their individual interpretations of the methods and materials varied so that they effectively operated two

distinct project strategies. Moreover, they managed their pupils differently and conducted their lessons using contrasting styles and techniques. It seems likely, too, that they held differing expectations of their pupils' performance and potential. Hence, under these circumstances, comparison of the two groups of pupils on the basis of ability rating alone would seem unwise, since each teacher brought to the project situation a range of additional variables to confound the issues under investigation.

Clearly, different teachers use different approaches which, in turn, present pupils with different opportunities for learning. Some teachers may encourage certain patterns of pupil behaviour whilst discouraging others. Thus, in acknowledging this as a criticism of the pilot scheme reported here, it follows that in any future study of project work activity among pupils of varying ability, systematic observation of different groups with the same teacher would be preferable.

(iii) The Topics

At the time of observation, the two groups of pupils used in the study were pursuing different project topics. These made differing demands on the pupils and provided varying degrees of scope.

In the above-average group, the pupils were required to concentrate mainly on the theoretical aspects of the topics whilst the project lessons for the lower ability groups were more practical-orientated (see Section 7.2.). In addition, the topics undoubtedly varied in their appeal to pupils and in considering the traditional patterns of socialisation and sex-role stereotyping, it seemed probable

that some of the topics appealed more to boys than girls and vice versa. (For instance, from discussions with the staff it seemed that 'electricity' - a topic which included such items as transformers, dynamos and power packs - was a firm favourite with the boys whereas 'disease' - perhaps because of its human/caring component - appealed more to the girls.)

Thus, the topics undertaken by the two groups of pupils provided different learning opportunities, made separate demands and held varying degrees of appeal. As a consequence, new variables were introduced to the research situation which clouded the main points under investigation and restricted the analysis and interpretation of the observation data. Hence, it follows that in any subsequent study of project work with pupils of varying ability, systematic observation of pupils pursuing either the same topic or a large representative sample of different topics would be more valuable.

(iv) The Project Strategy

Project work, as discussed in previous chapters, may be interpreted in a variety of ways by both the teachers implementing it and the pupils undertaking it. Different forms of project work vary in their balance of practical, theoretical and investigative work, in their levels of teacher involvement, in their demands on pupil initiative and in their formal organisation and management.

The project work observed in this study was characterised by a high incidence of guidance in the form of project booklets prepared by the teaching staff. Contained within these booklets were detailed instructions of all practical

procedures and investigations relating to the assigned topic as well as clear guidelines about syllabus and 'writing-up' requirements. Moreover, there was continual classroom supervision and all the necessary resources (books, papers, specimens and samples) were provided for the pupils' use.

At the outset, it seemed that this type of project strategy was fairly typical of the approach adopted at C.S.E. level. However, it was not every teacher's idea of project work at its most effective. To the contrary, from the summation of teachers' comments and observations recorded throughout this enquiry, it would appear that a number of constraints operate on the teaching situation to make the implementation of project work a compromise between the broadening of pupils' knowledge, skills and experience on the one hand and economy of time, resources and examination preparation on the other. It is not then surprising that many teachers saw the outcome of such a compromise as a form of project work that was too teacher-dependent, which imposed too many limitations on the individual pupil's abilities, aptitudes and initiatives and which required little from pupils in the way of independent enquiry, planning and decision-making.

Hence, before accepting or rejecting the project method on the basis of the findings presented here, it should be remembered that the data refer to just one type of project approach - a type where deficiencies are, in any case, readily acknowledged. Each alternative form of project work is likely to give rise to a different balance of pupil transactions. These shifts in balance must be

investigated separately since only by comparing the different types of project strategy and the pupil activities they promote, can a really meaningful evaluation be made of the overall value and effectiveness of the project method.

In conclusion, it would seem fair to say that the pilot observational study documented here, as well as posing some interesting speculation, has been helpful in highlighting several areas of difficulty. Clearly, some modification to the original scheme needs to be undertaken but it is hoped that the study, and its critique, will go some way towards generating further and improved investigations of this kind.

NOTES

1. and 2 . As discussed earlier (see Chapter 2) pupil ability, used here and throughout this study, refers to the conventional rating given to pupils on the basis of their past performance and their expected future progress in the school system. The factors affecting pupils' ability rating are not broached although it is acknowledged that the term 'pupil ability' may, in many instances, be better interpreted as 'pupil attainment'.

3. Calculated thus:

31 observations at maximum of 5 secs. = 155 secs.
= 2.58 mins.

and 2.58 mins., in 64 mins. (the total observation period) = 4% (approx.)

4. Similarly,

5 observations at maximum of 5 secs. = 25 secs.
= 0.42 mins.

and 0.42 mins. in 64 mins. = 0.6% (approx.)

5. This figure does not take into account the 'practical'
activity unrelated to the project topic (see Appendix VIIIfb).

CHAPTER EIGHT

MAJOR CONSTRAINTS ON THE IMPLEMENTATION OF PROJECT WORK

- 8.1. Introduction
 - 8.2. Main Reasons for Not Using Project Work in C.S.E.
Science
 - 8.3. Managerial and Organisational Aspects
 - 8.3.1. Class Size
 - 8.3.2. Class Composition
 - 8.4. Applicability of Project Work to Examination
Syllabus
 - 8.5. Pupil Ability
 - 8.6. Examination and Assessment Procedures
 - 8.7. Resources and Facilities
 - 8.8. Pupil Attitude
 - 8.9. Other Factors
 - 8.10. Summary and Discussion
- Notes

8.1. Introduction

At various points throughout this study, it has become clear that many factors both extrinsic (e.g. the resources of the school) and intrinsic (e.g. mixed ability classes) govern the methodology of science teaching. In addition to influencing the patterns of science teaching generally, these factors are also important in determining the types of project work, if any, that can be realistically undertaken and, in turn, they seem to play an integral part in the ultimate success or failure of the project method as a teaching/learning strategy and assessment tool. In this penultimate chapter, it seems appropriate therefore to draw together the findings of earlier chapters and to re-examine more critically those restrictive influences which appear to act on the teaching situation and affect teachers' judgments about project work. The purpose of the discussion here is three-fold:

- (i) to consider the main reasons for not using project work,
- (ii) to examine the validity of the arguments put forward in each case,
- (iii) to identify the chief constraints on the implementation of project work experienced by the C.S.E. teachers, and to explore ways in which they might be overcome.

8.2. Main Reasons for Not Using Project Work in C.S.E. Science

Item 2, Section B of the questionnaire posed the question 'What are your main reasons for not using project work as part of your C.S.E. science teaching programme at this present time?'

The question, being open-ended, produced a wide range of responses which, for the purposes of analysis and discussion, were collated and categorized into seven groups of generalised factors. These are listed in Table 8.1. together with the percentage frequency of response gained from teachers, both with and without past experience of project work⁽¹⁾, and across the four main subject areas. The discussion that follows focusses on each of these factors in turn.

8.3. Managerial and Organisational Aspects

One hundred and forty-nine teachers (49.5%) named managerial and organisational problems as a chief factor influencing their decision not to use project work with C.S.E. pupils. Of those respondents with some previous experience of the project method, over half (53.3%) indicated that these aspects were behind their decision to no longer employ it, and of those teachers with no prior experience of the project approach, 43.7% named managerial and organisational issues as an important reason. The problems seemed especially acute in Biology and Chemistry.

TABLE 8.1.

CHIEF FACTORS INFLUENCING TEACHERS IN THEIR DECISION NOT TO USE
PROJECT WORK AS PART OF THEIR C.S.E. SCIENCE TEACHING PROGRAMME

TEACHERS		FREQUENCY OF RESPONSE (% age)						
FACTORS	BY EXPERIENCE		BY SUBJECT AREA				All Non-Users' of Project Work	
	With Experience of Project Work	Without Experience of Project Work*	Biology	Chemistry	Gen.Sci.	Physics		
Managerial and organisational aspects	97 (53.3)	52 (43.7)	40 (52.6)	48 (57.1)	8 (33.3)	49 (45.8)	149 (49.5)	
Applicability of project work to examin- ation syllabus	86 (47.3)	50 (42.0)	35 (46.1)	34 (40.5)	8 (33.3)	55 (51.4)	136 (45.2)	
Pupil ability	69 (37.9)	36 (30.3)	29 (38.2)	29 (34.5)	12 (50.0)	32 (29.9)	105 (34.9)	
Examination and assessment procedures	71 (39.0)	27 (22.7)	22 (28.9)	32 (38.1)	5 (20.8)	37 (34.6)	98 (32.6)	
Resources and facilities	47 (25.8)	23 (19.3)	23 (30.3)	18 (21.4)	3 (12.5)	24 (22.4)	70 (23.3)	
Pupil attitude	31 (17.0)	14 (11.8)	12 (15.8)	13 (15.5)	5 (20.8)	13 (12.1)	45 (15.0)	
Other factors	45 (24.7)	36 (30.3)	17 (22.4)	24 (28.6)	4 (16.7)	35 (32.7)	81 (26.9)	
n= 182		119*		76	84	24	107	301

*The five respondents who failed to complete item 1 of Section B of the questionnaire (those providing no information about their experience of project work) are included in this category for the analysis.

A study of the teachers' responses volunteered on the questionnaire and during the personal interviews and visits revealed that the difficulties in hand centred mainly on issues of class size and composition, and were almost always related to the particular curricular programmes operating in their schools and colleges at the time. Hence, before discussing in detail the problems and anxieties in this area, it is perhaps more important to begin by reviewing some of the more common patterns of curricular organisation, and to describe those features of them which appear to have given rise to the difficulties in the first instance.

In secondary schools in Britain, many different types of curricula based on a variety of patterns of organisation have developed, but for those in the earlier years of secondary schooling there is, it seems a growing acceptance of a 'core' curriculum in which 'science' incorporates the essential elements of Biology, Chemistry and Physics, either as separate disciplines or in some combined, integrated or general form. This type of organisation has been well documented in the recent report on 'Aspects of secondary education in England', produced by Her Majesty's Inspectorate (H.M.S.O. 1979), and it has become clear that the common approach is favoured at the start of secondary education because it helps to alleviate some of the problems encountered through the differential treatment of science in the primary 'feeder' schools.

In the 4th and 5th years of secondary schooling the provisions for science are however more complex, and it

is at this level that most of the diversity in arrangements occurs.

For the final two years of compulsory education, most schools claim to offer a curriculum programme composed of certain 'core' subjects plus a range of optional ones, but 'core' in this context cannot be taken to imply the same subjects or the same syllabuses. For instance, in this enquiry, although pupils were usually required to study at least one science subject as part of their 4th and 5th year 'core' curriculum, differentiation (especially with respect to ability) was frequently reported. One teacher during interview explained the situation in his own school thus:

You see, all pupils have to do one science but to avoid the problems of mixed ability teaching, we allow only the top half of the ability range to do Physics and Chemistry - all the rest, within reason, do either Biology or General Science.
(231, Physics, interview)

Indeed, one of the more common arrangements to be adopted involved some type of setting with the more able pupils following the O-level syllabuses in the separate sciences, the less able the C.S.E. syllabuses in the form of combined, integrated or applied science, and the borderline (C.S.E./G.C.E.) cases attempting, in a number of circumstances, a mixture of the two⁽²⁾.

Further diversity is seen in the option schemes devised by schools to give pupils a degree of freedom in their choice of subjects at this level. A variety of option plans appear to have been developed although most depend on subjects arranged in 'blocks' from which pupils make their selection. Some version of the 'option block' method is now practised in the majority of secondary

schools although many of the respondents in this study commented on the shortcomings of the method. It seems that the 'option block' system is not totally satisfactory for a number of reasons.

Firstly, all subjects in one block are usually, for managerial convenience, timetabled to run concurrently. This means that the choice of one subject in a block automatically excludes the pupil from other subjects in that block and as a consequence, when required to choose between two favoured subjects, a pupil may be swayed by a number of extraneous factors e.g. the choices made by peers/friends, the popularity of the teacher, the examination 'success' record of the subject. In this way, biases may be introduced which can influence both the size and composition of the teaching groups in the 4th and 5th years and thereby affect teachers' decisions about the appropriateness of project work.

Secondly, there is a problem in that none of the subjects in an option block may appeal to a pupil so that the selection represents, in effect, a 'Hobson's Choice':

Because of the option arrangement, some pupils are forced into doing subjects which they do not particularly want to do.

(083, Physics, interview)

In this situation, a pupil opts for one subject only by rejecting all others more forcibly, and it follows that a class composed largely of subject conscripts rather than devotees is unlikely to be totally amenable to teaching strategies (such as project work) that place more responsibility on the pupils for their own learning and discipline.

These two aspects of the option block system are clearly not ideal but if the place of science in these blocks is examined more specifically, a third important element becomes apparent. For example, if a science subject is confined to only one block in the option range, this ensures that one large group is formed which can be divided later into smaller teaching groups. This arrangement often seriously restricts the pupils' choice although it seems to be frequently favoured on the understanding that the large group can be sub-divided into manageable classes on the basis of pupil ability (setted, for example, into three classes: an O-level class, a mixed C.S.E./O-level class and a C.S.E./non-examination class).

Alternatively, science may be represented in many or all of the option blocks. Such an arrangement, in contrast, greatly increases the choice open to pupils but tends to result in teaching groups, too small to be sub-divided, and yet composed of pupils of mixed ability, destined for different examinations.

Hence, from the variety of curricular programmes and patterns of organisation operating in schools, there is a clear indication that those currently in practice can profoundly influence both the size and composition of science classes in the 4th and 5th years.

Further discussions with the respondents in the East Midland region did however reveal additional factors which were, in some cases, contributing to the problems. In addition to such issues as friendship options, subject/teacher popularity and examination 'success' record, it seemed that parental pressure, for some teachers, played

played a secondary but nonetheless important part in generating problems related to class size and composition. Certain parents, for instance, were plainly anxious that their children should be placed in the G.C.E. classes for science. They viewed the C.S.E. as 'second-rate', at best, a dubious qualification and at worst, a stigma in the employment market. It seemed that a variety of techniques were employed by these parents to persuade the teaching staff - often against their better judgement - to accept their children into the higher status G.C.E. classes. Sometimes, these pupils fared well but often they were bewildered by the content and methodology of the G.C.E. courses and sadly deprived of the personal teacher/pupil relationships due to the problems of large pupil numbers arising from over-subscribed courses. Moreover, the difficulties were often heightened because, as one respondent explained:

In theory, the option blocks should give flexibility but in practice there is actually very little movement across them and so pupils may find themselves in inappropriate classes with respect to the subject and their ability.
(055, Chemistry)

Thus, from the teachers' comments, it appears that certain sets of conditions are instrumental in the formation of certain types of teaching groups, and that current curricular practices alongside external pressures are important influences in the school situation. Some degree of dissatisfaction is discernible in the teachers' accounts of the organisation of science teaching at secondary level and the provisions being made for prospective examination candidates, and it would seem that some of the existing arrangements (especially those

governing class size and composition) are not conducive to either successful science teaching or the implementation of effective project work. What follows therefore is a more detailed account of the points of view expressed by the respondents on these issues, together with illustrations of some of their chief anxieties about the use of project work in relation to class size and composition.

8.3.1. Class Size

Many teachers seemed anxious and frustrated about the size of their science classes. Although some respondents reported favourable staff/pupil ratios of about 1 : 16, classes of 25-plus were a more common occurrence.

Science classes composed of large numbers of pupils were considered unsatisfactory for a number of reasons. Firstly, there was the problem of safety. Accommodating large numbers of fifteen and sixteen year olds in one laboratory was a source of anxiety even when a traditional 'cook-book' approach to practical work was adopted, but the anxieties were still greater for the teacher attempting to implement an individualized approach to his science classes using, for example, the project method. Hence, a practical bias to project work, although often regarded as a highly desirable feature, was considered by a number of teachers to be totally irresponsible in a crowded science laboratory where pupils would be exposed

to a combination of physical and chemical hazards. In addition, the supply of protective clothing (goggles, laboratory coats, snoods) was often inadequate for the numbers involved, and where it was available, the teachers and technicians had to spend considerable time at the start and end of each lesson issuing and checking off the items being borrowed. Furthermore, as discussed later (see Section 8.7.), the supply of raw materials, apparatus and equipment, and their ultimate costing for a science department were parameters to be reckoned with.

As well as restricting activities in the laboratory, class size also acted as a constraint on the use of field projects. Several of the teachers interviewed commented on the difficulties of attempting new ventures with large numbers of pupils. Field trips, industrial visits and science excursions were, it was argued, 'a nightmare to organise' when over-sized classes were involved (Senior Examiner, Leicestershire, October 1978). Classes had to be split into manageable groups, timetables had to be altered, other teaching staff had to be implicated, transport had to be arranged and costings had to be calculated. All of these factors quite obviously reduced the teachers' willingness to arrange such activities. Consequently, although practical and field projects may in theory be an exciting approach to science, it is not difficult to see why in practice the teachers frequently failed to implement them as much as they would perhaps like.

Organisation and accommodation are not the only problems to arise from large classes. Several of the teachers

involved in this enquiry were also concerned about the supervision of large science classes, and about their control and discipline. For this reason alone, oversized classes seemed for some teachers adequate grounds for the rejection of project work as a teaching/learning strategy; as one Physics teacher explained:

It is difficult to envisage adequate control and pupil contact when projects are undertaken by individuals or small groups within large (over 25) classes. (049, Physics)

Similarly, as discussed in Chapter 4 (Section 4.2.1.), many teachers confronted by large classes felt that they could not ensure the amount of individual pupil contact necessary to maintain that critical level of supervision and guidance required to make project work a worthwhile endeavour:

Groups tend to be too large for effective control so that suitable guidance cannot be maintained. (360, Biology)

There is not sufficient time to supervise each pupil as regards carrying out experiments both safely and correctly. (252, Chemistry)

A few respondents also expressed doubts about the effectiveness of projects for the majority of pupils when the classes were large. One teacher maintained that:

With classes up to 30 pupils, it is impossible to get useful projects from all but the very ablest pupils. (061, Physics)

whilst others argued that:

Projects probably involve more teacher time than student time ... Projects are difficult to arrange with 3 and 4 scattered lessons and the rest of the student day very full. (010, Physics)

Teachers' time can be more profitably and honestly used in teaching than organising and 'chasing up' projects. (136, Physics)

Other teachers were clearly anxious about allowing large numbers of pupils to work independently on projects of a practical nature especially without the support of additional members of staff.

'Letting them loose on projects was' as one interviewee explained, 'an open invitation to the disruptive, unruly elements' (Biology Subject Panel member, Leicestershire, December 1978). This particular view was expressed in varying degrees both on the questionnaire document and during the interview programme but it should perhaps be stressed that discipline problems, although burdensome in a few schools, were virtually absent in many more⁽³⁾. For those respondents willing to declare their difficulties in this area, it seemed that their methods of avoiding disturbances inevitably involved the use of the more traditional, didactic/demonstration approach to science teaching, with all pupils 'secured at their desks' and with little opportunity for individual practical work.

In conclusion, it can be seen then that class size is an important consideration for all teachers, but above all for the teachers of science. A number of related issues have been raised - finance and management, safety, supervision and guidance, control and discipline - none of which can escape the attention of a teacher about to implement a new teaching strategy such as project work. However, for the teacher of science, responsible for a large number of pupils at one time, it would seem that such considerations are envisaged more often than not as major constraints.

8.3.2. Class Composition

In the introduction to this section, various problems of curricular organisation and option schemes were described and the occurrence of certain differences in class composition was demonstrated. Some of these differences were the result of pupil variables such as ability and attitude. Pupil attitude is dealt with in Chapter 5 and Section 8.8. of this chapter, but at this juncture, it is the intention to assess some of the main problems confronting the respondents in their attempts to teach science to classes composed of pupils mixed in ability and attainments, and destined for different national examinations.

The data collected in this context were plentiful but conflicting, and as such opened up a complex of points for discussion and debate. Some of the problems experienced by the teachers were seemingly inherent to the class system, being derived quite simply from the fact that all pupils are individuals with different experiences, aptitudes and needs. However, as the discussion proceeds, it is hoped to demonstrate that some of the dissatisfaction, expressed either directly or indirectly, is not solely attributable to the mixture of pupils confronting teachers but is also closely linked to other important issues such as comprehensive re-organisation and the accompanying responses of the teaching and administrative staff towards it, or, in other words, the ethos of the school or college.

On the basis of pupil ability, many different types of classes are theoretically possible but discussions

around discrete demarcations in ability would seem to be of limited value in this investigation since classes comprising pupils of overlapping ability levels (defined, for example, as 'average', 'above-average' and 'below-average') were much more in evidence. It was suggested that the spread of ability was reduced in some instances and expanded in others to produce classes that were compatible with the available teaching conditions, but a more critical examination of the setting procedures revealed what would seem to be a major point of contention within the comprehensive system.

Although it was undoubtedly true that small, narrowly-setted classes could not in many instances be permitted to run due to shortages of staff and resources, there were some notable exceptions especially for those pupils in the higher ability levels. Of the thirty-two schools visited throughout the course of this enquiry, no less than sixteen appeared to operate a setting-system biased towards those pupils in the top 20% of the ability range i.e. the prospective G.C.E. candidates. In the larger comprehensive schools, the number of pupils qualifying for this category was usually large enough, relatively, to justify the formation of a 'G.C.E. class', but in some of the schools visited, the 'top class' consisted of 10 - 15 pupils whilst other parallel classes (containing a large proportion of C.S.E. candidates) were running with thirty pupils or more. Thus, in some schools those classes composed of pupils across a wider spectrum of ability than the 'top' selective classes, also tended to carry with them a less favourable staff/pupil ratio. This condition seemed

especially common in those schools which prior to re-organisation had been secondary modern establishments. Some of the staff in these schools defended the notion of selective treatment for the brighter pupils. Newly-confronted with the 'cream', the 'high-flyers', these teachers seemed keen to nurture this potential in their pupils and some even spoke of their own heightened enthusiasm for teaching as a result of it. In addition, many of the secondary modern teachers in schools still undergoing comprehensive re-organisation commented on the high calibre of pupils now entering their schools and looked forward to the time when they would have sufficient numbers of high ability pupils in the 4th and 5th years to credit the formation of 'top' subject classes.

Other strong advocates for the selective treatment of pupils included, as might be expected, the old grammar school teachers who spoke nostalgically of their grammar school days and the ability, motivation and discipline of their former pupils. It was from the reflections of these respondents together with those of their secondary modern contemporaries that important links were formed between their past experiences, their attitudes towards pupils and their current problems with 'mixed ability' classes.

Some respondents, in contrast, were reluctant to commit themselves to value judgements on these issues although many acknowledged the existence of some sort of selection in their own establishments either by means of setting, banding or even, in some cases, streaming. However, perhaps in defence of the egalitarian philosophy underlying comprehensive education, many also stressed

the occurrence of 'mixed ability' groups within specific bands of ability. Hence, it would seem that the term 'mixed-ability' is open to varying interpretations and greeted with varying degrees of approval.

From the comments and observations volunteered on the questionnaire and during the interviews and visits, five general types of science classes based on specific ability groupings were identified:

- (i) Well above-average ability range, comprising G.C.E. candidates.
- (ii) Above-average to well above-average ability range, comprising good C.S.E. and G.C.E. candidates.
- (iii) Below-average to well above-average ability range, comprising both C.S.E. and G.C.E. candidates.
- (iv) Below-average to above-average ability range, comprising C.S.E. candidates.
- (v) Well below-average to above-average ability range, comprising non-examination and C.S.E. pupils.

Again, it should be stressed that the term 'average' used here is based upon definitions set out in the Seventh Report of the Secondary School Examinations Council (H.M.S.O. 1963). Such definitions were not always in agreement with the teachers' own interpretations of the term. As a consequence, the occurrence of the five types of classes outlined above was not only closely associated with such factors as the historical development of the schools, the experiences of the staff and the availability of resources but, for those teachers concerned, also carried various problems, attitudes and expectations. For the respondents participating in this study, the problems were probably greatest when dealing with those pupils

in categories (ii) and (iii) in the above list. It is now the task of this thesis to examine these problems in greater detail, in relation to the implementation of project work.

As discussed earlier, pupils across the entire ability spectrum were not usually classed together but pupils destined for different national examinations (C.S.E. and G.C.E.) were for various reasons frequently encountered in the same class. However, this type of arrangement was not found consistently across all the science subjects under investigation. Mixing of examination candidates was not found in the general, combined or integrated science courses included in this study, but comments collected during the interview programme typically reflect the situation in the three pure science disciplines:

Although numbers vary from year to year, we usually have a large middle class (mid 30's) of both C.S.E. and G.C.E. potential.
(131, Biology, interview)

Being a small school the chemistry groups in the 4th and 5th years are combined with individuals in the group varying from Grade A 0-level to Grade 5 C.S.E.
(284, Chemistry, interview)

... our students are not taught in separate classes for C.S.E. Both are taught together right until the examination.
(084, Physics, interview)

The problems of managing combined examination groups were clearly complex but in some cases certain arrangements existed that constrained teachers still further in their attempts to cope with these types of classes. For example, it appeared that following comprehensive re-organisation some school science departments were, by

choice, policy or tradition, persisting with their former examination practices. Some such practices, as illustrated in the following extracts, tended to favour the G.C.E. population by specifically following the 0-level syllabuses:

No C.S.E. courses have as yet been established in the 4th and 5th years. The C.S.E. candidates have been taught in 0-level sets, or in 'crash course' 6th form groups. (364, Physics)

C.S.E. in the group I take is for the 0-level candidates who do not come up to 0-level standard. I follow the 0-level syllabus. (231, Physics)

Students who do not appear likely to pass the 0-level may choose to do the C.S.E. Chemistry exam, but the 0-level syllabus is followed by all students. The 0-level syllabus does not allow enough time for project work. (174, Chemistry)

In contrast, other arrangements catered primarily for the C.S.E. candidates. For the G.C.E. pupils within these groups, extra tuition was sometimes provided either after school or during the lunch break:

We had four teaching groups, the two middle groups were made up of both C.S.E. and G.C.E. candidates ... Those doing G.C.E. had to be given extra tuition in the lunch hours. (062, Biology, interview)

A G.C.E. and C.S.E. (single-school) Mode III group are taught together. We give extra tuition to help the pupils - we provide an extra class at 4.45 p.m. (215, Physics, interview)

Some dissatisfaction was expressed about these types of arrangements both on the questionnaire and during the interviews. Several respondents criticised the practice of combining prospective C.S.E. and G.C.E. candidates in one class, and a number of reasons were put forward to suggest that the practice was detrimental to pupils' progress in science and their use of project work.

Firstly, the examination syllabuses were not always compatible and their different emphases presented problems when teaching mixed ability groups. Several teachers commented on the mathematical bias of some of the G.C.E. science syllabuses and the different levels of conceptualization demanded by them. Other respondents stressed that in the two examinations different techniques and skills had to be mastered by the pupils when answering the questions presented to them. Consequently, different types of teaching strategies were often called for even though the actual topics being studied were in some instances identical. This being the case, classes composed of both C.S.E. and G.C.E. candidates presented additional anxieties since it was not always possible to provide each individual pupil with those experiences appropriate and relevant to his/her examination requirements. Confronted with the G.C.E./C.S.E. dilemma, some teachers clearly had to attempt some kind of compromise with respect to course content and method, steering mid-course between the two syllabuses:

I use the basic sections of the O-level syllabus and combine it with the social biology sections from the C.S.E. one. (131, Biology)

Under such circumstances, the project method was often dismissed or abandoned in favour of other approaches more common to the separate examination systems. (These issues are taken up again in Section 8.6. of this chapter.)

The second line of criticism aimed at the combined C.S.E./G.C.E. classes centred on the use of resource material. The production and/or acquisition of teaching materials requires a good deal of thought and preparation

even when the pupils being considered are of uniform ability, but for a class of pupils of mixed abilities the task can be both arduous and time-consuming. The provision of a suitable range of resources to cater for the individual abilities of pupils appeared to be a particular problem for those teachers considering project work, and some respondents indicated that they could not implement the project approach for this very reason. The comments below accurately sum up this viewpoint.

Being a small school the chemistry groups in the 4th and 5th years are combined levels with individuals in the group varying from Grade A 0-level to Grade 5 C.S.E.; it would therefore be very difficult and time-consuming to devise project work suitable for all levels.

(284, Chemistry)

I have insufficient time to prepare an adequate range of materials to cover the needs of a class ranging from poor ability to potential grade I candidates.

(282, Chemistry)

My main reason (for not using project work) is probably a selfish one. Due to the shortage of science teachers in my school, I have virtually no free time and I am unwilling to devote the little I have to the development and application of such a course.

(184, Physics)

Hence, class composition can pose various problems for teachers considering project work as a teaching strategy. Mixed ability groups are an increased source of anxiety because pupils progress at different speeds, follow different examination syllabuses and require different sets of resources. It is perhaps not surprising therefore that some teachers, faced with these problems, prefer to adopt more traditional, teacher-controlled strategies rather than a project approach that requires pupils to assume a degree of responsibility for their own learning.

In conclusion, it is clear then that in this study managerial and organisational issues formed a major part of the argument against the use of project work at C.S.E. level. Unfavourable staff-pupil ratios, mixed ability classes, under-staffing of science departments, disjointed time-tabling arrangements and the need for strict supervision of pupils, alongside the problems associated with the dual system of examining at sixteen-plus, imposed serious restrictions on teaching staff, making the implementation of project work a formidable and, in some cases, largely impracticable proposition.

8.4. Applicability of Project Work to Examination Syllabus

Following on from the managerial and organisational problems associated with the operation of different examination syllabuses described in the previous section, a large proportion (45.2%) of the respondents in this enquiry indicated that they did not use project work with C.S.E. pupils because they believed it was an inappropriate approach for the particular syllabus they were following at the time. This view was held by teachers both with and without previous experience of the project method, from each of the four science subjects under study although the demands and restrictions of the examination syllabus were felt especially by the teachers of C.S.E. Physics (see Table 8.1., p.402.).

The time required to cover the material on the syllabus was the focus of much attention. In the main, the science syllabuses for the C.S.E. were regarded as too wide to allow the in-depth approach associated with project work, a feeling typified in the following comments:

I feel that C.S.E. courses cover too wide a range of material, and project work could only really be helpful if the syllabus was shortened to give more time to projects.
(371, Biology)

Content of courses (is) now so massive and examinations so early that little class time can be spared for this aspect; and the Board lays down that it must be part of teaching time allocation and not extra to it.
(360, Biology)

...Projects require too much time and effort, bring too little 'reward' and often mean one or two pupils doing the bulk of the work or just wholesale copying from publications.
(287, Physics)

Other respondents indicated that the length of time spent on project work in relation to the possible beneficial outcomes that may ensue did not always work well for students in their final examination. Some suggested that project work undertaken during the course may actually jeopardize their chances of success in the final examination:

The syllabus is too wide to allow pupils to follow the examination course and still successfully cover project work and get the highest possible grade in the examination.
(275, Physics)

With the requirements of the syllabus it is difficult to give pupils project work which will ensure they cover all the points laid down in the syllabus which will be essential for them in the examination.
(338, Chemistry)

Apart from the time element and the size of the existing syllabuses, there were some teachers who saw the actual content of the syllabuses as largely inappropriate for the adoption of project work. Moreover, the rigidity of the courses and their reliance on traditional teaching methods were seen as additional problems to be overcome if the project method was to be implemented successfully. Clearly, for some teachers of Physics the examination syllabus was highly influential in their decision not to undertake project work with C.S.E. pupils. The following extracts underline the difficulties:

... the East Midland C.S.E. syllabus does not provide much scope for project work, that is, there is hardly any 'applied physics' content in the syllabus.

(272, Physics)

Our Mode I, Syllabus 1 does not lend itself to the use of project work.

(287, Physics)

Syllabus content is too structured and often too complicated for self-study.

(117, Physics)

Whilst accepting that the existing syllabuses may not provide adequate openings for project work as a teaching/learning strategy and as an assessment procedure, it could of course be argued that the provision of the Mode III examination scheme within the C.S.E. framework, far from being rigid, gives teachers a unique degree of freedom in the planning of their courses so that these constraints need never exist⁽⁴⁾. Clearly, in theory at least, strong advocates of the project approach have - through the Mode III facility - the means to introduce it into their courses as they wish. However, such challenges are probably unfair in that they refer to an ideal which in

practice can only be partly realised. For various reasons, ranging from departmental policy and 'red-tapes' to staff turnover and personal commitments, it is not always possible to institute the desired changes, and so the situation persists with teachers left to deal as best they can with existing schemes.

8.5. Pupil Ability

Of the teachers with some previous experience of pupil project work, 37.9% named pupil ability as an important factor in their decision not to use the method with pupils studying for the C.S.E. Almost one third (30.3%) of the respondents with no prior experience of the project approach had similar views (see Table 8.1., p.402.). Many of these teachers also supported the notion that project work of any real value was 'beyond the scope of an average C.S.E. candidate' (see teachers' response to item 3, Section C of the questionnaire, documented in Chapter 6 and Table 6.12.).

On the question of pupil ability, a mature grasp of scientific concepts was seen to constitute an important element in the production of worthwhile projects. The comments which follow are typical and reflect the strength of opinion on this issue.

Integrated Science C.S.E. project work was a dismal failure as in my opinion project work needs a fairly deep previous knowledge in a particular area so that problems may be seen and solved. That is, project work should be a follow-up on basic knowledge in new situations ... Project work is relevant for intelligent and mature students, not the average C.S.E. candidate ... At C.S.E. level, the content must be mainly factual as the reasoning abilities of these immature young people is limited ... Project work, to be valid, expects too much at this level.

(268, Physics)

The entire notion of project work seems to have the same source of inspiration that most of the Nuffield has; old heads do not appear on young shoulders ... after my many years of experience I am quite positive that even a comparatively intelligent pupil is too immature at school age to direct his own education in the form of a project. Only a tiny minority will really learn anything in this manner, and school life is all too short for this time-wasting.

(118, Physics)

Other respondents stressed the need for direction and clarity in C.S.E. teaching programmes, and expressed doubts about the ability of C.S.E. pupils to conduct their own projects effectively. This view was applied in particular to General Science pupils who (as discussed in Chapter 6, Section 6.1.1.) were often of lower ability and motivation with respect to school science:

As far as I am concerned project work is a waste of time for the vast majority of pupils I take. They are not able to organise or think for themselves.

(143, General Science)

I strongly believe that any science course is a matter of understanding and appreciating the principles involved in the behaviour of the natural phenomena of our environment. I do not believe children can teach themselves in this respect, still less discover for themselves. Principles need illustration and explanation at first hand by an expert.

(334, General Science)

Even in Physics, a subject area associated with higher calibre pupils, similar difficulties with pupil ability were identified:

The 'average' pupil requires the security of being instructed most of the time, and tends to panic or 'switch-off' when presented with any vague or open-ended task. His thinking has very little depth or originality and is, I feel, unsuitable for project work.
(119, Physics)

Hence, pupil ability was seen by some as a serious restriction on the use of project work at C.S.E. level. Often it was felt that pupils were ill-equipped to deal with the independent demands of a project approach. Lacking a sound basic knowledge of the subject, they had difficulty organising work, thinking things through in depth and developing a coherent line of reasoning. For these reasons, project work was regarded as an unproductive exercise for a large number of C.S.E. pupils so that other, more structured and more traditional teaching methods were generally preferred.

8.6. Examination and Assessment Procedures

In defending their decision not to use project work with C.S.E. pupils, nearly one third (32.6%) of the respondents cast some doubt on the place of the project approach within the existing examination framework. Many of these respondents felt that it was unnecessary and unwise to incorporate project work into their C.S.E. teaching programme when it was not a formal or compulsory part of the course. Where project work was incorporated as an

option which could be entered for moderation in the final C.S.E. examination, a number of teachers expressed concern about the methods and criteria on which the assessments of project work were based. Some respondents also demonstrated a degree of scepticism about the reliability and validity of project work assessment on a national scale. This concern was felt especially by those teachers with some previous experience of the project method (see Table 8.1.). The following statements, given as reasons for not using project work, illustrate some of the doubts:

The impossibility of retaining a true meaning of a certificate gained by the pupil compared with other pupils locally or nationally ... The falsity (to my mind) of presuming that an average pupil of C.S.E. grade 4 standard can initiate, continue and complete a project that does not bear the stamp of the teacher to greater or lesser degree. (118, Physics)

Difficult to assess teacher involvement for examination grading. (221, Biology)

Other respondents were anxious about the possible advantages of project work assessment for pupils from resourceful homes where parental interest may go beyond the accepted level of encouragement so that the final product may far exceed that which could justifiably be labelled the pupils' own work:

Home background/support can be a major factor in the quality of the product. (074, Chemistry)

Moreover, it was recognised that even in homes where parents did not actively participate in the pupils' project work, the abundance of resources in the form of books, journals, family outings, holidays etc. could greatly favour the pupils since such life-styles could equip them

with a wealth of personal resources appropriate to many aspects of project work and, hence, improve their chances of a favourable grade over those pupils who had not been exposed to such enriching experiences. As one teacher commented:

Project work is detrimental to pupils who lack home facilities and/or interest, especially those whose families consider books to be a waste of time. (019, Biology)

The comments of other teachers revealed additional problems relating to the practice of examination entry. Because of the extensive use of mixed ability teaching in some schools and in an attempt to delay decisions about examination entries, the general policy in some science departments was to select syllabuses for G.C.E. and C.S.E. which provided courses that could be taught simultaneously given the appropriate 'dilution' in accordance with the standard of the class members. The provision of combined classes was seen as an incentive for C.S.E. pupils since those showing good progress could, in the final stages, be permitted to enter the G.C.E. Likewise, the combined classes enabled the C.S.E. to be offered as a 'second-chance' option to those G.C.E. pupils failing to reach the required standard. Whatever the reasons justifying the operation of joint G.C.E./C.S.E. groups, it is clear that the amalgamation of syllabuses, each with different methods of assessment, into a form suitable for administration to pupils of wide ability range, inevitably forced some teachers into abandoning any hope of implementing project work as a teaching/learning strategy and as an assessment procedure. The constraints seemed

especially acute in Chemistry and Physics as shown in Table 8.1. and highlighted in the following extracts:

The C.S.E. examination has only been followed during the last two years. An attempt has been made to follow a syllabus with a fair proportion of material common to the Oxford 055 syllabus so that the final decision concerning entry could be delayed until the end of the fourth year. This has meant that it has been difficult to involve project work.

(089, Chemistry)

Also, candidates who are initially 0-level pupils who do not really make the grade, can easily be transferred to a C.S.E. course if there is no project work.

(247, Chemistry)

... there is no need for project work, let alone time in which to do it. Besides this, our students are not taught in separate classes for C.S.E. Both G.C.E. and C.S.E. candidates are taught together right up until the examination. This gives all students a chance to take G.C.E. and our C.S.E. candidates have a very firm base from which to approach their exam.

(084, Physics)

The C.S.E. entry is drawn, at present, from a selective intake (our first non-selective intake will take C.S.E. in 1982) - so our major entry is for G.C.E. 0-level, and C.S.E. is an 'extra'. The final decision to enter C.S.E. is taken too late for project work to be undertaken.

(164, Physics)

Thus, in the examination context, project work for some teachers seemed fraught with difficulties and from the comments and observations volunteered on this issue, it is clear that concern over parental involvement, doubts about assessment and the existence of the dual system of examining at sixteen-plus made a number of respondents reject the method in favour of other strategies which they felt would give all pupils a fair chance in the examination stakes.

8.7. Resources and Facilities

The quality, quantity and availability of certain resources for the purposes of education can be seen to reflect (and, on some occasions, pre-empt) both the financial and social climates of the time. As such, the resources issue has been a continual source of heated discussion within the educational establishment at ministerial, local and neighbourhood level. It would appear that the provision of resources has been the cause of frustration, anger and despair for most teachers at some point in their careers and, as expected, many of those participating in this study readily volunteered their views on this matter, generally and with reference to their use of project work. Clearly, for some, the provision of resources was a crucial consideration, determining the manner in which the project method was (or could be) attempted, if at all.

In response to item 2, Section B of the questionnaire, almost one quarter (23.3%) of the teachers commented on the lack of suitable resources and facilities for project work within their departments, and named this as an important factor in their decision not to implement the method (see Table 8.1., p.402). This view was exemplified in item 18, Section C of the questionnaire where 44.2% of them agreed that 'Project work is too costly in resources to be catered for adequately by the standard school/college' (see Chapter 6, Table 6.12.).

Doubts about the adequacy of existing resources were pronounced in those teachers with some personal experience

of project work (see Table 8.1.), and weighed heavily on the teachers of Biology, as reflected in the following extract:

Some syllabuses having project work as an integral part can be very effective ... but these imply special commitment in terms of staff and resources. The apparent introduction of project work in so many of the curriculum subjects by examination decree or choice, with little consideration of facilities etc. leads to boredom, time-wasting and achieves little of educational value.

(113, Biology)

Problems of this kind were not confined to the teaching of Biology. As might be expected, teachers from other science disciplines made similar statements underlining the frustrations encountered in their attempts to engage pupils gainfully in project work, and their reluctance to use it now:

I have considered, seriously, using internally assessed project work ... and was keen to do so, but had to abandon the idea due to shortage of apparatus for sets of 25 students.

(085, Physics)

Several teachers defined problems of working space and the limited availability of ancillary assistance as restrictive, and responsible for the waning enthusiasm for project work by both staff and pupils:

We have had problems over working space ... even though staff/pupils keen at start, conditions soon took the edge off.

(194, Physics)

It is my opinion that the project work in C.S.E. is really a test of school resources and time available for the staff ... We have only one lab. technician for eight labs. and therefore are not able to run more than the minimum of practical work.

(002, Chemistry)

A project in Chemistry is only valuable if it involves individually planned and performed experiments to test the students' own hypotheses ... we do not have the resources, time or technical assistance needed.

(100, Chemistry)

Additional evidence in support of these statements was obtained from the personal interviews and school visits carried out in the region. The servicing of as many as six science laboratories by one full-time technician was a common occurrence, and in one of the schools visited, one lone part-time, untrained laboratory technician had to assume responsibility for the running of all six science laboratories. Similarly, in relation to working space, science lessons were observed in ill-equipped temporary classrooms, and in one establishment a class of twenty-plus C.S.E. pupils was accommodated in an electronics laboratory designed to hold twelve A-level students.

Not only did the scarcity of basic equipment and suitable facilities affect teachers' views about project work but the over-use of existing resources hampered progress to some extent too. As one Chemistry teacher explained:

Some projects involve apparatus being set up and left ... This means finding a safe place to leave the apparatus (if, indeed, space can be found anywhere) and taking that apparatus out of general use which we cannot afford to do.

(252, Chemistry)

Thus, it would seem that the anxieties and frustrations arising out of the lack of resources and facilities were, in many cases, well-founded.

To investigate these issues more thoroughly, it seemed important to include in the research study an item which sought to gain an overall picture of the existing conditions within schools and colleges actually utilising the project approach. Item 5, Section A of the questionnaire was designed with this in mind. Here, the respondents were asked to rate four specific facilities in their schools or colleges on a four-point scale ranging from

excellent to poor. Secondly, they were asked to indicate the availability of each of these facilities to pupils engaged in project work. A three-point scale (readily available/limited availability/not available) was provided to assist them in this task. The results of both sets of ratings are summarized in Table 8.2.

As shown in Table 8.2., the majority of respondents rated their facilities as either good or adequate although at least twenty-three teachers (14.4%) thought that the facilities in their schools and colleges were poor.

The provision of laboratories was generally good although 52.5% of the teachers described their availability to pupils as 'limited' in that pupils were only permitted to use them by prior arrangement with the teaching staff and laboratory technicians. Such arrangements were often difficult to make, but essential if existing health and safety regulations were to be upheld.

Library facilities were 'adequate-to-good' and in the majority (55.0%) of cases were readily available to pupils. Two respondents did however claim that such facilities were not available to their pupils and this was obviously a disturbing feature in an establishment of secondary education responsible for external examination work. Library staffing appeared to be the main problem. In two of the schools visited as part of the interview programme, library provision was solely dependent on the goodwill of the teaching staff in operating a voluntary rota system to man the library and to keep it open and functioning throughout the school week.

TABLE 8.2.

TEACHERS' RATINGS OF THE FACILITIES IN THEIR SCHOOLS AND COLLEGES,
AND THEIR AVAILABILITY TO PUPILS ENGAGED IN PROJECT WORK

% FREQUENCY OF RESPONSE AMONG USERS OF PROJECT WORK (n = 160)									
FACILITIES	TEACHERS' RATINGS OF FACILITIES					AVAILABILITY TO PUPILS			
	Excellent	Good	Adequate	Poor	Not ans.	Readily Available	Limited Availability	Not Available	Not answered
Laboratory	13.1	39.4	28.8	17.5	1.3	38.8	52.5	6.9	1.9
Library	6.3	31.9	38.8	21.9	1.3	55.0	41.9	1.3	1.9
Reprographic	15.6	32.5	35.0	14.4	2.5	5.6	23.1	68.8	2.5
Audio-visual	10.0	30.0	42.5	15.6	1.9	5.0	36.9	56.3	1.3

Reprographic and audio-visual facilities were adequate but largely unavailable to pupils except for 36.9% of the respondents who described the availability of the latter as 'limited' in that by a system of advanced booking (mainly through audio-visual/resource technicians) videos, films and tapes etc. might be loaned to pupils for the purposes of personal research. This type of loan-system was not widespread and in some schools it was running for an experimental/trial period only. In general, any inaccessibility of audio-visual and reprographic facilities to pupils was not seen as especially problematic in the teaching of science and/or the operation of project work. One interviewee suggested that teachers and pupils could progress well without 'such gimmicks' (330, Biology), a comment that has interesting implications, especially considering the wealth of scientific resource material produced by the educational divisions of organisations such as the BBC, IBA, ICI, Unilever, BP etc⁽⁶⁾. Moreover, it suggests that some science teachers are reactionary with regard to their own pedagogy. Not yet fully receptive to the new technology, they are inclined instead to remain with the more traditional teaching aids and strategies.

Accepting the teachers' different perspectives of the quality and availability of resource and facilities (and also the need for them) it was, however, interesting to observe the conditions existing in those schools and colleges visited as part of the interview programme in the East Midland region. Of those visited, over 60% of them appeared to be at least one laboratory less than the

number judged by HM Inspectorate to be necessary for the provision of practically-based courses⁽⁷⁾. (The survey conducted by HM Inspectors, covering a 10% sample of maintained secondary schools in England, had previously revealed that 40% of them did not have adequate laboratory provision⁽⁸⁾. It is important to bear in mind though that this figure was based on additional factors which took account of the size of the schools and other circumstances operating therein.)

In relation to these findings and in support of the teachers' personal ratings of resources and facilities, those respondents who did engage pupils in some form of science project work at C.S.E. level frequently claimed to do so in spite of unfavourable conditions. The resultant projects were often disappointing; they lacked any substantial investigative, practical theme and tended instead to be (as discussed in Chapter 3, Section 3.1. and Chapter 5, Section 5.3.1.) 'a rehash (usually poor) of text book material' (061, Physics).

The majority of respondents agreed that good facilities and a wide variety of resources, although not essential, were valuable aids to effective project work in science. In many establishments such aids were clearly inadequate to cope with the numbers of pupils involved. In addition, the practical slant - which was continually stressed as a desirable element of project work - demanded equipment and apparatus on a scale that was apparently inconceivable in some school science departments due to both the initial financial outlay and the problems arising out of storage and maintenance. Furthermore, it was

suggested that the conditions in schools and colleges would deteriorate still further as a result of vast cut-backs in cash allocations⁽⁹⁾. One member of staff predicted that 'project work will be the first to suffer' (033, Biology). Other respondents made frequent reference to resources in explaining the operation of very restricted forms of project work. In some circumstances it seemed that only certain types of project work could be realistically attempted, irrespective of the inherent interests and motivations of the pupils and staff concerned.

A few teachers were more optimistic. They did not accept that project work in science necessitated extensive and sophisticated resources. Some offered suggestions for alternative approaches to project work which required only quite basic resources and facilities and yet still retained the element of practical investigation. For example, in Biology, it was suggested that simple studies of seedlings and insects could be devised by pupils and that these, although not elaborate, could nonetheless tap the 'processes' of science such as the skills of observation, experimentation and prediction. Unfortunately, being reminiscent of the 'old school' biology course, it is questionable just how much interest, intrigue and relevance such investigations would hold for the average C.S.E. candidate. Nevertheless, the implication that project work, in the life sciences especially, can be utilised successfully with little extra cost in terms of money and resources is probably a realistic one.

Perhaps, of more interest to teachers and pupils was the suggestion made by a teacher of General Science:

Project work can be costly if the school is not prepared to make and maintain outside contacts with people who work at various project topics in their everyday work.

(021, General Science)

Indeed, taking science out of the classroom into the 'real world' was seen not only as a means of overcoming prohibitive costs but also as one of the best ways of making the study of science alive and meaningful. This was acknowledged in the recent H.M.I. report on secondary education where at least sixteen schools were commended for their 'major attempts to enrich the science teaching and enhance its relevance to pupils by reference to industrial processes and practices'(10).

As a consequence of recommendations to apply science to the everyday life of pupils, numerous attempts have been made to incorporate active environmental education into the curriculum at all levels and to increase awareness on environmental issues such as pollution, the energy crisis and the social implications of the microchip. For those associated with science education, this has involved visits to local industries, laboratories, processing plants, farms, museums, various ecological habitats and the like. Such activities are the sort frequently encouraged by some teachers for pupils engaged in project work but others, in contrast, are not convinced of their worth and question whether these excursions into the 'real world' are always as fruitful and beneficial as some would have us believe. Clearly, the recollections of staff and former pupils sometimes disclose a very different picture. Long, exhausting industrial visits accompanied by dull, high-level lectures, unforeseen closure of museum sections,

rain on the marshland and dead batteries in the portable meters are just some of the consequences of inadequate organisation that can rapidly convert a field project into a frustrating, negative experience.

The teachers participating in the study recognised these difficulties and many stressed the need for careful planning and preparation to ensure the optimum level of success. It was unfortunate that, given the existing working conditions and the heavy teaching load placed on staff, this was not always easy to fulfil.

One teacher from an especially troubled school stressed the importance of another disturbing issue, that of pupil discipline. He recounted how insolence, ignorance, excitement and carelessness resulted in pupils becoming dangerously out of hand when engaged on field projects. Such frightening outcomes drastically altered this teacher's perceptions of the value of field investigations and led ultimately to their disappearance from his science teaching programme.

Conversely, several respondents maintained that these adverse outcomes could be largely eliminated by ensuring that the specific objectives of project work are clearly stated to the pupils in advance so that they are able to appreciate the full purpose and relevance of it. However, the soundness of this argument still has to be verified for there is without doubt a real danger, as one teacher pointed out, of 'pupils working to satisfy the teachers' instructions rather than following a real interest line' (019, Biology). It does seem likely though that by specifying the aims and objectives of project work,

external resources could be profitably utilised in science, in a way of value to the average C.S.E. pupil.

In discussion about the feasibility of project work in the field, every one of the thirty teachers interviewed commented on the problems of school location and transport. Rarely were schools or colleges situated near or within easy access of appropriate educational resources such as industrial processing plants, ecological habitats and museums. Visits to these places therefore often necessitated the organisation of transport (that is, either the use of the school vehicle, public transport or hiring firms) which was not itself without problems. Firstly, although the majority of teaching establishments possessed some form of transport (a school mini-bus, Land Rover or the like) only a limited number of suitably qualified staff was usually permitted to drive it due to strict insurance restrictions. Secondly, school vehicles were frequently too small to accommodate a complete C.S.E. science class in a single journey. As a consequence, classes participating in such excursions inevitably had to be divided into smaller, more manageable parties. This, in turn, imposed additional problems with staff coverage for classes and time-tabling manipulations which were known on occasions to cause ill-feeling among colleagues.

As an alternative, transport could be hired privately but, in common with public transport, this was seldom economical or convenient. Further difficulties were encountered with respect to the financing of such expeditions. Given the constraints on expenditure operating within education during the period of the enquiry, pupils

were usually required to pay the costs themselves.

However, many respondents felt strongly that this was unfair on the less academic, less science-orientated pupils and their parents, and therefore endeavoured to avoid it.

Thus, having reviewed just some of the many problems and anxieties associated with providing an adequate range of resources and facilities for pupils engaged in project work, it is perhaps easy to understand why teachers sometimes ask 'is it really worth all the trouble?' Similarly, it is not difficult to see why some teachers feel inclined to opt out of project exercises altogether. The quality, quantity and availability of resources, both within the school and outside, are clearly important factors influencing the types of projects that can be realistically attempted, if at all.

8.8. Pupil Attitude

The importance of pupils' attitudes towards project work has been discussed fully in Chapter 5 in relation to the acquisition of skills and the development of favourable attitudes towards learning and science. It is however helpful at this point to examine the issue again, emphasising briefly the chief anxieties experienced by teachers concerned about the successful implementation of the project approach at C.S.E. level.

Of those teachers not using project work at the time of the enquiry, forty-five (15.0%) cited pupil attitude

as a main factor influencing their decision not to employ the method (see Table 8.1., p. 402).

Concern over pupils' attitude was felt especially by those teachers with some previous experience of the project approach. They commented on the 'discouraging lack of initiative shown by some of the pupils' (365, Chemistry) and the 'change in attitudes particularly in the pupils - apathy, lack of self-discipline, very little urgency or drive' (408, General Science).

Unfavourable pupil attitudes seemed especially acute in General Science where the following comments were largely typical of the views put forward by the respondents:

Most General Science candidates tend to be of lower ability and not able to work in the disciplined way required of project work.
(156, General Science)

I feel to use projects the pupils must be well-motivated and must possess the ability to work on their own to a certain extent ... This would, in my school, rule out most pupils.
(210, General Science)

Lack of drive and low levels of motivation among pupils were observed in other areas too:

In my opinion, a well-motivated, more able pupil can gain much from the individual project work. In my experience, however, the 'average C.S.E. pupil' does not often fit this description in both respects.
(233, Chemistry)

In my experience, pupils put little thought or effort into project work ... Project work in class is seen by pupils as a 'rest period'. Pupils themselves see little value in the often large numbers of projects they have to complete in the 5th year.
(055, Chemistry)

I would have preferred their projects to consist more of practical investigation but the pupils did not have the necessary drive.
(186, Biology)

Project work that involves research of literature and synthesis of information is beyond the capabilities of poorly-motivated (not necessarily 'average' C.S.E. candidates).
(068, Biology)

Even in Physics, a subject commonly attracting a higher proportion of more able pupils, similar problems were identified:

At C.S.E. level, I am doubtful of the gains which would be obtained by using project work in view of the attitude of the average pupil. I feel that the disadvantages greatly outweigh the advantages.
(050, Physics)

At C.S.E. level, teaching is the essential ingredient. 'Children love to learn but hate to think'. Project work, to be valid, expects too much at this level. (268, Physics)

Other difficulties seemed rooted in the dual system of examining at 16-plus and the 'poor relation' image of the C.S.E. One teacher summed up his own experiences as follows:

C.S.E. is inevitably regarded as second-rate and pupils taking it tend to regard themselves as sub-standard. Their feelings of rejection and frustration often shown themselves in discipline problems.
(327, Biology, interview)

Thus, from the comments volunteered on the questionnaire and during the interview programme, it can be seen that pupil attitude was a cause of some anxiety to those involved with C.S.E. science teaching. Many felt that pupils' lack of self-discipline and enthusiasm, combined in many cases with lower ability, was a serious deterrent to the use of project work at C.S.E. level. Some respondents acknowledged that in other contexts, with highly motivated, more able pupils, project work could be valuable and effective, but at C.S.E. level they saw it as a generally unproductive exercise and for this reason

decided not to implement it.

8.9. Other Factors

A variety of alternative reasons were given in response to the questionnaire item asking teachers to consider the main factors guiding them in their decision not to undertake project work as part of their C.S.E. teaching programme.

Several respondents indicated that they did not use the project method because it was not their departmental policy to do so and in some cases it was suggested that little, if any, discussion about teaching strategies was engaged in between colleagues. As one Biology teacher explained:

A lot of the decisions involved are not my responsibility and, as yet, have not been discussed with me. Some, if not most of the points (i.e. those raised in the questionnaire) I have never really considered.

(358, Biology) (Authors' parentheses)

Other teachers expressed doubts about their own expertise in the management of pupil project work; inexperience made them reluctant to tackle this type of approach. Some also hinted at the lack of support and guidance given to staff in their departments:

I find many of the questions difficult to answer due to my relative inexperience in C.S.E. teaching in Science ... And due to the fact that the Head of Science had made certain decisions regarding syllabi in the future.

(356, Chemistry)

Project work is rarely exploited to its full potential largely due to the inadequacy of the staff involved.

(267, Biology)

I feel my personal problems will arise from lack of variety of topics, lack of resources due to my own inexperience ... Having taught for a relatively short period of time, I find that my training as a teacher did not prepare me for teaching ... I found I knew too little about examining boards, different courses and I am sure it would have been valuable to have known.
(190, Biology)

The staff concerned also feel that while they have a deal of subject specialism, they need to develop different techniques to apply them to a project-based course.
(211, General Science)

Anxieties of this sort were not confined to the 'Non-Users' of project work. Even among those teachers actually using the project method, concern about their own lack of experience and expertise was found to influence their choice of topics and thereby restrict their use of project work (see Chapter 3, Section 3.2.). Hence, on this issue, the teachers' comments hold clear implications for the pre-service and in-service training of teachers and their secondment into fields outside education (see Chapter 6, Section 6.2.6.).

In contrast, there were some respondents (notably the teachers of Chemistry) who maintained that their pupils were already undertaking several long projects in other C.S.E. subjects and that to give them further project work was, in their view, an unnecessary burden:

It seems that in some subjects (certainly in this school) too much emphasis is placed on project work e.g. in History and R.E. They do several projects over two years - enough is enough!
(229, Chemistry)

Most pupils have their fill of project work in Humanities' subjects. (043, Chemistry)

Very often, these pupils of average or below average ability are faced with project work from other subjects making a total work load for their courses at C.S.E. well beyond their real capabilities.
(110, Chemistry)

Some respondents felt that formally organised, practical sessions were a more appropriate and effective teaching strategy than project work and, in line with arguments put forward in Sections 8.4. and 8.6. of this chapter, provided a more valid means of assessment:

My views however are that more valid ways of assessing specific criteria (e.g. drawing conclusions, recording, observation) can be used and, therefore, as far as assessment is concerned, project work is unnecessary. In order to direct a class in project work, in my view, it would have to be so closely structured that it may no longer be considered to be a project.
(198, Biology)

Thus, from these final comments, it is clear that some teachers, through inexperience combined with lack of departmental support and initiative, felt ill-equipped to handle a project approach whilst a reluctance to place excessive demands on pupils alongside the availability of alternative (and more familiar) teaching/learning strategies convinced others of the inappropriateness of the method for the C.S.E. pupils involved in the study.

8.10. Summary and Discussion

In reviewing teachers' reasons for not using project work with C.S.E. pupils, a multiplicity of factors were identified. Although all of these factors are important, contributing in whole or part to the teachers' decision not to implement the project approach, it was by all accounts the culmination of several unfavourable aspects that made the adoption of project work, or (in some 60% of cases) its continuation, an unappealing proposition.

For the respondents in this study, managerial and organisational problems, arising out of different patterns of curricular organisation, formed the main body of the argument against the use of project work at C.S.E. level, and centred chiefly on the issues of class size and composition.

Although intuitively many experienced teachers would seem to accept that small classes must, by definition, be educationally beneficial and thereby desirable, the empirical research carried out in this area has produced statistics that are conflicting and assumptions that are generally confused (see Cullen 1979).

A study by Burstall (1968; 1979) of class-size effects in primary French classes generated some interesting discussion although the conclusions of her work offered:

... no support to either view (i.e. that of some earlier researchers tending to favour larger classes, and that of teachers favouring smaller ones): no evidence was found to suggest that levels of achievement in French, whether rated by the Inspectors or measured by the objective tests, varied as a function of class-size.(11)

Similar reports have been made in other subject areas by Pidgeon (1973), and Ryan and Greenfield (1975) and although the general finding recorded above is not untypical, points have emerged to suggest that class-size as an educational issue may be considerably more complex than a single calculation of the staff-pupil ratio. For example, evidence on pupil participation in classes of varying sizes, presented by Burstall (1968), indicates that smaller classes are advantageous in the sense that they provide more opportunities to practise orally and that the less able pupils are more likely to play an active part in this.

In addition, there is a suggestion from a study by Summers and Wolfe (1977) that it is only low ability pupils who benefit much from being in small classes.

Extrapolation of these findings to the present study might then be taken to suggest that small classes encourage lower ability pupils to become more practically involved and to participate more actively in discussions around project topics. It should however be stressed that in the study by Burstall cited earlier, the heightened levels of involvement and participation observed in pupils in smaller classes were not reflected in higher levels of achievement. It follows therefore that if one uses educational achievement as an indicator of success, then small classes are not necessarily successful, but if other elements (such as co-operation, communication, confidence) are to be included among the aims and objectives, then by these criteria small classes may well be desirable.

The implication that small classes may be beneficial was also made by H.M. Inspectorate in a discussion document on mixed ability work in comprehensive schools (H.M.S.O. 1978). Although it was acknowledged that small classes were not always possible, the case for the formation of small working groups within a larger class was put as follows:

Perhaps the most promising method was that which provided for small group working. This could allow for pupils being at different stages of development and for the good intellectual and social effects of group interaction; foremost amongst these was the increased opportunity for language development. (12)

Further indirect support for small classes was provided by H.M. Inspectorate in the report on secondary education

cited earlier. With special reference to the teaching of science, large classes were identified as a serious problem, but given the declining economic outlook for education at the time of the survey, small classes were also in some respects regarded as an unjustifiable luxury.

The following extract explains the position:

That there should be any science classes of over 30 for fourth and fifth year pupils is a source of concern. It is difficult to teach, to organise and to control practical work effectively with classes of this size and questions of safety are more likely to arise. In contrast, classes of fewer than 13 pupils can be uneconomical and lead to extravagant use of teacher and laboratory time⁽¹³⁾.

The issue of class size is therefore both complex and ambivalent, and clearly any further investigations in this area demand a research strategy beyond the scope of this current enquiry. Hence, this investigation serves not to dismiss or re-assert any claims already made on this topic but instead to examine more critically the major difficulties confronting teachers in their attempts to engage large numbers of pupils in a worthwhile form of science.

In the present study, large classes presented problems of a material nature (e.g. the provision of adequate accommodation, facilities and resources) and of an educational kind (e.g. the provision of appropriate levels of guidance and supervision). However, whilst acknowledging these difficulties, the results of earlier studies would seem to suggest a strong case for the formation of small working groups within large classes. Moreover, under such circumstances, it seems likely that the introduction of a project approach to learning, incorporating a wide variety of separate study topics, rather

than generating problems, might actually help to alleviate them.

On the question of class composition, further important points emerged concerning the organisation and management of science lessons. From the comments and observations of the respondents, it became apparent that for various reasons (e.g. the historical development of the school, the experiences of the staff, the availability of key resources) pupils of different abilities and destined for different national examinations were frequently taught together in the same class. Combined classes of this sort were a constant source of anxiety for many teachers in that the pupils concerned were individuals, progressing at different speeds, pursuing different goals and requiring different sets of resources.

Various teaching strategies were adopted to cope with these diversities. In some cases, the lessons favoured the G.C.E. population whilst others catered primarily for C.S.E. candidates with the more able pupils receiving extra tuition. Alternatively, much of the pedagogy and content choice settled, as Davies (in Davies and Cave 1977) has observed, for convenience on the mass in the middle with the upper and lower ability levels seen as 'harassing problems', and it seemed that even in a mixed ability situation, whole-class teaching tended to persist. It was an approach that was familiar, easy to organise and one in which many teachers felt confident. It did not eliminate the problems of mixed ability grouping but it did help teachers to cope.

Concerning teachers' ability to handle combined classes, Caulfield (in Davies and Cave 1977) has stressed

that the biggest problem facing teachers in the mixed ability situation is the lack of ancillary support. Commenting on the subtle changes in methodology required in mixed ability teaching, he argues that valuable hours of teacher time are taken up on routine tasks - such as the reproduction of materials and the filing of work-cards - which could instead be carried out by competent ancillary staff. Clearly, if clerical assistance of this kind were available, then more teacher-time could be spent on the preparation of an appropriate range of materials to cover the needs of pupils of varying abilities.

The importance of ancillary assistance is also acknowledged in the H.M.I. discussion document on mixed ability teaching cited earlier in this section. In this document, it is emphasised that with mixed ability groups, ancillary staff are even more necessary than with those organised by ability. Furthermore, whilst accepting that the teacher is the crucial factor in determining the success of any form of grouping, it is argued that with good resources and facilities, and with classes that are not too large, many of the disadvantages of mixed ability classes are avoidable.

Thus, on the issue of class composition, it seems likely that many of the problems confronting teachers could be alleviated if additional staff were available to undertake the routine clerical tasks which accompany the development of new/revised teaching strategies. Clearly, without such assistance, many teachers feel unable to introduce new approaches like project work

because they have insufficient time to work out new schemes and to build up sets of resources. Hence, the traditional, and well-tried, practices tend to remain despite their inappropriateness. Indeed, in this enquiry, many of the respondents acknowledged that such practices are often detrimental to pupils' progress in science.

As well as the managerial and organisational difficulties arising out of variations in class size and composition, other factors emerged as influential in teachers' decision not to use project work with C.S.E. pupils. A number of respondents felt constrained by the existing syllabus requirements and assessment procedures. Some felt that the subject content was not suitable for a project approach whilst others maintained that project work failed to equip pupils with the expertise necessary to gain a good grade in the final examinations. In this context, it was agreed that syllabuses and examinations, through the Mode III facility, could be made more relevant but again lack of time and support prevented teachers from developing such courses. As a consequence, the project approach tended to be rejected in favour of more traditional strategies which were seemingly more compatible with the existing examination syllabuses and assessment procedures.

Among the other factors to emerge from this enquiry, pupil ability and attitude received considerable attention. Some respondents regarded the project approach as beyond the scope of average C.S.E. pupils who, it was argued, had difficulty organising work, thinking problems

through and developing a sound line of reasoning. In addition, it was suggested that many of the pupils lacked the motivation and tenacity necessary to sustain a project. Hence, teaching strategies that were more structured were generally preferred. Again, this was an unfortunate outcome since several earlier studies have demonstrated increased levels of understanding and improved attitudes towards learning among pupils engaged in project work (see Chapter 5, Section 5.6.).

The quality, quantity and availability of resources and facilities were also named as important factors influencing teachers' decisions about the use of project work. Although there were some who argued that a wealth of resources and facilities was not an essential ingredient of good project work, many were adamant that the resources and facilities in their schools were inadequate for a project-type approach. Others commented on the difficulty of using the resources and facilities that existed outside school. Financial constraints as well as the problems of pupil supervision and transport were just some of the troublesome aspects of project work undertaken off the school premises.

Pupil characteristics, examination arrangements and school conditions were not the only problems confronting staff. From their comments, it was evident that some teachers, through inexperience combined with lack of departmental support, felt ill-equipped to handle a project approach, whilst anxieties about placing excessive demands on C.S.E. candidates caused others to stay with the more traditional (and more familiar) science teaching strategies.

Having reviewed the main reasons for not using a project approach with C.S.E. pupils, and considered in some detail the major constraints on the operation of project work in C.S.E. science, it would however be wrong to conclude that teachers' attitudes toward the project strategy were inevitably and irreversibly negative. In fact, in the final analysis, the opposite would seem to be true with the majority of respondents indicating that a project approach could, under certain circumstances, be a valuable and effective teaching/learning strategy. These more positive aspects of project work are discussed in the last chapter where the ideas, knowledge and expertise of the teachers participating in this study are drawn together in an attempt to formulate a clear statement of the conditions under which project work may successfully implemented.

NOTES

1. For data on teachers' past experience of project work, see Appendix IX.
2. To illustrate the differentiation that in some cases exists, one of the schools visited during the interview programme claimed not only to implement different science subjects and syllabuses but also to use different Examination Boards according to the ability rating of the pupils concerned. The O-level Chemistry set followed a Nuffield syllabus, the C.S.E. set followed the E.M.R.E.B. Materials Science syllabus, and those C.S.E. pupils who

showed some promise were entered for the Oxford traditional 0-level examination (433 Chemistry). This, it was suggested, enabled any incorrectly 'setted' pupils to be more easily switched to an alternative examination scheme at a later date. It would seem that such discrimination not only affects the size and composition of classes but also, perhaps more importantly, affects the pupils' self-concept, their feelings about the science subject being studied and, consequently, their attitude toward work.

3. It could be argued that discipline problems (whether acknowledged openly or not) cannot be so easily dismissed since many teachers may be reluctant to admit that they do not have complete control over their classes. Hence, it is recognised that discipline problems may be under-reported here.

4. These views were set out in early documents relating to the C.S.E.; see Secondary School Examinations Council: Examinations Bulletin No.1, The Certificate of Secondary Education, H.M.S.O., 1963.

5. The home issue is taken up in various contexts throughout this study; the reader is referred to Chapter 4 (Section 4.3.1.) and Chapter 5 (Section 5.8.).

6. These include publications, films, resource packages, available free or on loan/hire to schools and colleges on request.

7. See Aspects of secondary education in England: A Survey by H.M. Inspectors of Schools, H.M.S.O., December 1979, Chapter 8, para. 14.26., p.202.

8. Op.cit., Chapter 8, para. 6.2., pp. 174 - 175.

9. See 'Spending per head on educational equipment, materials and books in local education authorities in England and Wales', Times Educational Supplement, 23 January, 1981.
10. Op.cit. Chapter 8, para. 3.6., p. 171.
11. See 'Time to mend the nets: a commentary on the outcomes of class-size research' by Clare Burstall, Trends in Education, Autumn 1979(3).
12. See Mixed Ability Work in Comprehensive Schools, H.M.I. Series: Matters for Discussion, No. 6., H.M.S.O., 1978, p.138.
13. Op.cit., Chapter 8, para. 8.7., p. 182.

CHAPTER NINE

FINDINGS AND IMPLICATIONS

- 9.1. The Findings: An Overview
 - 9.2. Implications
 - 9.3. Recommendations
 - 9.4. Towards Further Research
- Notes

9.1. The findings: An Overview

The progression from examinations catering primarily for the minority of scholars destined for the universities and professional bodies to a system serving the much larger proportion of 'average' pupils was a lengthy, drawn out process. Indeed, the introduction in 1965 of the C.S.E. with its provision for alternative modes of examination was by all accounts a long-awaited exciting innovation.

By placing the responsibility for curriculum development in the hands of the teachers and emphasising the importance of 'effective teacher control' of the examinations, it was anticipated that the C.S.E. would encourage teachers to consider more critically the content of their courses, their teaching strategies and their assessment procedures, and lead ultimately to substantial improvements in course design and examining techniques.

The emergence of the C.S.E. coincided with a move away from the traditional emphasis on the 'products' of learning to more objective statements of the 'processes' of learning and the skills expected of pupils, and it was in response to these developments that the project approach grew in popularity and expanded across all areas of the school curriculum.

With the raising of the school-leaving age to sixteen, the support for project work increased still further as the need to develop courses and assessment methods suitable for the increasing numbers of non-academic pupils staying on at school became apparent. The strength of project work lay in

in the belief that it could tap those interests and skills which under more traditional/academic methods might escape detection. Hence, for the less-academically motivated pupils, it was seen as a much fairer means of assessing their real capabilities.

The project approach was not however without its critics and over the years that followed serious doubts were raised about its value as a teaching/learning strategy and its worth as a method of assessment. The current enquiry sought to examine the validity of some of these criticisms by studying the nature and management of pupil project work in the four main C.S.E. science subjects, and exploring in some depth teachers' own views on its effectiveness.

Three types of project work were identified: the report-type in which pupils were required to write a report based on information collected from books and journals etc., the discovery-type where pupils attempted to solve a problem using the results of their own experimentation, and the combination-type in which pupils answered a question by means of information gathered from books and data collected from simple investigations.

The discovery approach - although often regarded as highly desirable in allowing pupils to practise 'real' science - was not generally utilised at C.S.E. level. Many respondents argued that inexperience and lack of ability on the part of the pupils and the difficulty of providing adequate resources and facilities for such a practically-based approach made this type of project work extremely difficult to implement successfully. Others

pointed to examination syllabuses built around traditional teaching methods as a factor inhibiting the use of the discovery approach. The 'reporting' and 'combination' projects were found to be the ones most frequently employed at C.S.E. level although from the teachers' comments it was clear that projects so defined often emerged as exercises in plagiarism, with the emphasis on neat presentation rather than understanding. Most respondents were harshly critical of this outcome although a few teachers commented that 'dedicated copying' was preferable to classroom rowdiness and that as a form of class control, this type of project approach worked well. Moreover, many pupils (especially the girls) actually seemed to enjoy it.

Although personal choice of project topics by pupils was generally recognised as an important motivating feature of project work, freedom of choice was often restricted because of the size of the examination syllabuses, the weight of material that had to be covered to ensure success in the final examination, and the difficulty of providing adequate resources to cater for individual interests. To overcome these problems, some teachers asked pupils to select their topics from a general list compiled by the teacher. This method was seen as the best way of enabling pupils to choose those aspects of the course of most interest to them whilst still ensuring coverage of important sections of the syllabus and availability of resources. However, regardless of the acknowledged value of personal choice, most topics for project work were, in practice, assigned by the teacher and were intended to cover specific subsections of the examination syllabus. The assignment of

topics in this way not only guided pupils' progress through the course, it also to some extent eased the work-load on teachers.

Pupil project work was organised mostly on an individual basis with pupils working and writing up independently. This arrangement was usually preferred as it allowed individual pupils' progress to be followed. Group projects were sometimes undertaken to overcome shortages of equipment but many respondents did not favour this type of organisation as it was not always easy to monitor individual contributions. The 'passenger' in the group was sometimes difficult to identify especially when classes were large and groups were working on a variety of topics.

The amount of guidance and supervision given to pupils engaged in project work was a cause of concern due to the difficulties of standardizing these aspects for the purposes of assessment. It was recognised that if the pupil was to benefit from the project approach, a careful balance was needed between an attitude of 'laissez-faire' and one of total monopoly by the teacher. Pupils who were unfamiliar with the project approach often lacked confidence in their ability to work independently and tended to panic when faced with this degree of responsibility. Hence, it was felt that teachers needed to supervise their work, to ensure an appropriate level of support without intervening too early or too often.

Helping to break down some of the traditional subject boundaries and allowing pupils the opportunity to experience science in a relevant context was a much valued feature of certain aspects of project work. In fact, making science

more relevant to the 'real life' of the pupils was probably one of its best selling points. It was therefore surprising that projects undertaken out of school, at home, in the local community and countryside were not more popular in this enquiry. The difficulty of assessment as well as concern about home conditions, personal circumstances and pupil motivation made many teachers anxious about the value of projects undertaken out of school. Of those projects that were undertaken outside school, many were the reporting-type since it was felt that to implement reporting exercises during school time was wasteful of school resources. Such activities could, it was argued, be more usefully included as part of the normal homework allocation.

Generally, it was felt that pupils spent less time than they should on project work in C.S.E. science. The reasons why this should be so were confused although unfavourable pupil attitudes (in some cases, the result of inadequate planning on the part of the teacher) and lack of coherent induction programmes were seen as contributory factors.

It was recognised that more able pupils in a class tended to work faster than the less able who, through inability compounded by a lack of understanding and clear guidance in the preliminary stages, often found themselves lost in the open-endedness of the project approach. All too often (and the observation data lends some support to this) project work for these pupils emerged as a negative, frustrating experience to be readily abandoned.

A range of skills and attitudes was associated with pupil project work but, by and large, it was agreed that the project method - although often useful - was not usually essential to the acquisition of these skills and attitudes.

The socio-attitudinal aspects of the project method attracted most attention. Project work as a means of increasing pupils' interest in science, improving attitudes towards learning, promoting self-confidence (especially in girls) and encouraging co-operation and communication between pupils and teachers was acknowledged in all four of the C.S.E. science subjects studied and was substantiated to some extent by the observational study. Some respondents thought that such improvements in attitude and social behaviour occurred only in the more able pupils but there were others who commented on the progress made in this respect by those of below average ability.

Teachers' views on the role of project work in the acquisition of cognitive skills were divided. With reporting projects, attempts to discourage plagiarism frequently passed unheeded so that it was often hard to assess the cognitive level, especially in pupils who found it difficult to articulate their thoughts in written reports. It was agreed that projects involving an element of practical investigation could be valuable in giving pupils practice in the handling and interpretation of data although a number of respondents felt that to acquire the skills of deduction, pupils needed more painstaking, stepwise guidance from their teachers.

The project approach was not found to be helpful for the learning of facts but it was acknowledged that when

topics were relevant and interesting to pupils, project work could help them to grasp theoretical concepts and build up a store of scientific facts to be recalled when needed.

Project work demanded a good deal of planning and preparation on the part of the teachers to ensure that pupils became fully involved in it. When projects were made appropriate to the capabilities, interests and needs of pupils, and were supported by appropriate levels of guidance and supervision, they could, it was argued, provide a worthwhile training in the scientific skills of enquiry, experimentation, analysis, abstraction and interpretation. Many felt that only when pupils have been given the chance to construct hypotheses, test them, and put their results into practice can they reasonably be expected to acquire these high level cognitive skills. If project work provides pupils with these opportunities, then it has value.

There was a prevailing scepticism about the role of project work in the acquisition of organisational and managerial skills. Skill in the planning and organisation of scientific investigations was associated mainly with non-report type project approaches whilst teachers implementing reporting projects tended to be much less confident about pupils' ability in this respect.

Little emphasis was placed on the role of project work in the acquisition of practical/manipulative skills even though the importance of giving pupils the chance to involve themselves in practical, scientific investigations was stressed time and time again. By way of explanation, it

it was suggested that although practical skills could be developed through project work, these skills could be acquired more effectively through structured practical sessions in which, with the aid of well-designed sequences of instruction, pupils were taken through the stages necessary to gain experience and expertise in the practical skills of science.

Evidence of the importance of project work in increasing pupils' levels of literacy was conflicting. Some teachers believed that by calling on pupils to use resources other than the teacher and requiring them to refer to library sources for information, project work led to an improvement in pupils' ability to read and write. Other respondents felt strongly that the project approach favoured the more literate pupils and that certain pupils were handicapped by their literacy so that plagiarism was the inevitable outcome.

Many teachers were critical of the apparent emphasis on the neat presentation of material in the assessment of project work although there were some who argued that for certain pupils neat presentation was an important and worthy achievement, an indication of success for those who by more traditional science teaching strategies might never achieve it.

What can be achieved through the project approach clearly depends on the type of project work that is undertaken, the nature of guidance given in the early stages, the level of supervision proffered during its course, and the amount of time spent finally drawing together ideas, filling gaps in knowledge, clarifying points and highlighting

important concepts and principles. This was recognised by a large number of the teachers participating in the study, who saw the acquisition of skills and the development of favourable attitudes as dependent to a large extent on the clear definition, early on, of the main aims and objectives of project work, adequate planning and preparation, good organisation and management, and appropriate levels of guidance and supervision. Several respondents regretted that they were not always able to ensure that all these requirements were met although many worked hard, despite the constraints of time, resources, facilities, staff/pupil ratios, to provide an adequate working environment for pupils engaged in project work.

It was acknowledged that the benefits to be gained from project work varied with respect to pupil ability. The majority of teachers agreed that pupils of above-average ability gained most from project work, irrespective of the type of project approach being implemented. Pupils of lower ability found it difficult to organise their work, and were slower achieving results. The relationship between pupil ability and effective project work was however complicated by the important factor of motivation. Above-average pupils were rated as 'definitely enthusiastic' in their approach to project work although inevitably there were some minor exceptions. Several additional factors were believed to influence pupils' attitude. Good teacher/pupil relations were seen as important in promoting pupil enjoyment whilst sound classroom practice (e.g. punctuality, consistency, attention to detail) as well as pleasant working conditions (e.g. light, spacious well-equipped teaching rooms) were thought to contribute in part to an

improvement in pupils' attitude toward project work as a teaching/learning strategy.

Data from the observation study suggested that project work was tackled differently by pupils of varying ability. More able pupils appeared to work more continuously with good pupil/pupil and pupil/teacher exchanges on all aspects of the project approach: facts, principles applications, hypotheses, procedures. They also displayed more confidence in the writing-up elements of project work. Less able pupils, on the other hand, worked at a much slower pace, with longer pauses between activities. Conversation among these pupils was concerned mainly with 'doing things right' and gaining reassurance. In all the project lessons observed, practical work was seen to occupy only a small proportion of the total class-time although from the data available it was clear that practical activity among the less able pupils tended to be a routine following of instructions rather than a process of discovery. In conclusion, it was agreed that pupils differing in ability and attitude require differing levels of guidance and supervision, and differing degrees of support in the form of reassurance and encouragement. When these factors are carefully tailored to suit the needs of the pupils, the project approach can without doubt be a valuable and effective teaching/learning strategy.

An analysis of teacher characteristics revealed that attitudes and beliefs about project work and teachers' use of it in C.S.E. science teaching programmes stemmed not

from characteristics such as age, sex, qualifications, training and experience but were based on teachers' perceptions of the usefulness and success of project work in a variety of contexts.⁽¹⁾ Several important considerations caused teachers to reject the project method or accept it as a worthwhile teaching strategy and assessment procedure.

Managerial issues arising out of different patterns of curricular organisation formed the main body of the argument against the use of project work in C.S.E. science. In this context, class size was an important consideration since large classes not only heightened anxiety about the financial burden of project work, they also gave rise to doubts about the levels of guidance and supervision given to pupils, and their control and discipline in the project situation. Other anxieties focussed on class composition. Mixed ability groups posed special problems because the pupils in them progressed at different rates, were destined for different national examinations and as a consequence required different sets of resources. All of these problems were compounded by the widespread understaffing of science departments, the disjointed time-tabling arrangements and the inadequate laboratory accommodation.

The syllabus and examination were also seen as serious constraints on the operation of project work. Some respondents (especially the teachers of C.S.E. Physics) felt that their syllabuses were not compatible with a project approach. The rigidity of the courses and their reliance on formal teaching methods and traditional assessment procedures were not, it was argued, conducive to a project-type strategy. Moreover, the size of the existing

syllabuses and the depth of material that had to be covered during the course caused many teachers to reject the project method in favour of more 'economic' teaching strategies. Where project work was incorporated as an option for moderation in the final examination, there was concern about the methods and criteria on which the assessments were based. It was clear that the difficulty of standardizing project work, of controlling the degree of parental involvement and of ensuring fair levels of guidance and supervision from the teacher, led to doubts about the usefulness of project assessments and made a number of teachers choose other strategies which they felt would give all pupils a better and more equal chance in the examination stakes.

For over one third of the respondents the decision not to implement a project approach was also influenced by the ability level of the pupils. Many of these teachers felt that project work was beyond the scope of average C.S.E. pupils who, it was claimed, required more structured teaching methods. There was some uneasiness about the ability of these pupils to handle the open-endedness of projects, and the need for direction and clarity in C.S.E. teaching was stressed with the result that more traditional approaches were generally preferred.

The quality, quantity and availability of key resources and facilities were also important considerations influencing the manner in which project work could be undertaken, if at all. Of those teachers not using project work, over 40% agreed that it was too costly in resources to be catered for adequately by the standard school or college. Good

facilities and a wide range of resources, although not essential, were regarded as valuable aids to effective project work, and on this issue shortages of equipment, accommodation and technical assistance emerged as major grievances. Taking projects out into the community was put forward as one means of overcoming these shortages but this was not without its problems; transport, insurance, time-tabling and staff/pupil ratios were just some of the many difficulties attending such ventures.

Some teachers, trained in accordance with the more conventional, subject-centred approaches (particularly those of the grammar school tradition) were plainly sceptical of the claims made for project work but others, whilst acknowledging its usefulness, felt ill-equipped to handle a project approach in science whether it involved the production of project materials and worksheets, the management of practical/investigative work in the field or the supervision of project discussions, drawing together pupils' queries, comments and ideas. Moreover, it seemed that lack of familiarity with the procedures of the Examination Boards, combined with feelings of isolation among colleagues, increased anxiety in this area.

Hence, it can be seen that in summarizing the main findings to emerge from this study, both positive and negative aspects of project work have been identified. The next section considers some of these aspects more closely, discusses the implications of the research findings for the recent developments in science education and youth training, and attempts to formulate a clear idea of where

project work succeeds and how it may be improved for pupils of average ability.

9.2. Implications

When viewed as a whole, it would appear that the negative aspects of project work identified in this study reflect not on the project approach as a teaching/learning strategy but focus instead on managerial and organisational difficulties with the school and examination system. When these issues are set aside, sufficient positive features emerge from the research to provide a strong case for the inclusion of project work in the school science schemes of the eighties, over and above the more traditional approaches involving exposition, demonstration and assigned practical exercises. The following features are considered especially important and in line with today's perspectives of science education, its aims, objectives and future directions.

1. Project work that requires pupils to formulate problems, devise investigations and evaluate results, enables them to experience first-hand the spirit of inquiry. It gives pupils a measure of personal responsibility for their own learning and instills in them a system of thinking and learning that will be of long-term value in a rapidly changing world.

It is now generally accepted that facts which are awarded importance today may be largely redundant in the world of tomorrow, and for this reason much of the literature focussing on the aims of education concerns itself not with the 'products' of learning (i.e. the knowledge to be acquired by the pupil) but rather the 'processes' (i.e.

the means through which and by which the pupil learns.)

In other words, there is strong support for the idea that pupils should be taught how to learn so that at a future date they may be able to apply their 'learning skills' in a variety of contexts, outside school.

In 1979, in the secondary school survey cited earlier, Her Majesty's Inspectorate found science teaching in many schools to be less than satisfactory, the major criticisms being the pre-occupation of some teachers with external examinations, the widespread use of didactic teaching methods and the failure of schools as a whole to encourage individual initiative and a spirit of inquiry. In the report, the ability to use the skills and processes of science: observation, seeking and explaining patterns, practical skills, and the ability to apply previously-learned generalizations to new situations were all awarded importance.

Two years later, the Government in its document 'The School Curriculum' (H.M.S.O. 1981) acknowledged the need to develop in pupils 'lively, enquiring minds' and the ability to question and argue rationally and apply themselves to tasks, while 'The Practical Curriculum' produced by the Schools Council (1981) emphasised attitudes such as curiosity, enthusiasm, responsibility and self-discipline. A subsequent bulletin on 'Information Skills in the Secondary Curriculum' (Schools Council 1981) argued for the reward of pupils' mastery in learning skills rather than the 'short-circuited learning of the answers' and expressed continued concern over schools' lack of success in teaching pupils how to learn.

More recently, the discussion document on 'Science in Primary Schools' produced by the Science Committee of the Inspectorate (H.M.S.O. 1983) has stressed the importance of developing, early on, the ability to think and work scientifically: observing, explaining, seeking patterns and applying them, and of generating a spirit of inquiry around practical work.

On this theme, Sutton (1981) in an article on practical work in science has argued that 'practical work is not enough ... doing does not always lead to understanding'. Noting teachers' anxiety over the quality of thinking that accompanies traditional practical work, Sutton focussed attention on the role of language in learning science and emphasised the need for pupils to be actively involved in the 'thinking' aspects of their practical work through discussions, reading and writing, suggesting it is through these channels that pupils learn how to learn⁽²⁾.

The spirit of inquiry and the acquisition of learning skills is also implicit in the operation of the mandatory thirteen-week off-the-job section of education and training within the Government's new Youth Training Scheme. Within this section of the scheme, core areas of study include number, communication, manual dexterity, problem-solving and planning, and computer literacy/information technology. The approach adopted to cover these areas has, in many cases, incorporated independent, resource-based learning. Indeed, a major aim of the Scheme is that the trainees should learn skills which will be of use in a broad range of occupations and be able to apply their learning to other areas.

Thus, if school-leavers are to be able to adapt successfully to life outside school, it would seem vital to equip them with the skills and attitudes necessary to go on learning beyond the period of formal, compulsory education. Clearly, if pupils are to be prepared for life, they must be taught how to study independently, how to think about problems and tackle them, and how to pursue tasks in a systematic, disciplined way. It follows then that for those who view education in these wide-reaching terms, the project approach may have much to offer. By requiring pupils to assume a measure of personal responsibility for their own learning, allowing them to become actively involved in the organisation of their learning and enabling them to gain experience and practice in the skills of inquiry, project work may instill in them a system of thinking and learning that will be a valuable, long-term asset in an ever-changing world.

2. Project work helps to break down traditional subject boundaries and in so doing goes some way towards providing a broader base for the study of science.

In the publication 'The School Curriculum' (cited earlier) the Government outlined recommendations for a broad curriculum, and called on schools to plan their curriculum as a whole and not simply as ^acollection of separate subjects. A similar theme ran through the Schools Council advisory document 'The Practical Curriculum' which proposed that pupils should receive a broad and largely common curriculum up to the age of fifteen, and advised that schools should include all forms of knowledge in their pupils' educational experience, the aim being to promote

flexibility of attitudes and ability to learn sufficient to cope with future changes in technology and careers.

Focussing on the operation of the Youth Training Scheme, a more recent report entitled 'Implementing the 14 - 18 curriculum: new approaches' produced by the Bristol-based Youth Education Service (Brockington et al. 1983) has recommended a timetable for 14 - 18 year olds that includes a systematic network of tutorials, small-group teaching and project work that cuts across the usual subject boundaries, whilst the Secondary Science Curriculum Review (1983, p.14 - 15) in its paper 'Science Education 11 - 16' has stressed the need for more experimentation with new ways of teaching that erode conventional barriers and forge links with other sections of the school timetable.

Hence, given these recommendations, it would seem that if the project approach can be used to encompass different parts of the school curriculum, to allow different subjects to be linked in a 'total' learning setting and, in this way, lessen the compartmental nature of science teaching, it has much to contribute to science courses of the future.

3. Project work which allows pupils to experience the social, economic and applied aspects of science helps make the study of science more interesting and relevant to the lives of the pupils.

The notion that science teaching should go beyond the learning of facts and laws discovered centuries before and should instead bring pupils in touch with the social, economic and applied aspects of science has, in recent years, gained momentum as recognition of the importance

of science and technology to the lives of 'average' pupils has spread.

In 1981, 'The Practical Curriculum' envisaged by the Schools Council (cited earlier) sought to help pupils to acquire understanding of the social, economic and political order while 'The School Curriculum' (H.M.S.O., 1981) recommended that schools should prepare pupils for working life by forming better links with industry and by relating the curriculum to what happens outside the school, particularly through more applied and practical work in science and mathematics. Both these documents emphasised the need to help pupils to understand the world in which they live and the interdependence of individuals and groups.

The Secondary Science Curriculum Review has, since its inception in 1981, argued that the content of science teaching in schools has failed to be relevant to the contemporary individual and social needs, and has (in the paper quoted earlier) made a case for the introduction of more technologically-oriented science syllabuses incorporating elements from fringe subjects such as astronomy. A move away from early specialization in the three 'academic' science subjects towards a new approach emphasising 'the technological, social, historical and cultural dimensions' has therefore been deemed desirable.

Moreover, the Association for Science Education and the Institute of Physics have both supported proposals to include 'science and society' perspectives in the revised criteria for the new 16-plus examination. Both these organisations maintain that pupils should be tested on

their understanding of how the subject impinges on day-to-day living. However, in the case of Physics, this level of support conflicts sharply with the recent and highly controversial interdict by the Secretary of State for Education and Science, rejecting examination questions dealing with the social and economic implications of the subject. Whether or not hard scientific content should be 'diluted with social considerations' (an expression coined by those anxious to preserve academic standards) remains the focus of heated debate although for those less academically-oriented pupils who will nonetheless be confronted by a rapidly-changing, highly technological society outside school, the case for including these aspects remains relatively sound.

It follows then that if project work can be used to draw the study of science closer to the lives of 'average' pupils, help them to appreciate the far-reaching consequences of scientific and technological advancement and thereby make science more relevant and interesting, it would seem to have much to offer as a teaching/learning strategy for the pupils of today.

4. Project work which removes some of the competitiveness of the classroom, creates opportunities for independent, self-paced study and allows pupils to consider science in the human context, helps make the study of science more attractive to girls.

Concern continues over girls' failure to pursue science subjects at school and their greatly reduced chances of employment and success in the fields of science and technology. The Seventh Annual Report of the Equal Opportunities Commission (1982) showed that the number of

girls taking science, mathematics and technical subjects was still disturbingly low and pointed to the discriminatory attitudes that persist among pupils, teachers and parents with respect to girls' ability in these fields.

Several research studies have shown that girls take a more active part in lessons which relate science and technology to human problems and many have suggested that if the applications of science and its social relevance were integrated into science courses, more girls would find these appealing.

In 1980, the document 'Girls and Science' produced by Her Majesty's Inspectorate advocated radical changes in examinations and syllabuses to include more of the practical, real-life and social implications of science in place of some of the more theoretical aspects. It was anticipated that only by changing the emphasis in this way would girls come to choose such traditionally 'male' subjects as physics and chemistry.

In addition, many writers (see Kelly 1981) feel that in the conventional science-learning setting, the confidence of girls is undermined because of the dominant attitude adopted by male contemporaries, and that this contributes ultimately to their marked under-achievement in science. Indeed, there is some evidence to show that girls achieve better with women science teachers and in single-sex schools (Byrne 1974) and there is a strong suggestion from the research reported here that girls have increased confidence, higher aspirations and greater success in science when they are given the opportunity to work alone or in small groups, at their own unpressured

pace. This appears particularly true when the 'human side' of science about which girls tend to feel more direct concern and involvement is brought into their study.

Hence, for those concerned about the under-representation and under-achievement of girls in science, project work holds some promise. Certainly, project work that removes some of the open competitiveness, creates opportunities for independent, self-paced study and allows the 'human element' to be considered can go a long way towards making science more attractive to girls.

9.3. Recommendations

The research reported here, whilst identifying some of the positive features of project work and recognising its potential value in the present and future education of pupils, has also drawn attention to a number of problem areas which if allowed to persist will continue to mar the effectiveness of the project approach as a teaching/learning strategy for the 'average' pupil.

By looking at these areas of difficulty and seeing how each may be overcome, clear guidelines have emerged which appear especially conducive to the successful implementation of project work. These are summarised below, in point form.

It would, almost certainly, be unrealistic to expect all of the conditions listed below to be met by the standard school or college, given the constraints of time,

finance, staffing and syllabuses, but it is recommended that each should be under consideration during the preparatory stages of project work if the final implementation of it is to be a successful and rewarding experience for pupils.

1. The Curriculum

Project work should be an integral part of the pupils' course and not merely an after-thought, something to employ when other methods have been exhausted.

Ideally, the core of existing syllabuses should be rationalized so that through project work more emphasis may be placed on the 'processes' and skills of science and less on the quantity of 'facts' to be learned by the pupils.

Aspects of applied science should be incorporated into the school syllabuses, as should the social, economic and political implications, and studies that cut across traditional subject boundaries should be encouraged.

2. Staff Commitment

Staff must feel committed to project work and confident about their ability to handle it. Where possible, in-service staff training courses should be made available so that those teachers who feel uncertain about their expertise may be given guidance in the organisation and management of project work and made aware of its usefulness and limitations.

Science staff should be encouraged to collaborate with colleagues within the department and those outside,

in an effort to formulate a clear idea of the aims and objectives of project work. Skills, knowledge and experience should be pooled, perhaps in a team-teaching setting or in the preparation of project materials. The project approach, to be fully effective, requires the support and co-operation of colleagues.

3. Pupil Attitude

Pupils must understand the aims and objectives of project work, appreciate its value and be enthusiastic about pursuing it. They should feel confident in their ability to contribute to their own learning and be prepared to assume a degree of responsibility for it. They must feel able to work on their own to some extent but, at the same time, feel supported and encouraged by their teacher. They must want to succeed and to this end be tenacious in their approach to project work.

4. Pupil Ability and Training

Regardless of ability, pupils that have been accustomed to the more traditional, didactic methods of teaching in which they adopt a largely passive role in their own learning, cannot be expected, without prior training, to be able to pursue a project approach with confidence, enthusiasm and expertise. Pupils need to be introduced to the project method by means of a carefully constructed programme of induction in which pupils, through a series of teacher-managed exercises, are given more and more responsibility for their own learning and increased practice in the skills of inquiry such as the identification of

problems, the design of investigations, the collection of data, the analysis of findings. Pupils who are not given a proper training in the use of project work are unlikely to be able to cope with it and accept it as a valuable and worthwhile teaching/learning strategy.

5. Planning and Preparation

Teachers need to plan and prepare for project work well in advance and allow ample time for this aspect of the work.

Induction programmes for pupils unfamiliar with the project approach have to be developed early on if the implementation of project work with such pupils is to be successful.

The type of project to be undertaken by the pupils also has to be considered. If project work of a reporting nature is to be attempted, the preparation of information packages may be necessary. If, on the other hand, projects of a discovery type are envisaged, laboratory and/or field facilities have to be thoroughly checked. Laboratory accommodation, equipment and materials have to be itemised, ordered and made available to pupils as appropriate, and for field trips, the location, times, dates, pupil numbers, transport and insurance all have to be reviewed in good time and relevant support material, for use by pupils, produced. Timetable arrangements and staff coverage must also be discussed.

Project work that is aimed at specific areas of the syllabus requires, in many cases, the preparation of resource packages, worksheets and self-assessment tests

for pupils to use independently. In addition, lists of suitable topics may need to be compiled if pupils are to be given a degree of choice in their project work. Moreover, if projects are to be used as part of the formal assessment of pupils for examination purposes, it is crucial that the assessment criteria are understood and worked out well in advance with the Examination Boards, teachers and pupils.

Hence, irrespective of the type of project approach that is anticipated, a good deal of planning and preparation is required on the part of the teacher. The attitude of 'Today, we'll start project work' holds little chance of success.

6. Type of Project and Choice of Topic

To be of lasting value, project work should require pupils to apply their knowledge of facts and understanding of concepts to new situations, and use information compiled personally to answer a question or investigate a problem. Whether this involves the collection and interpretation of data from practical work in the field or laboratory, or simply the use of material from books, resource packages etc. is dependent to a large extent on the ability and attitudes of the pupils, the staff/pupil ratios and the availability of time, resources and facilities all of which are important considerations in the project situation. Most teachers agree, however, that project work that emerges as an exercise in plagiarism, where large extracts are copied from secondary sources with no real understanding, is a little value in teaching pupils how to learn although it may sometimes be employed as a

method of class control and pupil discipline.

Although giving pupils freedom in the choice of their project topics is often seen as a way of generating interest and enthusiasm, it is in practice seldom totally successful with C.S.E. pupils. Some pupils inevitably find it very difficult to identify areas of investigation that interest them. Others may choose topics that are too complicated or too simplistic, irrelevant to the examination syllabus or too reliant on secondary sources of information. It is therefore often advisable for teachers to produce a list of suitable project topics for pupils to select from. This method not only reduces pupils' anxiety about topics whilst still giving them a degree of choice, it also enables teachers to plan for project work, build up resources and organise facilities as appropriate, and thus optimize the chances of success.

7. Grouping of Pupils

Pupils may work independently, in pairs, small groups or as a class on projects. Decisions about the grouping of pupils for project work should be made by the teacher bearing in mind the ability and attitudes of the pupils, the availability of resources and facilities, and the assessment criteria. When group projects are undertaken, teachers should be aware of the difficulty of identifying the 'passenger' in the group (i.e. the pupil who is carried along with the project by the dominant and often more able members of the group) and should appreciate the importance of individual contributions to the project.

8. Guidance and Supervision

Teachers should provide guidance in the early stages of project work, if necessary, assisting in the choice of the topic and the design of the investigation. They should monitor pupil progress and supervise the collection of data, its interpretation and the 'writing-up' process. Teachers should provide encouragement and support, and attempt to keep pupils on course by weighing carefully the cost of intervention against the price paid by the pupil for a mistake. Pupils should be encouraged, through discussion and argument, to find their own way around difficulties; they should not see project work as a frustrating, negative experience but neither should they regard it as a recipe, devised by the teacher, to achieve the 'right' answer.

9. Discussion

Discussion should form an important part of the project approach. In the preliminary stages of project work, pupils should be encouraged to discuss among themselves and with their teacher possible areas of study, methods of enquiry, predictions and problems.

Discussion should continue during the course of the project. In class or tutorial periods, pupils should feel able to talk about their progress, and to work out their difficulties and clarify their ideas through discussion with their peers and teacher.

In the final stages of project work, teachers should provide time for class discussion in which pupils may report

on their projects and discuss their results with other members of their class. The teacher should direct these discussions, guide pupils' thoughts and help them to develop clear lines of reasoning. Lastly, the teacher should help to draw together the discussions and conclude the projects by summarising the main findings, evaluating the results and highlighting important concepts.

10. Assessment

Teaching staff must feel confident in the assessment of project work for examination purposes.

At present, many teachers are unhappy about existing schemes, arguing that they continue to place undue emphasis on the written products rather than the skills learned by pupils on the way. Some are doubtful of the reliability and validity of the current schemes because of the wide variation in project topics and types of approach and the failure to standardise levels of guidance and supervision. In addition, an alternative to the system of postal moderation is required by teachers, many of whom regard it as too remote to be useful. Some have suggested the provision of 'centre days' when large samples of projects from all the centres are gathered together for teachers to inspect and discuss. Through group meetings of this kind, problems could be talked through and clear ideas formulated about the nature, management and assessment of projects for the examination.

Overcoming the difficulties that persist in the assessment of project work clearly calls for more teacher involvement in the examination process and more two-way communication

between practising teachers and Examination Boards. However, until teachers are allowed time in lieu of teaching for examination commitments, inside and out of school, progress on this front is likely to be slow.

9.4. Towards Further Research

Although a number of organisational and managerial difficulties have been associated with the implementation of project work, the research study concludes that the project approach as a teaching/learning strategy has much to contribute to the teaching of science to pupils approaching school-leaving age. However, in highlighting the positive features of project work, the study has left a number of questions unanswered and revealed several areas in need of further investigation:

1. The research reported here focussed on teachers' perspectives of project work and made only very informal contacts with the pupils themselves. It seems likely that the development of a pupil questionnaire and interview schedule would provide more reliable information on pupils' attitudes to project work and their concerns about it.

2. More research into the development of skills and attitudes through project work is also vital. It is anticipated that the use of pre- and post-tests similar to those employed by the Assessment of Performance Unit in 'Science in Schools. Age 15' (1983) would be valuable although more rigorous investigation of pupil outcomes in relation

to the nature and management of project work is clearly necessary.

3. The possibility of providing induction programmes for pupils about to begin project work needs further investigation. Perhaps, the development of work packages, each consisting of a sequence of practical exercises designed to give pupils more confidence in their ability to participate in their own learning, to give them a training in inquiry skills, enabling them eventually to design and implement their own investigations, would be useful. On this issue, closer consultation between teachers on the aims of science education at both primary and secondary levels is called for and more careful consideration of the skills expected of pupils at the time of transfer is essential.

4. The observation schedule devised for use in the pilot study, although satisfactory in general terms, possessed several flaws indicating that further work and refinement of the schedule is still needed if an effective tool for investigating pupils' transactions during project work is to be developed⁽¹⁾. Moreover, the observational study itself concentrated solely on assigned project work in which the pupils pursued topics through worksheets devised by the teaching staff. This type of project work, although relatively common in C.S.E. teaching, was not regarded as the most useful form of project approach. Certainly, observational studies of more radical methods, e.g. those involving pupils in the identification of problems, the design of investigations and the interpretation and evaluation of results, are urgently required.

5. Lastly, more research is needed into the skills and expertise required by teachers prior to and during project work, and on this theme there is a good case for a more detailed feasibility study of project work organised on a team-teaching basis. More attention needs to be paid to teachers' lack of confidence with respect to project work and the possibility of providing in-service training/ refresher sessions should be examined.

Thus, whilst investigating the nature, management and relative effectiveness of project work in C.S.E. science, this study has opened up many new fields of enquiry. Continued research in these areas is exciting not only because the future of project work may depend on it but also because it may be crucial to the success of science education in preparing pupils for life in a rapidly-changing technological society.

NOTES

1. The Science Teacher Observation Schedule developed by Eggleston et al (1975) was modified by Hacker (1982) and a Science Lesson Analysis System (S.L.A.S.) was developed. In a follow-up observational study involving 144 science teachers, delivering 864 lessons to 3,751 students in 62 primary and secondary schools in Western Australia, six approaches to science teaching have been identified and three types (genera) of science teachers recognised (Hacker 1983). Poor adoption rates for curriculum project materials have been linked with dissonance between recommended approaches

and the preferences of practising teachers, and the need to take cognisance of classroom processes has been stressed.

2. Attention is drawn to recent (unpublished) work by Kerry et al at the University of Nottingham, School of Education. Investigating the development of thinking skills through topic work, the general findings of the research project suggest that thinking skills fail to be fully developed in pupils due to the continued emphasis on the content of topics rather than the 'process' potential. For preliminary, early information on this research project the reader is referred to Kerry (1981, 1982).

APPENDICES

APPENDIX I



University of Leicester School of Education

21 University Road, Leicester · Telephone 24211

RESEARCH QUESTIONNAIRE FOR TEACHERS OF SCIENCE AT C.S.E. LEVEL

Compiled by E.J. Sadler, B.Sc., M.I.Biol.

Preliminary Information: Please read carefully

The questionnaire appears in four parts:

SECTION A Is to be completed only by those teachers who use (or sometimes use) project work as part of their C.S.E. Science teaching programme.

SECTION B Is to be completed only by those teachers who do not, at present, use project work as part of their C.S.E. Science teaching programme.

SECTIONS C and D are to be completed by all those Science teachers whose responsibilities include the C.S.E. regardless of whether or not they use project work as part of their teaching/learning strategy. The first of these sections attempts to identify some of the advantages and disadvantages of project work as envisaged by Science Teachers. The second section involves the collection of some personal data. Please feel assured that this section, as with all the others, will be treated with absolute anonymity and confidentiality.

There are three types of questions incorporated into this questionnaire:

- (i) Most questions provide a column of boxes alongside a number of possible replies. These questions require only one tick (✓) in the most appropriate box.
- (ii) Some questions provide a column of possible answers, one, some, or all of which may be relevant. These questions require a tick for each of the appropriate answers.
- (iii) A few questions ask for certain details about yourself, your views or your situation. Please try to complete these open questions as accurately as possible in the space provided.

I should, perhaps, emphasise that throughout this questionnaire the term 'AVERAGE' is used to describe a pupil who could reasonably be expected to gain a Grade 3 or 4 in the final C.S.E. examination.

The array of figures on the right-hand side of each page can be ignored; they serve to facilitate computation procedures.

Professors of Education: Gerald Bernbaum, Brian Simon, Derek Wright

STRICTLY CONFIDENTIAL

Name _____ School/College _____

C.S.E. _____ Examination _____

Mode _____ Syllabus (if applicable) _____

No. of pupils in your class(es) expected to sit this examination Summer 1979
(If precise figure is not known, please give an approximation) _____

PROJECT WORK

N.B. Throughout this questionnaire the term 'average' will be used to describe a pupil who could reasonably be expected to gain a Grade 3 or 4 in the final C.S.E. examination.

Please respond by placing a tick (✓) in the most appropriate box.

1. Do your pupils studying for the C.S.E. _____ examination undertake any kind of project work?

YES ☐
SOMETIMES ☐
NO ☐

If your answer to Question 1 is NO, please disregard Section A which follows. Turn instead to Page 8 and complete Sections B, C and D only.

If your answer to Question 1 is YES or SOMETIMES, please go on and complete Section A which follows.

SECTION A

TO BE COMPLETED ONLY BY THOSE TEACHERS WHO USE (OR SOMETIMES USE) PROJECT WORK AS PART OF THEIR C.S.E. TEACHING PROGRAMME

2. Is project work optional, compulsory or recommended for your pupils?

OPTIONAL ☐
RECOMMENDED ☐
COMPULSORY ☐

3. Assignment or Choice of Topic

- (a) Are the topics for project work assigned or do the pupils choose their own topics?

All pupils are assigned specific topic(s) for their project work ☐
All pupils select their own topic(s) from a number of assigned ones ☐
Some pupils are assigned their specific topic(s), others choose their topic(s) with guidance where necessary ☐
All pupils choose their own topic(s) independently with guidance where necessary ☐

For office use only

CARD 1

1 2 3

--	--	--

4 5 6

--	--	--

7 8 9

--	--	--

10 11 12

--	--	--

13

--

14

--

15

--

For office
use only

3. (b) If you feel able, please explain the factors which guide you when deciding whether to assign topics or give pupils choice.

16	
17	
18	
19	

4. (a) Given the following definitions;

- (i) A considerable amount of guidance - Pupils are assigned specific topics; they are guided through them and given all the necessary resources. They are advised about the presentation of their work and directed toward its conclusion.
- (ii) A limited amount of guidance - After suggestions have been made and discussed, pupils select their topics. They are guided through the difficult areas and given advice about possible resources.
- (iii) A minimal amount of guidance - After discussing the aims and objectives of project work, pupils choose their own topics. From then on, they work independently, assuming personal responsibility for both the content and presentation of their work. They are assisted only when problems beyond their control are encountered.

How much guidance do you have to give the pupils of average ability with their project work?

A considerable amount
A limited amount
A minimal amount

20

- (b) When is this guidance usually given?

During teaching periods
During school hours, out of teaching periods
Out of school hours

21

5. Which of the following descriptions best characterizes the type of project actually carried out by the majority of your C.S.E. pupils?

TYPE A: A reporting type in which the pupils collect information from books, journals and other secondary sources and then write an account in the form of a booklet, folder or the like.

TYPE B: A discovery type in which the pupils attempt to answer a question by means of information gathered through experimentation and/or observation; the project being written up in the form of a simple research paper.

TYPE C: A combination of the reporting and discovery type.

For office
use only

TYPE D: Other types (please specify) _____

TYPE A (REPORT) ☐
TYPE B (DISCOVERY) ☐
TYPE C (COMBINATION) ☐
TYPE D (OTHER, as specified) ☐

22 ☐

6. (a) How would you rate each of the following facilities in your school/college

	Excellent	Good	Adequate	Poor
Laboratory facilities				
Library facilities				
Reprographic facilities				
Audio-visual facilities				

23 ☐

24 ☐

25 ☐

25 ☐

(b) Are these facilities available to pupils engaged in project work in your school/college? Please indicate, by placing a tick in the table below, the availability of each of the named facilities

	Readily available to pupils	Limited availability to pupils	Not available to pupils
Laboratory facilities			
Library facilities			
Reprographic facilities			
Audio-visual facilities			

27 ☐

28 ☐

29 ☐

30 ☐

7. (a) When working on their projects, how are your pupils usually organised?

On an individual basis, working and writing up independently ☐
In pairs or groups, working together but writing up independently ☐
In pairs or groups, working and writing up together ☐
Other arrangements (please specify) _____ ☐

31 ☐

For office
use only

7. (b) How do you prefer your pupils to be organised?

- On an individual basis, working and writing up independently ☐
- In pairs or groups, working together but writing up independently ☐
- In pairs or groups, working and writing up together ☐
- Other arrangements (please specify) _____ ☐

32
☐

8. Where do you think your pupils should carry out most of their project work?

- At school/college during _____ lessons ☐
- At school/college during free time ☐
- Out of school/college ☐

33
☐

9. (a) How much school time does the average C.S.E. pupil spend on project work for your course? (Total number of school hours per course)

- 10 hours or less ☐ 1
- Between 10+ and 20 hours ☐ 2
- Between 20+ and 30 hours ☐ 3
- Between 30+ and 40 hours ☐ 4
- Between 40+ and 50 hours ☐ 5
- Between 50+ and 60 hours ☐ 6
- Over 60 hours ☐ 7

34
☐

(b) How much time in all do you think a pupil should spend on project work for your course? (Total number of hours at home, school or elsewhere)

- 15 hours or less ☐ 1
- Between 15+ and 30 hours ☐ 2
- Between 30+ and 45 hours ☐ 3
- Between 45+ and 60 hours ☐ 4
- Between 60+ and 75 hours ☐ 5
- Between 75+ and 90 hours ☐ 6
- Over 90 hours ☐ 7

35
☐

(c) How does the time you think pupils should spend on their project work relate to the amount of time the majority of them actually spend?

- Pupils actually spend more time on their projects than I think they should ☐
- Pupils actually spend about the same amount of time as I think they should ☐
- Pupils actually spend less time on their projects than I think they should ☐

36
☐

For office
use only

10. Given the following definitions,

- Definitely enthusiastic: Pupils are keen to begin their projects, they work well, enjoy the enterprise and are not easily distracted. Their project work tends to exceed the specified requirements of the course.
- Indifferent: Pupils are detached in their approach; they accept project work as part of the course but tend to fulfil only the basic requirements. They display no real enthusiasm or interest.
- Definitely unenthusiastic: Pupils show obvious reluctance to undertake the project work. They show no interest, are easily distracted and tend to waste a lot of time. Pupils often need to be cajoled into fulfilling even the most basic requirements of the course.

(a) How do you rate the attitude of pupils of average ability to project work?

Definitely enthusiastic ☐
Indifferent ☐
Definitely unenthusiastic ☐

37
☐

(b) How do you rate the attitude of pupils of above average ability to project work?

Definitely enthusiastic ☐
Indifferent ☐
Definitely unenthusiastic ☐

38
☐

(c) How do you rate the attitude of pupils of below average ability to project work?

Definitely enthusiastic ☐
Indifferent ☐
Definitely unenthusiastic ☐

39
☐

11. Do you think that the project work (of the type undertaken by your C.S.E. pupils) develops skills and attitudes which are appropriate to the major objectives of a C.S.E. science course?

YES ☐
NO ☐

40
☐

For office
use only

12. (a) Do you think that the project work (of the type undertaken by your C.S.E. pupils) is important as a means of developing skills and attitudes which may not otherwise be tapped in a C.S.E. science course?

YES ☐
NO ☐

41
☐

- (b) If your answer to Question 12(a) is YES, please specify those skills and attitudes which you think are (or can be) developed mainly through project work.

42 ☐
43 ☐
44 ☐
45 ☐
46 ☐

13. (a) Do you think that the benefits derived from project work vary according to the ability level of the pupil?

YES ☐
UNCERTAIN ☐
NO ☐

47
☐

- (b) If your answer to Question 13(a) is YES, please specify:

The pupil of average ability gains most benefit ☐
The pupil of above average ability gains most benefit ☐
The pupil of lower than average ability gains most benefit ☐

48
☐

14. (a) Are the products of your pupils' project work entered as moderation pieces in the C.S.E. examination, thus contributing to the final assessment?

YES ☐
SOMETIMES ☐
NO ☐

49
☐

- (b) If your response to Question 14(a) is NO or SOMETIMES please use the space below to indicate your main reasons for not submitting your pupils' project work for moderation in the C.S.E. examination

50 ☐
51 ☐
52 ☐
53 ☐

For office
use only

15. Are the products of your pupils' project work associated with any kind of formal exhibition in the school/college? (e.g. Parents' evenings, Open Days, Speech Days or the like)

YES ☐
SOMETIMES ☐
NO ☐

54

END OF
CARD 1

Thank you very much for your co-operation so far. If you wish to make any comments on the questions in this section, please use the space below for this purpose.

Now, please disregard Section B which follows.

Turn instead to Page 10 and complete Sections C and D only. Thank you.

SECTION B

TO BE COMPLETED ONLY BY THOSE TEACHERS WHO DO NOT, AT PRESENT, USE PROJECT WORK AS PART OF THEIR C.S.E. TEACHING PROGRAMME

1. Have you ever engaged pupils in project work of any kind?

YES ☐
NO ☐

If YES, please specify:

(a) the age range of the pupils _____

15 ☐
16 ☐
17 ☐
18 ☐
19 ☐

(b) the course(s) of study they were following (subject areas, if applicable) _____

(c) the examination(s) of which it was part (if applicable) _____

20 ☐
21 ☐
22 ☐
23 ☐
24 ☐

2. What are your main reasons for not using project work as part of your C.S.E. science teaching programme at this present time?

25 ☐
26 ☐
27 ☐
28 ☐
29 ☐

30 ☐
31 ☐
32 ☐
33 ☐
34 ☐

For office
use only

CARD 1

14 ☐

For office
use only

3. Do you think project work can ever be used as a valuable and effective teaching/learning strategy?

YES ☐
NO ☐

35 ☐

If YES, please try to specify as clearly as possible the conditions under which you would envisage project work as a valuable and effective tool.

36 ☐
37 ☐
38 ☐
39 ☐
40 ☐

Thank you very much for your co-operation so far. If you wish to make any additional comments on the questions in this section, please use the space below for this purpose.

END OF
CARD 1

Now, please turn to Page 10 and complete Sections C and D. Thank you.

SECTION C

For office
use only

Listed below you will see twenty statements about project work in schools and colleges, some favourable, others less favourable. As a teacher of _____ and with reference to the average C.S.E. candidate (where applicable) please place a tick in one of the columns to indicate your level of agreement with each of these statements.

CARD 2

1 2 3 4
2 ☐ ☐ ☐ ☐

STATEMENTS ABOUT PROJECT WORK	Agree	Uncertain	Disagree	
1. Project work increases pupils' interest in the subject				5 <input type="checkbox"/>
2. Many pupils waste time during class periods allocated to project work				6 <input type="checkbox"/>
3. Project work of any real value to the pupil is beyond the scope of an average C.S.E. candidate				7 <input type="checkbox"/>
4. An ability to apply previous understanding of fundamental concepts to new situations is derived from project work				8 <input type="checkbox"/>
5. A large measure of subjectivity is involved in the assessment of project work				9 <input type="checkbox"/>
6. Communication skills are developed through project work				10 <input type="checkbox"/>
7. Pupils gain self-confidence through project work				11 <input type="checkbox"/>
8. Project work results in large volumes of material being copied directly from books and journals				12 <input type="checkbox"/>
9. Project work makes excessive demands on the free time of the teacher				13 <input type="checkbox"/>
10. Project work ensures pupils take care over the presentation of their work				14 <input type="checkbox"/>
11. Project work cannot be reliably standardized; a pupil may be severely handicapped by his/her choice of topic				15 <input type="checkbox"/>
12. Project work is too time-consuming to be done well within the confines of a school/college timetable				16 <input type="checkbox"/>
13. Enquiry skills are developed through project work				17 <input type="checkbox"/>
14. Pupils learn self-discipline through project work				18 <input type="checkbox"/>
15. Some pupils are placed at a serious disadvantage when they have several projects to do in different subjects				19 <input type="checkbox"/>

For office
use only

STATEMENTS ABOUT PROJECT WORK

Agree

Uncertain

Disagree

16. Pupils' powers of deduction are developed through project work

20
☐

17. Skill in the planning and organisation of scientific investigations is acquired through project work

21
☐

18. Project work is too costly in resources to be catered for adequately by the standard school/college

22
☐

19. Project work favours the child from the resourceful home

23
☐

20. Skill in the handling and interpretation of data is acquired through project work

24
☐

If you feel you have some comments to make on any of the statements in Section C, please use the space below for this purpose.

Thank you for your assistance. Finally, for the purposes of statistical analyses only, would you please be so good as to complete the very last section which follows?

SECTION D

1. Sex: Male ☐
Female ☐

2. Age: Under 25 years ☐ 1.
25 to 29 years ☐ 2.
30 to 34 years ☐ 3.
35 to 39 years ☐ 4.
40 to 44 years ☐ 5.
45 to 49 years ☐ 6.
50 to 54 years ☐ 7.
55 to 59 years ☐ 8.
60 years or over ☐ 9.

25
☐

26
☐

11.

For office
use only

3. Qualifications/Training

- (a) Teacher-trained graduate with good Honours degree ----- ☐ 1.
Teacher-trained graduate without good Honours degree ----- ☐ 2.
Non-graduate with teacher training ----- ☐ 3.
Untrained graduate with good Honours degree ----- ☐ 4.
Untrained graduate without good Honours degree ----- ☐ 5.
Untrained non-graduate ----- ☐ 6.

27

- (b) Do you have any Higher Degree(s)?

YES ☐
NO ☐

28

If YES, please specify:

29

30

- (c) If you wish to state any other qualifications of which you are in possession, please use the space below.

31

32

33

- (d) Do you consider your present teaching commitments to be appropriate to your specific qualifications and training?

YES ☐
UNCERTAIN ☐
NO ☐

34

4. (a) Approximately how long have you been teaching in your present establishment?

(If, as a result of merger or the like, the establishment has changed its name and/or type, please indicate the full period before and after the change).

- 1 year or under ☐ 1.
1+ to 3 years ☐ 2.
3+ to 5 years ☐ 3.
5+ to 7 years ☐ 4.
7+ to 9 years ☐ 5.
9+ to 11 years ☐ 6.
11+ to 13 years ☐ 7.
13+ to 15 years ☐ 8.
Over 15 years ☐ 9.

35

4. (b) How many years have you been teaching in all?

- 1 year or under
- 1+ to 5 years
- 5+ to 10 years
- 10+ to 15 years
- 15+ to 20 years
- 20+ to 25 years
- 25+ to 30 years
- 30+ to 35 years
- Over 35 years

<input type="checkbox"/>	1.
<input type="checkbox"/>	2.
<input type="checkbox"/>	3.
<input type="checkbox"/>	4.
<input type="checkbox"/>	5.
<input type="checkbox"/>	6.
<input type="checkbox"/>	7.
<input type="checkbox"/>	8.
<input type="checkbox"/>	9.

For office
use only

36 ☐

(c) Prior to your present position, did you hold any other full-time teaching posts in secondary education?

YES	<input type="checkbox"/>
NO	<input type="checkbox"/>

37 ☐

If YES, please indicate the type(s) of establishment at which you taught:

- Comprehensive Lower School (11 - 14 yrs.)
- Comprehensive Upper School (14 - 18 yrs.)
- All Through Comprehensive School (11 - 18 yrs.)
- Grammar School
- Secondary Modern School
- Technical School
- Special School
- Others (please specify) _____

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

38	<input type="checkbox"/>
39	<input type="checkbox"/>
40	<input type="checkbox"/>
41	<input type="checkbox"/>
42	<input type="checkbox"/>
43	<input type="checkbox"/>
44	<input type="checkbox"/>
45	<input type="checkbox"/>

5. Have you ever had full-time employment of longer than six months duration outside the field of education?

YES	<input type="checkbox"/>
NO	<input type="checkbox"/>

46 ☐

If YES, please give brief details _____

47 ☐

and indicate approximately how many years in total you have spent in full-time employment outside the field of education.

- 1 year or under
- 1+ to 3 years
- 3+ to 5 years
- 5+ to 7 years
- 7+ to 9 years
- 9+ to 11 years
- 11+ to 13 years
- 13+ to 15 years
- Over 15 years

<input type="checkbox"/>	1.
<input type="checkbox"/>	2.
<input type="checkbox"/>	3.
<input type="checkbox"/>	4.
<input type="checkbox"/>	5.
<input type="checkbox"/>	6.
<input type="checkbox"/>	7.
<input type="checkbox"/>	8.
<input type="checkbox"/>	9.

48 ☐

6. Prior to your present position, did you have any experience of C.S.E. science teaching?

YES ☐
NO ☐

For office
use only

49 ☐

If YES, please indicate your experience of C.S.E. science:

(a) Science Subject(s)	(b) Examinations Board(s)	(c) Mode of Exam.
(i) _____	_____	_____
(ii) _____	_____	_____
(iii) _____	_____	_____
(iv) _____	_____	_____
(v) _____	_____	_____

50 ☐
51 ☐
52 ☐
53 ☐
54 ☐
55 ☐
56 ☐

Please use the space below for any additional comments you may have.

57 ☐
58 ☐
59 ☐
60 ☐

Many thanks for your assistance in the completion of the questionnaire;
your co-operation in this research project is greatly appreciated.

END OF
CARD 2

REGIONAL COMPOSITION : SAMPLING OF CENTRES
-Techniques used in the East Midland Survey

. Total number of Centres in the East Midland Region as specified in the EMREB List of Registered Centres 1979 (excluding Colleges of F.E. and Special Schools) = 362

. Total number of Centres approached for preliminary information on science subjects and teaching staff = 151

. Total number of Centres from which completed questionnaires were received for analysis* = 98

COUNTY/AREA	NUMBER OF CENTRES			TOTAL RECEIVING QUESTIONNAIRE
	TOTAL IN EACH AREA	TOTAL INITIALLY CONTACTED		
1. Derbyshire				
North	33	14	9	
Central	28	12	8	=25
South	29	12	8	
2. Leicestershire				
North	33	14	8	=16*
South	31	13	8	
3. Lincolnshire				
North	26	11	7	
South	21	9	6	=13
4. Northamptonshire				
North	31	13	8	
South	25	10	7	=15
5. Nottinghamshire				
North	29	12	8	
West	32	13	9	=26
East	34	14	9	
6. S. Humberside				
Grimsby	10	4	3	=3

* Incomplete return from initial communication; only 8 centres responded from Leicestershire North. Thus, only 98 centres used in the final analysis.

APPENDIX III

THE SURVEY POPULATION : SAMPLING BY COUNTY/SUBJECT AREA

COUNTY	NUMBER OF TEACHERS				ALL SUBJECTS
	BIOLOGY	CHEMISTRY	GENERAL SCIENCE	PHYSICS	
<u>1. Derbyshire</u>					
North	15	14	7	13	49
Central	8	4	9	8	29
South	20	13	11	17	61
	=43	=31	=27	=38	=139
<u>2. Leicestershire</u>					
North	20	19	11	20	70
South	24	15	8	14	61
	=44	=34	=19	=34	=131
<u>3. Lincolnshire</u>					
North	13	10	6	8	37
South	8	4	1	5	18
	=21	=14	=7	=13	=55
<u>4. Northamptonshire</u>					
North	14	13	14	11	52
South	18	19	7	16	60
	=32	=32	=21	=27	=112
<u>5. Nottinghamshire</u>					
North	17	12	7	18	54
West	13	11	8	12	44
East	17	14	10	19	60
	=47	=37	=25	=49	=158
<u>6. S. Humberside</u>					
Grimsby	3	3	4	4	14
	=3	=3	=4	=4	=14
GRAND TOTALS	190	151	103	165	609

APPENDIX IV

THE SURVEY POPULATION : ANALYSIS BY COUNTY AND USE OF PROJECT WORK

COUNTY	Total number of questionnaires despatched (a)	Total number of completed questionnaires received from:		Total number of usable replies	Total percentage sampled from each county
		'Users' of Project Work	'Non-Users' of Project Work		
<u>DERBYS:</u>					
North	49 (9)	12	27	39	22.3%
Central	29 (8)	11	13	24	
South	61 (8)	12	28	40	
	<u>139</u>	<u>35</u>	<u>68</u>	<u>103</u>	
<u>LEICS:</u>					
North (b)	70 (8)	20	32	52	21.0%
South	61 (8)	13	32	45	
	<u>131</u>	<u>33</u>	<u>64</u>	<u>97</u>	
<u>LINCS:</u>					
North	37 (7)	11	16	27	7.4%
South	18 (6)	3	4	7	
	<u>55</u>	<u>14</u>	<u>20</u>	<u>34</u>	
<u>NORTHANTS:</u>					
North	52 (8)	9	27	36	17.1%
South	60 (7)	9	34	43	
	<u>112</u>	<u>18</u>	<u>61</u>	<u>79</u>	
<u>NOTTS:</u>					
North	54 (8)	21	12	33	19.3%
West	44 (9)	9	15	24	
East	60 (9)	18	14	32	
	<u>158</u>	<u>48</u>	<u>41</u>	<u>89</u>	
<u>S.HUMBER:</u>					
Grimsby	14 (3)	1	10	11	2.4%
	<u>14</u>	<u>1</u>	<u>10</u>	<u>11</u>	
NOT IDENTIFIED	-	11	37	48	10.4%
<u>GRAND TOTALS</u>	<u>609 (98)</u>	<u>160</u>	<u>301</u>	<u>461</u>	<u>100%</u>

(a) Figures in brackets refer to the number of centres contacted in each case.
 (b) Due to lack of response to initial communication from Leicestershire North, only 8 Centres were used in the questionnaire survey (i.e. one fewer than required by strict stratified sampling techniques).

APPENDIX V

ANALYSIS OF RESPONSE TO QUESTIONNAIRE

BY TEACHERS OF C.S.E. SCIENCE

Total number of questionnaires despatched	609
Total number of questionnaires returned:	
-complete and identifiable by area	413
-complete but not identifiable by area	48
-complete and used in the analysis	<u>461</u>
-incomplete; respondent no longer applicable	11
-incomplete with refusal to participate in survey	8
-incomplete and not used in the analysis	<u>19</u>
Grand total of questionnaires returned	480
Percentage Response	<u>78.8</u>
Total number of questionnaires applicable of those despatched	598
Adjusted Percentage Response (of those applicable)	<u>78.4</u>

APPENDIX VI

THE INTERVIEW POPULATION : SAMPLING BY COUNTY/AREA

COUNTY/ AREA	Number of teachers responding to the question- naire	Number of teachers invited for interview	Number not replying to invitation	Number refusing to participate in interviews	Number of teachers no longer applicable	Number of teachers finally interviewed
1. <u>Derbyshire</u> North Central South	39 24 40	4 2 4	1 1 0	0 0 0	0 0 1	3 1 3
2. <u>Leicestershire</u> North South	52 45	5 4	0 1	0 0	0 0	5 3
3. <u>Lincolnshire</u> North South	27 7	3 2	0 0	1 1	0 0	2 1
4. <u>Northamptonshire</u> North South	36 43	4 4	1 0	1 0	0 1	2 3
5. <u>Nottinghamshire</u> North West East	33 24 32	3 2 3	1 0 1	0 0 0	0 0 0	2 2 2
6. <u>S. Humberside</u> Grimsby	11	2	0	0	1	1

APPENDIX VII

INTERVIEW ITEMS

a. Topics frequently included on the C.S.E. Science Syllabuses

CHEMISTRY

01. Chromatography
02. Boiling points
03. Outline of atomic structure
04. Electron transfer
05. pH
06. Composition of air
07. Hardness of water
08. Saponification
09. Allotropy
10. Catalytic action
11. Covalency
12. Neutralisation of an acid
13. Rusting of iron
14. Solubility
15. Water of crystallization
16. Exothermic reactions
17. Oxidation
18. Preparation of oxygen
19. The Law of Constant Composition
20. Brownian motion

GENERAL SCIENCE

01. Density
02. Transference of heat
03. The light spectrum
04. Chief properties of magnets
05. Electrolysis of water
06. Osmosis
07. Photosynthesis
08. Food Chains
09. Transpiration
10. Vegetative reproduction
11. Hardness of water
12. The simple Voltaic Cell
13. Rusting of iron
14. Fire extinguishers
15. Levers
16. Laws of reflection
17. Structure of the human eye
18. Outline of atomic structure
19. Preparation of oxygen
20. The balanced diet

BIOLOGY

01. Classification of Living Things
02. Cell structure
03. The balanced diet
04. Enzymes
05. Anaerobic respiration
06. Disease
07. Pollution
08. Conservation
09. Food Chains
10. Osmosis
11. Evolution
12. Monohybrid inheritance
13. Tropisms
14. Hormones
15. Vegetative reproduction
16. Animal locomotion
17. Transpiration
18. Animal territories
19. Birth control
20. Soil communities

PHYSICS

01. Density
02. The properties of the pendulum
03. Flotation
04. The use of the manometer
05. Thermometers
06. The Transference of Heat
07. Properties of magnets
08. Static electricity
09. Use of the ammeter to measure current
10. The construction of the Leclanché Cell
11. The Joule
12. Refraction
13. Alternating Current
14. Brownian Motion
15. Electromagnetic Spectrum
16. Expansion of solids
17. Inertia
18. Diffusion
19. Elasticity
20. Work

APPENDIX VII (Continued)

b. Teaching Strategies and Assessment Procedures

01. Lecture (verbal exposition)
 02. Practical Exercises (by pupil)
 03. Demonstration (by teacher)
 04. Field Work/visits
 05. Project Work (on an individual basis)
 06. Project Work (on a group basis)
 07. Class Discussion
 08. Mixed Media (films, video recordings etc.)
 09. Pupil Reading
 10. Programmed Texts
 11. Simulation Exercises (role-playing, games etc.)
-
01. Short answer exercises, factual recall
 02. Problem-solving exercises
 03. Multiple-choice tests
 04. Essay-type questions
 05. Written work in class
 06. Oral questions/responses
 07. General impression
 08. Practical exercises

c. Possible Constraints

01. Timetable allocation (hours/week)
02. Timetable pattern (single, double, triple periods)
03. Laboratory/room space
04. Availability of equipment/apparatus
05. Availability of teaching aids (projectors, films, models etc.)
06. Room/Laboratory facilities (power points, gas taps, black-outs etc.)
07. Library and other resource facilities
08. Staff/pupil ratios
09. Availability of ancillary assistance
10. School/college location (with respect to museums, natural habitats, industries etc.)
11. Availability of transport (school buses, public transport, hiring facilities, drivers etc.)
12. Syllabus content
13. Pupil attitude (including discipline)
14. Pupil ability
15. Attitude of fellow members of staff
16. Attitude of parents
17. Attitude of other parties (employers, governors etc.)

APPENDIX VIIIa

SAMPLING IN THE OBSERVATIONAL STUDY

	Pupil ID	Sex	PERIOD DIVIDED INTO OBSERVATIONAL UNITS OF FOUR MINUTES DURATION (3)												
			1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th 14th 15th 16th
S - BAND CLASS Pupils of above average ability (1)	01	F	X						X			X			
	02	M		X			X					X			X
	03	F			X					X	X				X
	04	F				X		X					X		X
			First class period of 50mins.								Second class period of 50mins.				
G - BAND CLASS Pupils of below average ability (2)	05	M	X					X			X				X
	06	F		X			X					X			
	07	M			X					X		X			X
	08	F				X			X				X		X

- (1) Pupils who could reasonably be expected to gain a grade 1 or 2 in the final examination.
- (2) Pupils who could reasonably be expected to gain a grade 5 or below in the final examination.
- (3) Delays at the start and end of each class period together with the administrative details of the study meant that only eight units of four minutes each could be conveniently recorded in a 50 minute class period i.e. in each lesson, each pupil was observed twice, as shown by 'X'.

APPENDIX VIIIb

FREQUENCY OF USE OF CATEGORIES OF THE SCIENCE PUPIL OBSERVATION SCHEDULE

PUPIL TALKING : TO PEER(S)	Pupil ID (Sex)	PUPIL ABILITY RATING													
		Above Average							Below Average						
		01 F	02 F	03 M	04 F	Total	05 M	06 F	07 M	08 F	Total	09 M	10 F	11 M	12 F
01. Non-related to topic		5	3	12	16	36	5	4	8	2	19				
Related to topic															
02. Asks question about the facts/principles		3	3	2	2	10	1	-	-	1	2				
03. Asks question about application of facts/principles		-	5	1	1	7	1	-	-	2	3				
04. Asks question about the hypothesis or problem		3	2	1	2	8	1	-	2	1	4				
05. Asks question about the procedure		1	1	3	-	5	1	2	-	1	4				
06. Replies to question about the facts/principles		2	7	6	2	17	1	1	-	1	3				
07. Replies to question about application of facts/principles		1	1	1	1	4	-	-	-	-	0				
08. Replies to question about the hypothesis or problem		1	-	2	1	4	-	-	-	-	0				
09. Replies to question about the procedure		-	1	1	5	7	-	2	-	2	4				
10. Makes comment/observation about the facts/principles		2	8	2	4	16	2	3	2	1	8				
11. Makes comment/observation about the application of facts/principles		1	1	1	-	3	-	-	-	-	0				
12. Makes comment/observation about hypothesis or problem		2	1	-	-	3	-	-	-	-	0				
13. Makes comment/observation about procedure		-	-	4	2	6	3	2	4	2	11				
14. Asks question about results/data/recordings		1	2	1	1	5	-	-	-	-	0				
15. Replies to question about results/data/recordings		2	1	-	-	3	-	-	-	-	0				
16. Makes comment/observation about results/data/recordings		2	2	1	-	5	-	3	-	1	4				
Total number of observations for each pupil =		26	38	38	37	139	15	17	16	14	62				

APPENDIX VIIIB

FREQUENCY OF USE OF CATEGORIES OF THE SCIENCE PUPIL OBSERVATION SCHEDULE (cont)

PUPIL TALKING : TO TEACHER	PUPIL ID (Sex)	PUPIL ABILITY RATING													
		Above Average							Below Average						
		01 F	02 F	03 M	04 F	Total	05 M	06 F	07 M	08 F	Total	09 M	10 F	11 M	12 F
17. Non-related to topic		-	1	-	-	1	-	3	-	-	3	-	-	-	3
Related to topic															
18. Asks question about the facts/principles		1	2	-	1	4	-	1	-	2	3	-	-	-	-
19. Asks question about application of facts/principles		1	3	-	2	6	-	-	-	1	1	-	-	-	-
20. Asks question about the hypothesis or problem		1	1	1	-	3	-	-	-	1	1	-	-	-	-
21. Asks question about the procedure		1	-	3	1	5	-	1	4	3	8	-	-	-	-
22. Replies to question about the facts/principles		1	1	-	-	2	-	-	-	-	0	-	-	-	-
23. Replies to question about application of facts/principles		-	-	-	-	0	-	-	-	-	0	-	-	-	-
24. Replies to question about the hypothesis or problem		-	-	-	1	1	-	-	-	-	0	-	-	-	-
25. Replies to question about the procedure		-	2	1	-	3	-	2	2	1	5	-	-	-	-
26. Makes comment/observation about the facts/principles		2	1	-	2	5	1	-	-	1	2	-	-	-	-
27. Makes comment/observation about application of facts/principles		-	-	-	-	0	-	-	-	-	0	-	-	-	-
28. Makes comment/observation about the hypothesis or problem		-	-	1	-	1	-	-	-	-	0	-	-	-	-
29. Makes comment/observation about procedure		-	-	-	-	0	1	-	2	-	3	-	-	-	-
30. Asks question about results/data/recordings		-	-	-	-	0	-	-	-	-	0	-	-	-	-
31. Replies to question about results/data/recordings		-	-	-	-	0	-	-	-	-	2	-	-	-	-
32. Makes comment/observation about results/data/recordings		-	-	-	-	0	-	-	-	-	0	-	-	-	-
Total number of observations for each pupil		7	11	6	7	(=31)	2	7	8	11	(=28)	-	-	-	-

APPENDIX VIIIB

FREQUENCY OF USE OF CATEGORIES OF THE SCIENCE PUPIL OBSERVATION SCHEDULE (CONT.)

PUPIL ID (SEX)	PUPIL ABILITY RATING													
	Above Average							Below Average						
	01 F	02 F	03 M	04 F	Total	05 M	06 F	07 M	08 F	Total	09 F	10 F	11 F	12 F
PUPIL READING														
33. Non-related to topic	-	-	-	-	0	-	-	-	-	0	-	-	-	0
34. Alone } Related to topic	10	3	6	4	23	1	1	-	-	2	-	-	-	2
35. With peer(s) } Related to topic	1	-	3	4	8	-	-	-	-	0	-	-	-	0
36. With teacher } Related to topic	-	-	-	-	0	2	1	-	-	3	-	-	-	3
Total number of observations for each pupil	11	3	9	8	(31)	3	2	0	0	(5)				
PUPIL WRITING														
37. Independently } Alone	2	12	10	8	32	-	-	-	-	0	-	-	-	0
38. From prepared text } Alone	6	3	4	4	17	1	-	-	-	1	-	-	-	1
39. With peer(s) and no text	-	2	-	2	4	-	-	-	-	0	-	-	-	0
40. With peer(s) and using text	1	1	4	-	6	1	-	-	-	1	-	-	-	1
41. With teacher and no text	-	-	-	-	0	-	-	-	-	0	-	-	-	0
42. With teacher and text	-	-	-	-	0	1	-	-	-	1	-	-	-	1
Total number of observations for each pupil	9	18	18	14	(59)	3	0	0	0	(3)				
PUPIL PRACTICAL WORK														
43. Non-related to topic	-	-	-	-	0	-	-	-	-	1	-	-	-	1
Preparing material/setting up apparatus	3	1	-	-	4	1	5	4	-	10	-	-	-	-
44. Alone } Related to topic	1	1	-	-	2	3	-	6	-	9	-	-	-	-
45. With peer(s) } Related to topic	-	-	-	-	0	-	-	-	-	2	-	-	-	2
46. With teacher } Related to topic	-	2	1	1	4	4	1	-	-	12	-	-	-	-
47. Managing/observing the investigation	1	-	4	4	9	2	-	-	-	4	-	-	-	4
48. Recording the results/data														
Total number of observations for each pupil	5	4	5	5	(19)	10	6	12	9	(38)				

APPENDIX IX

THE 'NON-USERS': THEIR EXPERIENCE OF PROJECT WORK

In the investigation, substantial knowledge was gained about the nature of project work, its organisation and management, and its relative success as perceived by the teachers of C.S.E. science participating in the study. However, since almost two-thirds of the teachers responding to the enquiry were not at that time implementing project work with their C.S.E. pupils, it was clearly important not only to examine their views more closely but also to assess the validity of their responses by establishing the bases on which their opinions and assumptions were formed. It was important to determine whether their prevailing attitudes about project work arose from first-hand experience of the method or were the result of secondary sources of information, heresay or mere intuition. Section B of the questionnaire (which was completed only by those teachers, three hundred and one in all, not using the project approach with C.S.E. pupils at the time of the enquiry) sought to investigate these issues in more depth. The items included in this section enabled the incidence of project work experience among the current 'Non-Users' to be ascertained and provided additional data on the age range of the pupils, the courses and the examinations for which it had been used. Thus, by examining both the nature and extent of project work experience among the 'Non-Users', a check on the validity of their responses to this and later sections of the questionnaire could, more fairly, be made.

What follows, is a review of the main findings in this area.

Item 1, Section B of the questionnaire posed the question 'Have you ever engaged pupils in project work of any kind?'. A breakdown of the teachers' response to this item is given in Table IX.a.

TABLE IX.a.

PREVIOUS EXPERIENCE OF PUPIL PROJECT WORK

QUESTION	RESPONSE	FREQUENCY OF RESPONSE (% age)
Have you ever engaged pupils in project work of any kind?	YES	182 (60.5)
	NO	114 (37.9)
	NOT ANS.	5 (1.7)

n = 301

Of the 301 science teachers (the 'Non-Users') responding to this item, 182 (60.5%) claimed to have used a project approach with pupils at some time during their teaching career. 114 (37.9%) of them admitted to having never used project work in their teaching repertoire whilst a further 5 respondents failed to answer the question.

From these general observations, several interesting points emerged. Considering the first group of teachers (i.e. those with some previous experience of pupil project work) two main issues warranted closer study; these concerned the reasons why the project method was no longer being utilised. Had these teachers abandoned the use of

project work because on previous occasions they had found it unsatisfactory? Alternatively, had they abandoned the method because although it had been satisfactory in the past, altered circumstances (e.g. category of pupil, examinations, timetables, resources etc.) now made it less so. In other words, the important issue here centred on whether project work was relinquished because the method itself was unsatisfactory or because the existing working conditions were largely unsuitable.

Concerning the second group of teachers - the 37.9% who had no first-hand knowledge of project work in action - further questions arose as to why these teachers failed to introduce the project approach. On what grounds did they base their decision not to adopt the project method? What, if anything, caused them to reject project work as a teaching/learning strategy? These issues were taken up in subsequent items on the questionnaire.

Firstly, those respondents who had some prior experience of the project approach were asked to give the following details:

- (i) the age range(s) of the pupils carrying out the project work,
- (ii) the course(s) or subject(s) they had been pursuing,
- and (iii) the examination(s), if any, of which it formed part. The findings are summarised in Tables IXb, IXc and IXd.

The enquiry into the age range of pupils with whom project work had been implemented, revealed that 163 (54.2%) of the teachers in the 'Non-User' category had personal

TABLE IX.b.

THE AGE RANGE OF PUPILS WITH WHOM PROJECT WORK
HAD PREVIOUSLY BEEN USED

AGE RANGE OF PUPILS (years)	FREQUENCY OF RESPONSE		
	RAW*	PERCENTAGE	
		'Non-Users' with past experience of project work	All 'Non-Users'
5+ to 7	1	0.5%	0.3%
7+ to 11	2	1.1%	0.7%
11+ to 14	53	29.1%	17.6%
14+ to 16	163	89.6%	54.2%
16+ to 18	23	12.6%	7.6%
Over 18	-	-	-

n = 182

n = 301

* see Table IXd.

TABLE IX.c.
THE COURSE(S)/SUBJECT(S) OF WHICH PROJECT WORK
HAD PREVIOUSLY BEEN PART

COURSE/SUBJECT	FREQUENCY OF RESPONSE		
	RAW*	PERCENTAGE	
		'Non-Users' with past experience of project work	All 'Non-Users'
BIOLOGY	36	(19.8%)	(12.0%)
CHEMISTRY	49	(26.9%)	(16.3%)
GENERAL SCIENCE	47	(25.8%)	(15.6%)
PHYSICS	35	(19.2%)	(11.6%)
RURAL SCIENCE	3	(1.6%)	(1.0%)
INTEGRATED SCI.	8	(4.4%)	(2.6%)
ENGINEERING SCI.	5	(2.7%)	(1.7%)
PHYSICS WITH CHEM.	4	(2.2%)	(1.3%)
OTHERS ...	39	(21.4%)	(13.0%)

n = 182 301

* see Table IXd.

TABLE IX.d.

THE EXAMINATION(S) FOR WHICH PROJECT WORK HAD
PREVIOUSLY BEEN USED

EXAMINATION	FREQUENCY OF RESPONSE		
	RAW*	PERCENTAGE	
		'Non-Users' with past experience of project work	All 'Non-Users'
C.S.E.	132	(72.5%)	(43.9%)
G.C.E. O-LEVEL	10	(5.5%)	(3.3%)
G.C.E. A-LEVEL	17	(9.3%)	(5.6%)
NON-EXAMINATION	35	(19.2%)	(11.6%)
OTHERS ...	6	(3.3%)	(2.0%)
n =		182	301

*It should be emphasised that these figures are not discrete in that one teacher may have used project work with a variety of age groups, in a range of science courses and for several different examinations.

experience of the method with pupils in the 14-16 year age range. Such a high percentage is of interest indicating as it does that a large proportion of the respondents, failing to use project work in C.S.E. science, had on previous occasions used it with this age group. Fifty-three teachers (17.6%) had used a project approach with pupils during their earlier (11 - 14) years of secondary education while only twenty-three (7.6%) had implemented the method with the over-16 age group.

With reference to the types of subjects and courses in which project work had previously been used, the respondents were found to have had a spread of experience across the

range of school science subjects. Thirty-six teachers (12.0%) had undertaken a project approach in Biology, forty-nine (16.3%) in Chemistry and forty-seven (15.6%) in General Science, and even in Physics - a subject area noted for its traditional approaches and its low incidence of project work - thirty-five teachers (19.2%) claimed to have had some personal experience in this field.

On the question of examination target, it was found that 132 respondents (43.9%) (see Table IXd) had at some time used the project approach as part of a C.S.E. teaching programme while only ten (3.3%) had used it in G.C.E. O-level work. In the older pupil age group, seventeen teachers (5.6%) had undertaken project work at A-level. Thirty-five respondents (1.6%) indicated that they had used it in a **non-examination** context.

Thus, from these findings it can be seen that of those teachers not using project work in C.S.E. science, a substantial proportion of them had previously gained experience of the method at C.S.E. and other levels, in a range of subjects and with a variety of age groups. Moreover, bearing in mind the breadth of project experience gained by these teachers, it would seem to be of major value to consider their views on project work carefully since in a number of cases these represent informed opinion based on first-hand working knowledge. The reasons why these teachers did not use, or failed to continue to use the project approach at C.S.E. level, are therefore pressing issues. They are discussed in depth in the main section under Chapter Eight.

BIBLIOGRAPHY

Abousief, A.A. and Lee, D.M. (1965) 'The Evaluation of certain science practical tests at the secondary school level', British Journal of Educational Psychology, 35, pp. 41 - 49.

Adams, G.S. and Torgerson, T.L. (1964) Measurement and Evaluation in Education, Psychology and Guidance, N.Y., Holt, Rinehart & Winston.

Adams, R.S. (1972) 'Observational studies of teacher role', International Review of Education, 18, pt.II, pp. 440 - 59.

Allanson, J.T. (1970) Continuous Assessment, Paper submitted for discussion at the Schools Council, October.

Anthony, W.S. (1973) 'The development of extraversion, of ability and of the relation between them', British Journal of Educational Psychology, 43, pp. 223 - 7.

Armstead, D.E.F. (1975) Project Work in Chemistry, M.Sc. Dissertation, University of Reading.

Armstead, D.E.F. (1979) 'Project Work in Science' School Science Review, 60 (212), pp. 570 - 573.

Association for Science Education (1973) An Association View on School Science and Technology, Discussion Document, November.

Association for Science Education (1976) Non-streamed Science: The Training of Teachers, Study Series No. 8.

Association for Science Education (1976) A Teachers' Handbook I: A Guide to the Project, edit. by D. Wilkinson and J. Bowers, L.A.M.P. Project.

Association for Science Education (1981) The Supply of Science Teachers, Symposium of the Annual Meeting of the A.S.E., University of Warwick.

Ausubel, D.P. (1968) Educational Psychology: A Cognitive View, N.Y., Holt, Rinehart & Winston.

Backstrom, C.H. and Hursh, G.D. (1963) Survey Research, Northwestern University Press.

Bailey, K.D. (1974) 'Cluster analysis' in Sociological Methodology edited by D. Heise, San Francisco, Jossey-Bass, 1975.

Banks, Olive (1971) The Sociology of Education (2nd edition) London, Batsford Ltd.

Benn, C. and Simon, B. (1972) Half Way There (2nd edition) Harmondsworth, Penguin Books Ltd.

Bennett, Neville (1976) Teaching Styles and Pupil Progress, London, Open Books Pub. Ltd.

Bennett, S. and Bowers, D. (1976) An Introduction to Multivariate Techniques for Social and Behavioural Sciences, London, Macmillan.

Berlyne, D.E. (1954) 'An Experimental Study of Human Curiosity', British Journal of Psychology, XLV, pt. 4, pp. 256 - 265.

Bernbaum, G. (1973) 'Countesthorpe College, Leicester U.K.', Case Studies of Educational Innovation III, C.E.R.I.

Bernstein, B. (1970) 'Education cannot compensate for society', New Society, 387, pp. 344 - 7.

Biddle, B.J. and Ellena, W.J. (eds.) (1964) Contemporary Research on Teacher Effectiveness, N.Y., Holt, Rinehart and Winston.

Blashfield, R.K. (1976) 'Mixture model tests of cluster analysis: Accuracy of four agglomerative hierarchical methods', Psychological Bulletin, 83, pp. 377 - 388.

Bloom, B.S. (1956) Taxonomy of Educational Objectives I, London, Longmans Green.

Bollen, F.A. (1967) 'Modern science at C.S.E. level', School Science Review, 165 (48), pp. 347 - 362.

Bosworth, D.P. (1967) 'Subject Teaching in Non-streamed Comprehensive Schools: Science', Forum, 9 (3), pp. 87 - 89.

Bowles, S. and Gintis, H. (1976) Schooling in Capitalist America: Educational Reform and the Contradictions of Economic Life, N.Y., Basic Books.

Bradley, H.W. and Goulding, J.G. (eds.) (1973) Handling Mixed Ability Groups in the Secondary School, University of Nottingham, School of Education.

Bradshaw, K.D. (1966) 'A School Reaction to C.S.E.', Forum, 9 (1), pp. 28 - 31.

Brennan, T. (1972) Numerical Taxonomy: Theory and some applications in educational research, Ph.D. Thesis, University of Lancaster.

Brennan, E.J.T. (1977) 'The Great Debate: some personal reflections', The Vocational Aspect of Education, XXIX (74), pp. 99 - 101.

Brimer, M.A., Madaus, G.F. Chapman, B., Kellaghan, T. and Wood, R. (1977) Sources of Difference in School Achievement. Report to the Carnegie Corporation, New York.

Brockington, D., White, R. and Pring, R. (1983) Implementing the 14 - 18 curriculum; new approaches, Bristol, The Youth Education Service.

Brookover, W.B. (1955) The Sociology of Education, N.Y., American Book Co.

Brown, R. and Daniels, C. (1979) 'The Myth Exposed?',
Times Educational Supplement, 30th November.

Browning, D.R. (1967) 'Project Work in Chemistry',
Education in Chemistry, 4 (2), pp. 68 - 70.

Bruner, J.S. (1961) 'The Act of Discovery' Harvard
Education Review, 31, pp. 21 - 32.

Bruner, J.S. (1966) Toward a Theory of Instruction, Cambridge,
Harvard University Press.

Budd Rowe, Mary (ed.) (1978) What Research Says to the
Science Teacher, Volume 1, Washington, National Science
Teachers Association.

Burstall, Clare (1968) French from Eight: A National
Experiment, Slough, N.F.E.R.

Burstall, Clare (1979) 'Time to mend the nets: a commentary
on the outcomes of class-size research,' Trends in
Education, 3, pp. 27 - 33.

Byrne, E.M. (1974) Planning and Educational Inequality,
Slough, N.F.E.R.

Calthrop, K. and Owens, G. (eds.) (1971) Teachers for
Tomorrow, London, Heinemann Educational Books Ltd.

Carin, A.A. and Sund, R.B. (1970) Teaching Science through Discovery (2nd edition) Columbus, Merrill.

Cattell, R.B. (1931) 'The Assessment of Teaching Ability', British Journal of Educational Psychology, 1, pp. 43 - 71.

Caulfield, M. (1977) 'Mixed ability at Bishop Douglass School' in Mixed ability teaching in the Secondary School edited by B. Davies and R.G. Cave, London, Ward Lock Ltd.

Chemical Society, The (1972) The Role and Nature of Experimental Work in Chemistry Courses, Report of a symposium of the Education Division, University of Nottingham.

Clegg, A. and Megson, B. (1968) Children in Distress, Harmondsworth, Penguin Books Ltd.

Cohen, L. and Holliday, M. (1979) Statistics for Education and Physical Education, London, Harper & Row Ltd.

Coleman, J.S. et.al. (1966) Equality of Educational Opportunity, Washington, U.S. Government Printing Office.

Coleman, J.S. (1975) 'Methods and results in the I.E.A. studies of the effects of school on learning', Review of Educational Research, 45, pp. 335 - 86.

Cook, Ann and Mack, Herb (1971) The Teacher's Role, British Primary Schools Today Series, London, Macmillan Education Ltd.

Corbishley, Peter (1977) 'Research Findings on Teaching Groups' in Mixed ability teaching in the Secondary School edited by B. Davies and R.G. Cave, London, Ward Lock Ltd.

Cowan, G. (1969) An Experimental Study of the Use of the Project Method in Teaching Selected Groups of Pupils in a Secondary Modern School, M.Phil. Thesis, University of London.

Cronbach, L.J. and Snow, R.E. (1969) Individual differences in learning ability as a function of instructional variables. Final Report, Stanford University, Contract O.E.C., U.S. of Education.

Cross, A.H. (1979) Examination Entries at 16-plus - A Decisional Dilemma, M.Ed. Thesis, University of Leicester, School of Education.

Cullen, B.D. (1979) 'Lessons from class-size research - an economist's perspective', Trends in Education, 4, pp. 29 - 33.

Darke, J. (1970) 'Mixed Ability Science', Forum, 13 (1), pp. 15 - 17.

Davies, B. and Cave R.G. (eds.) (1977) Mixed ability teaching in the Secondary School, London, Ward Lock (Education) Ltd.

Davies, Brian (1977) 'Meanings and Motives in "going mixed ability"', in Davies and Cave (Ibid.).

Davies, W.J.K. (1978) Guidelines 4 - Implementing Individualised Learning, Council for Education Technology.

Deere, M.T. (1978) 'The Assessment of Project Work' in Techniques and Problems of Assessment edited by H.G. Macintosh, London, Arnold.

Douglas, J.W.B. (1964) The Home and the School, London, MacGibbon & Kee.

Dowdeswell, W.H. (1970) Nuffield A-level Biological Science Project: Teachers Guide 1, Harmondsworth, Penguin Books Ltd.

Dowdeswell, W.H., Ellis, A., Gray, J.H., Kelly, P.J., and Lister, R.E. (1970) 'A Modern Biology Syllabus at O-level', Journal of Biological Education, 4, pp.205 - 217.

Dowdeswell, W.H. and Tricker, B.J.K. (1970) Nuffield A-level Biological Science Project: Projects in Biological Science, Harmondsworth, Penguin Books Ltd.

Driver, Rosalind et.al. (1982) 'Science in Schools: age 15', Assessment of Performance Unit, Report No.1, London, H.M.S.O.

Edwards, C.H. and Fisher, R.L. (1977) Teaching Elementary School Science - A Competency-Based Approach, N.Y., Praeger Pubs.

Eggleston, J.F. (1965) A Critical Review of Assessment Procedures in Secondary School Science, University of Leicester, School of Education.

Eggleston, J.F. and Kelly, P.J. (1970) 'The Assessment of Project Work in A-level Biology', Education Research, 12 (3), pp. 225 - 229.

Eggleston, J.F., Galton, M.J. and Jones, M.E. (1975) A Science Teaching Observation Schedule, London, Macmillan Education.

Eggleston, J.F., Galton, M.J. and Jones, M.E. (1976) Processes and Products of Science Teaching, London Macmillan Education.

Eggleston, J. (1980) 'The drawbacks of Projects', The Times Educational Supplement, 12th September.

Elliot, J. (1976) 'Preparing Teachers for Classroom Accountability', Education for Teaching, 100, pp. 49 - 71.

Elliott, J. (1974) 'Sex Role Constraints on Freedom of Discussion', The New Era, 55 (6)

Entwistle, N.J. and Brennan, T. (1971) 'The Academic Performance of Students: II Types of successful students', British Journal of Educational Psychology, 41, pp. 268 - 276.

Equal Opportunities Commission (1982) Seventh Annual Report, Manchester E.O.C./London, H.M.S.O.

Evans, K.M. (1961) 'An Annotated Bibliography of British Research on Teaching and Teaching Ability', Education Research, 4 (1), pp. 67 - 80.

Everitt, B. (1974) Cluster Analysis, London, Heinemann (S.S.R.C.).

Fairbrother, R.W. (1977) Good and Poor Science Teachers: A Cluster Analysis Study of the Personalities of Student Science Teachers and Practising Science Teachers, Ph.D. Thesis, Centre for Science Education, Chelsea College, University of London.

Finlayson, D.S. and Cohen, L. (1967) 'The Teacher's Role: A Comparative Study of the Conceptions of College of Education Students and Head Teachers', British Journal of Educational Psychology, 37, pp. 207 - 208.

Flanders, N.A. (1970) Classroom Interaction Analysis, A Manual for Observers, University of Michigan, School of Education.

Flecknoe, M. (1976) 'The Teaching of Science at the Sutton Centre' in Non-streamed Science: The Training of Teachers; Association for Science Education, Study Series No. 8.

Flintham, A.J. (1977) 'The Contribution of Arthur Smithells F.R.S. to Science Education' History of Education, 6 (3), pp. 195 - 208.

Gage, N.L. (1963) Handbook of Research on Teaching Chicago, Rand McNally & Co.

Galton, M.J. (ed)(1980) Curriculum Change: The Lessons of a Decade, Leicester University Press.

Gough, B. and McGhee, J. (1977) 'Planning for mixed ability' in Mixed ability teaching in the Secondary School edited by B. Davies and R.G. Cave, London, Ward Lock Ltd.

Grace, G.R. (1972) Role Conflict and the Teacher, London, Routledge & Kegan Paul.

Grace, G.R. (1978) Teachers, Ideology and Control: a study of urban education, London, Routledge & Kegan Paul.

Green, Eric (ed.) (1976) Towards Independent Learning in Science, St. Albans (U.K.), Hart-Davis Educational.

Gronlund, N.E. (1976) Measurement and Evaluation in Teaching (3rd edition) London, Macmillan.

Hacker, R.G. (1983) A Typology of Approaches to Science Teaching in Primary and Secondary Schools, The University of Western Australia, Department of Education (Nedlands, W.A. 6009).

Halliday, A.K. (1972) 'As things are at the Secondary Level' in The Role and Nature of Experimental Work in Chemistry Courses, Symposium of the Education Division of the Chemical Society, Nottingham, 1972.

Halsey, A.H., Floud, Jean and Arnold Anderson, C. (eds.) (1965) Education, Economy and Society, U.S., Free Press Edition; London, Collier-Macmillan.

Halsey, A.H., Heath, A.S. and Ridge, J.M. (1980) Origins and Destinations: family, class and education in Modern Britain, Oxford Clarendon Press.

Hamilton, D.F. (1968) 'Nuffield Science in Unstreamed Classes in a Comprehensive School', Forum, 10(3), pp. 100 - 101.

Handy, J. and Johnstone, A. (1974) 'Project assessment', Education in Chemistry, 56 (11), (ii), pp. 56 - 57.

Harlen, Wynne (1977) 'Progress in Learning Science' Cambridge Journal of Education, 7 (3) pp. 188 - 196.

Harper, J.L. (1972) 'Projects and their assessment in degree examinations' Journal of Biological Education, 6, pp. 318 - 321.

Hays, William L. (1974) Statistics for the Social Sciences (2nd edition), N.Y., Holt, Rinehart & Winston.

Head, J. (1974) 'Methods and Techniques of Teaching' in The Art of the Science Teacher edited by C.R. Sutton and J.T. Haysom, London, McGraw-Hill.

Heaney, Sally (1971) 'The Effects of Three Teaching Methods on the Ability of Young Pupils to solve Problems in Biology: An Experimental and Quantitative Investigation', Journal of Biological Education, 5, pp. 219 - 228.

Hendrix, Gertrude (1961) 'Learning by Discovery', The Maths Teacher, 54 (5), pp. 290 - 99.

Hewitt, S.J. (1970) 'Project Work and the Average Child', Engineering and Applied Science Form Journal, 19.

Hiles, D.A. and Heywood, J. (1972) 'Teacher Attitudes to Projects in A-level Engineering Science', Nature, 236, pp. 61 - 63.

Hill, Katherine E. (1961) 'Varying Perceptions of Science Phenomena', Science Education, 45 (1), pp. 29 - 32.

Hockey, S.W. (1982) A Statistical Analysis of the Nuffield Physical Science Project Assessment. Personal communication on an earlier paper (reference unknown), Marlborough College.

Horne, D.H.T. (1943) A Comparison in Methods of Teaching Science, M.A. (Education) Thesis, University of London.

Hoste, Roland (1977) An Evaluation of a Certificate of Secondary Education Examination in Biology, Ph.D. Thesis, Centre for Science Education, Chelsea College, University of London.

Hudson, Liam (1966) Contrary Imaginations, London, Methuen.

Hurd, DeHart, Paul (1969) New Directions in Teaching Secondary School Science, New Trends in Curriculum and Instruction Series, London, Rand McNally & Co.

Inhelder, B. and Piaget, J. (1958) The Growth of Logical Thinking, London, Routledge & Kegan Paul.

Jackson, Brian (1964) Streaming: An Education System in Miniature, London, Routledge & Kegan Paul.

Jenkins, E.W. (ed.) (1973) The Teaching of Science to Pupils of Low Educational Attainment, Centre for Studies in Science Education, The University, Leeds.

Jensen, A.R. (1969) 'How much can we boost IQ and scholastic achievement?' Harvard Education Review, 39, pp. 1 - 123.

Johnson, Margaret E.B. (1966) 'Teachers' Attitudes to Educational Research', Educational Research, 9 (1), pp. 74 - 79.

Jones, Lyndon H. (1970) 'The Project in NEBSS Courses', The Vocational Aspect of Education, XXII(53), pp. 145 - 149.

Joyce, C.R.B. and Hudson, L. (1968) 'Student Style and Teacher Style: An Experimental Study', British Journal of Medical Education, 2, pp. 28 - 32.

Kamm, M.D. (1969) 'Teaching a basic science course to mixed ability groups', School Science Review, 175 (51), pp. 263 - 9.

Kaye, B. and Rogers, I. (1968) Group Work in Secondary Schools and the training of teachers in its methods, London, Oxford University Press.

Kelly, Alison (1978) Girls and Science: An International Study of Sex Differences in School Science Achievement, International Association for the Evaluation of Educational Achievement I.E.A. Monograph Studies No. 9., Stockholm (Sweden), Almqvist & Wiksell Int.

Kelly, Alison (ed.) (1981) The Missing Half: Girls and Science Education, Manchester University Press.

Kelly, Alison (1982) 'Why girls don't do science', New Scientist, 20th May.

Kelly, P.J. and Dowdeswell, W.H. (1970) 'Nuffield A-level Biological Science Project', Journal of Biological Education, 4, pp. 251 - 260.

Kelly, P.J. (1971) 'Evaluation Studies of the Nuffield A-level Biology Trials: 1. Overall Achievements of Students', Journal of Biological Education, 5, pp. 315 - 327.

Kelly, P.J. (1972) 'Evaluation Studies of the Nuffield A-level Biology Trials: 4. School Characteristics and Achievement', Journal of Biological Education, 6, pp. 197 - 205.

Kelly, P.J. (1972) 'Evaluation Studies of the Nuffield A-level Biology Trials: 5. Students after the Trials', Journal of Biological Education, 6, pp. 259 - 266.

Kerr, J.F. (1963) Practical Work in School Science, Leicester University Press.

Kerry, T. (1981) 'Thinking in science lessons', School Science Review, 63 (223), p. 355.

Khan, M.A. (1951) A Study of Ability and Interest of Secondary School Pupils in Science, M.A. (Education) Thesis, University of London.

King, J. (1974) 'Women and Work: Sex Differences and Society', Manpower (Paper No.10), Department of Employment H.M.S.O.

King, J. (1976) 'Sex Differences and Career Guidance', Careers Bulletin, Department of Environment, H.M.S.O.

King, R.A. (1969) Values and Involvement in a Grammar School, London, Routledge & Kegan Paul.

Kirkham, W.J. (1979) 'Science Teachers for the 1980's', Education in Science, 83, pp. 16 - 17.

Kob, J. (1965) 'Definition of the teacher's role' in Education, Economy and Society edited by A.H. Halsey et.al., London, Collier-Macmillan.

Kuslan, L.J. and Stone A.H. (eds.) (1969) Readings on Teaching Children Science, U.K., Wadsworth: Prentice-Hall.

Lafitte, P. and Holt, N.F. (1955) 'The Purpose and Conduct of Examinations', in Teacher, Pupil, and Task edited by O.A. Oeser, London, Tavistock.

L.A.M.P. Project, see Association for Science Education (1976)

Layton, David (ed.) (1979) Studies in Science Education, 6, Centre for Studies in Science Education, The University, Leeds.

Lewis, D.G. (1967) 'Ability in science at Ordinary Level of the General Certificate of Education', British Journal of Educational Psychology, 37, pp. 361 - 370.

Lucas, S.B. and Burlando, A.B. (1975) 'The New Science Methods and Reading', Language Arts, 52, pp. 769 - 770.

Maccoby, E. and Jacklin, C. (1975) The Psychology of Sex Differences, London, Oxford University Press.

MacCullum, M.A. (1972) 'Student Views of Practical Work: The Result of a Project on Student Attitudes', in The Role and Nature of Experimental Work in Chemistry Courses, see The Chemical Society (1972).

MacInness, Iain (1980) 'Shortage of Physics Teachers', School Science Review, 61 (217), pp. 783 - 786.

Macintosh, H.G. (ed.) (1978) Techniques and Problems of Assessment (2nd edition), London, Arnold.

Mackenzie, R.F. (1965) Escape from the Classroom, London, Collins.

Maclure, S. (ed.) (1965) Comprehensive Planning, U.K., Councils and Education Press.

Maden, M. (1971) 'Young Teachers - Change or Absorption?' in Teachers for Tomorrow edited by K. Calthrop and G. Owens, London, Heinemann Educational Books Ltd.

Marburger (1963) 'Considerations for Educational Planning' in Education in Depressed Areas edited by A.H. Passow, N.Y., Teachers College Bureau of Publications.

Mardia, K.V., Kent, J.T. and Bibby, J.M. (1979) Multivariate Analysis, London, Academic Press.

Mason, Stuart (1960) The Leicestershire Experiment and Plan, U.K., Councils and Education Press.

Mason, S.C. (1965) 'The Leicestershire Plan' in Comprehensive Planning edited by S. Maclure, U.K., Councils and Education Press.

Mather, D.R., France, N. and Sare, G.T. (1965) The C.S.E.: A Handbook for Moderators, London, Collins.

Maxwell, A.E. (1961) Analysing Qualitative Data, London, Methuen.

McCormick, D. (1974) 'Exploring Chemistry', Education in Chemistry, 48 (11) ii, pp. 48 - 49.

McGuire, J. and Johnstone, A. (1974) 'Projects in Scotland', Education in Chemistry, 48 (11) ii, pp. 50 - 51.

McIntyre, D. and Macleod, G. (1978) The Characteristics and Uses of Systematic Classroom Observation, University of Stirling.

Mealings, R.J. (1963) 'Problem-solving and Science Teaching', Education Review, 15, pp. 194 - 207.

Melton, Larry (1978) 'Student progress in self-paced, competency-based individualised science classes in an alternative Philadelphia school', Education (American), 98, pt.4, pp. 440 - 443.

Meyer, G.R. and Edwards Penfold, D.M. (1961) 'Factors associated with Interest in Science', British Journal of Educational Psychology, 31, pp. 33 - 37.

Michael, W.B., Herrold, E.E. and Cryan, E.W. (1951) 'Survey of Student-Teacher Relationships', Journal of Education Research, 44 (9), pp. 657 - 673.

Montross, H.W. (1954) 'Temperament and Teaching Success', Journal of Experimental Education, 23 (1), pp. 73 - 97.

Morrison, A. and McIntyre, D. (1969) Teachers and Teaching Harmondsworth, Penguin Books Ltd.

Morrison, C.M. (1976) 'Ability Grouping and Mixed-Ability Grouping in Secondary Schools', Educational Issues, 1, Edinburgh, The Scottish Council for Research in Education.

N.A.T.E. (1978) A Common System of Examining at 16+, Examinations Booklet 1.

National Examinations Board in Supervisory Studies (1981) Notes for Guidance on Projects, NEBSS.

Nie, N.H., Hull, C.H., Jenkins, J.G., Steinbrenner, K. and Bent, D.H. (1975) Statistical Package for the Social Sciences, N.Y., McGraw-Hill.

Nuthall, G.A. (1970) Classroom Observation, London, Rand McNally & Co.

O'Brien, R. (1983) 'The threshold of a great advance',
The Times Educational Supplement, 6th May.

Oeser, O.A. (ed.) (1955) Teacher, Pupil, and Task:
Elements of Social Psychology applied to Education, London,
Tavistock Pub. Ltd.

Oliver, M. (1965) 'The Efficiency of Three Methods of
Teaching High School Biology', Journal of Experimental
Education, 33 (3), pp. 289 - 300.

Olsen, Ingrith D. (1976) 'Project-Oriented Work for
Pre-service Biology Teachers', American Biology Teacher,
38 (2), pp. 86 - 7.

Oppenheim, A.N. (1976) Questionnaire Design and Attitude
Measurement, London, Heinemann.

Paisey, H.A.G. (1975) The Behavioural Strategy of Teachers
in Britain and the United States, Slough, N.F.E.R.

Paris, J.A. (1831) Life of Sir H. Davy, London, Colburn and
Bentley.

Parten, Mildred (1950) Surveys, Polls and Samples: Practical
Procedures, N.Y., Harpers and Bros.

Partridge, J. (1968) Life in a Secondary Modern School,
Harmondsworth, Penguin Books Ltd.

Passow, A.H. (ed.) (1963) Education in Depressed Areas, N.Y., Teachers College Bureau of Publications.

Perkins, H.V. (1964) 'A Procedure for Assessing the Classroom Behaviour of Students and Teachers', American Ed. Research Journal, 1, pp. 249 - 260.

Perry, L.R. (1969) 'Training', Education for Teaching, Summer (Based on a paper read to the A.T.C.D.E. Education Section, January 1969).

Peterson, W.A. (1964) 'Age, Teacher's Role, and the Institutional Setting', in Contemporary Research on Teacher Effectiveness edited by B.J. Biddle and W.J. Ellena, N.Y., Holt, Rinehart and Winston.

Phillips, Ray C. (1968) Evaluation in Education, Foundation of Education Series, U.K., Merrill: Prentice-Hall.

Pidgeon, D.A. (1970) Expectation and Pupil Performance, Slough, N.F.E.R.

Pidgeon, D.A. (1973) 'Class-size as a factor of pupil performance: a policy analysis', in New Patterns of Teacher Education and Tasks: General Analyses, Paris, O.E.C.D.

Porter, D. (1970) Technical and Vocational Education: Six Areas of Studies, Council for Cultural Co-operation of the Council of Europe.

Postman, N. and Weingartner, C. (1971) Teaching as a Subversive Activity, Harmondsworth, Penguin Education Books.

Prosser, P. (1970) 'Nuffield Science and the Average Secondary Pupil', Forum 13(1), pp. 26 - 28.

Reed Campbell, J. (1977) 'Science Teachers' Flexibility', Journal of Research in Science Teaching, 14 (6), pp. 525 - 532.

Reid, D.J. and Booth, P. (1970) 'The Effect of Individual Learning upon the Future Demand for Science Teachers', Journal of Biological Education, 4, pp. 187 - 195.

Reid, D.J. and Booth, P. (1971) 'Independent Learning in Biology: Results of trials 1968 - 70', School Science Review, 52 (180) pp. 500 - 12.

Rinard, Phillip M. (1978) 'Ghosts in the Classroom', Physics Teacher, 16 (5), pp. 290 - 291.

Ripon and York St. John, College of (1979) Re-training in the Physical Science - A Possible Solution to the Shortage. A Report produced by the College.

Robson, Colin (1973) Experiment, Design and Statistics, Harmondsworth, Penguin Modern Psychology Texts.

Rosenshine, Barak (1971) Teaching Behaviours and Student Achievement, Slough, N.F.E.R.

Rosenthal, R. and Jacobson, L. (1968) Pygmalion in the Classroom, N.Y., Holt, Rinehart & Winston.

Rowe, A.W. (1959) The Education of the Average Child, London, Harrap Ltd.

Rutter, M., Maughan, B., Mortimore, P. and Ouston, J. (1979) Fifteen Thousand Hours: Secondary Schools and their effects on children, Somerset (U.K.), Open Books Pub. Ltd.

Ryan, D.W. and Greenfield, T.B. (1975) Clarifying the Class-size Question, Toronto, Ontario, Ministry of Education.

Ryans, D.G. (1964) 'Research on Teacher Behaviour in the Context of the Teacher Characteristics Study' in Contemporary Research on Teacher Effectiveness by B.J. Biddle and W.J. Ellena, N.Y. Holt, Rinehart and Winston.

Samual, Judy (1981) 'Feminism and science teaching: some classroom observations' in The Missing Half edited by Alison Kelly, Manchester University Press.

Sayer, M. (1973) 'Technology Appreciation', School Science Review, 54 (189), p. 795.

Sears, P.S. (1963) The Effect of Classroom Conditions on the Strength of Achievement Motive and Work Output of Elementary School Children. Report of Co-operative Research Project, Washington D.C., Dept. of Health, Education and Welfare (Office of Education).

Seaver, W.J. (1973) 'Effects of naturally induced teacher expectancies', Journal of Personality and Social Psychology, 28, pp. 333 - 342.

Seckington, R. (1968) 'Transition to Non-streaming in Secondary Schools', Forum, 10 (2), pp. 61 - 63.

Secondary Science Curriculum Review (1983) Science Education 11 - 16: proposals for action and consultation, London, S.S.C.R.

Schlenker (1970) 'Analysing the Questioning Behaviors of Science Teachers' in What Research says to the Science Teacher edited by Mary Budd Rowe, National Science Teachers Association, 1978.

Shapland, Jeff (1976) 'Teaching Chemistry to Non-streamed Groups at Countesthorpe College' in Non-streamed Science: The Training of Teachers, Association for Science Education, Study Series No. 8.

Sharpe, S. (1976) Just like a Girl, Harmondsworth, Penguin Books Ltd.

Sheehan, D.S. and Hambleton, R.K. (1977) 'Adapting Instruction to Student Differences in an Individualized Science Program', Journal of Research in Science Teaching, 14 (1), pp. 27 - 32.

Shipman, M.D. (1967) 'Theory and practice in the education of teachers', Educational Research, 9, pp. 208 - 212.

Small, Margaret A. (1973) Investigation into the Use of the Student Project in Colleges of F.E., University of Aston in Birmingham.

Sorenson, A.G., Husek, T.R. and Constance Yu (1963) 'Divergent Concepts of Teacher Role: An Approach to the Measurement of Teacher Effectiveness', Journal of Educational Psychology, 54 (6), pp. 287 - 294.

Spender, Dale (1982) Invisible Women: The Schooling Scandal, London, Writers and Readers Publishing Co-operative Society.

Spindler, G.D. (ed.) (1963) Education and Culture, N.Y., Holt, Rinehart & Winston.

Steckline, V.S. (1977) 'Independent Study in Physics', Physics Teacher, 15 (3) pp. 157 - 161.

Steedman, J. (1980) Progress in Secondary Schools - Findings from the National Child Development Study, London, National Children's Bureau.

Stephens, J.M. (1967) The Process of Schooling, N.Y., Holt, Rinehart & Winston.

Sturges, L.M. (1973) 'Problems of Teaching Science to Non-streamed classes', School Science Review, 55 (191) pp.224 - 232.

Summers, A.A. and Wolfe, B.L. (1977) 'Do schools make a difference?', American Economic Review, as cited in Rutter et.al. (1979)

Sutton, C.R. and Haysom, J.T. (eds.) (1974) The Art of the Science Teacher, School Teacher Education Project, London, McGraw-Hill.

Sutton, C. (1981) 'Practical work is not enough', The Times Educational Supplement, 18th September.

Sweetman, J. (1980) 'More than a million words', The Times Educational Supplement, 21st November.

Taba, Hilda (1963) 'Learning by Discovery: Psychological and Educational Rationale', Elementary School Journal, 63, pp. 308 - 316.

Taba, Hilda (1966) 'Teaching Strategies and Cognitive Functioning in Elementary School Children', U.S.O.E. Co-operative Research Project (San Francisco State College, No. 2404).

Taba, Hilda (1969) 'Strategies for Learning' in Readings on Teaching Children Science edited by L.J. Kuslan and A.H. Stone, U.K., Wadsworth: Prentice-Hall.

Tamir, P. (1972) 'The Practical Mode - A Distinct Mode of Performance in Biology', Journal of Biological Education, 6, pp. 175 - 182.

Taylor, J. (1978) Girls' Science Education and Possible Text Book Bias, M.Ed. Thesis, Centre for Science Education, Chelsea College, University of London.

Taylor, P.H., Christie, T. and Platts C.V. (1970) 'An Exploratory Study of Science Teachers' Perceptions of Effective Teaching', Education Review, 23 (1), pp. 19 - 32.

Taylor, P.H., Christie, T. and Platts, C.V. (1980) Studies in the Structure of Science Teaching: No. 1 The Personalities and Attitudes of Science Teachers and their Perceptions of Effective Teaching, University of Birmingham, Faculty of Education.

Thelen, Herbert A. (1960) Education and the Human Quest, N.Y., Harper & Row.

Tisher, R.P., Power, C.N. and Endean, L. (1972) Fundamental Issues in Science Education, Sydney (Australia), Wiley Ltd.

Tomley, D. (1980) 'The Selection of Curriculum Content: Issues and Problems', in Curriculum Change: The Lessons of a Decade edited by M.J. Galton, Leicester University Press.

Travers, R.M.W. (1969) An Introduction to Educational Research (3rd edition), London: Collier-Macmillan.

Trow, M. (1968) Research and the Racial Revolution in American Education. Paper read at the 16th Congress of Int. Assoc. of App. Psych. (Amsterdam).

Tuppen, C.J.S. (1966) 'The Measurement of Teachers' Attitudes', Educational Research, 8 (2), pp. 142 - 5.

Walker, R. and Adelman, C. (1975) 'Interaction analysis in informal classrooms: a critical comment on the Flanders' system', British Journal of Educational Psychology, 45, pp. 73 - 76.

Waring, Mary (1979) Social Pressures and Curriculum Innovation - A Study of the Nuffield Foundation Science Teaching Project, London: Methuen.

Watts, J. (ed.) (1977) The Countesthorpe Experience: The First Five Years, London: Allen & Unwin Education Books.

Wells, J. (1972) 'Some aspects of adolescent thinking in science', Educational Review, 24, pp. 212 - 224.

Whalley, G.E. (1969) The Certificate of Secondary Education, The University of Leeds, Institute of Education.

Whitehead, A.N. (1947) The Aims of Education, London, Williams and Norgate Ltd.

Whitfield, R.C. (1974) 'Aims and objectives' in The Art of the Science Teacher edited by C.R. Sutton and J.T. Haysom, London, McGraw-Hill.

Whittaker, P. (1981) 'Disturbing power shift', The Times Educational Supplement, 20th November.

Williams, W.F. (1978) 'The social function of science education', Trends in Education, 1, pp. 32 - 35.

Wilmut, J. (1971) The Effect of Project Work on Pupils' Attitudes to Science, M.Ed. Thesis, University of Bath.

Wilson, W. (1976) 'Hard Look at Independent Study', Independent School Bulletin, 35, pp. 64 - 5.

Wilton, P.J., Whittle, S.J. and Teather, D.C.B. (1971) 'A Comparison between Teaching Methods in Secondary School Biology', Journal of Biological Education, 5 (4), pp. 179 - 185.

Wiseman, S. (1971) 'The Educational Obstacle Race: factors that hinder pupil progress', Forward Trends, 15, pp. 13 - 18.

Woods, G.T. et.al. (1974) 'Physical Science Projects', Education in Chemistry, 11 (ii), pp. 52 - 53.

Wragg, E.C. (ed.) (1976) Teaching Mixed Ability Groups, Newton Abbot (U.K.): David & Charles.

Wright, C.J. and Nuthall, G. (1970) 'Relationships Between Teacher Behaviours and Pupil Achievement in Three Experimental Elementary Science Lessons', American Educational Research Journal, 7 (4), pp. 477 - 491.

Yager, Robert E. (1966) 'Teaching effects upon the outcomes of science instruction', Journal of Research in Science Teaching, 4, pp. 236 - 242.

Youngman, M.B. (1975) 'Structuring work for training purposes', The Vocational Aspect of Education, 27 (68), pp. 77 - 86.

Youngman, M.B. (1976) Programmed Methods for Multivariate Data (PMMD, Version 5), University of Nottingham, School of Education.

Youngman, M.B. (1979) Analysing Social and Educational Research Data, Berkshire (U.K.): McGraw-Hill.

Zillman, D. and Cantor, J.R. (1973) 'Induction of Curiosity via Rhetorical Questions and its Effect on the Learning of Factual Materials', British Journal of Educational Psychology, 43, pp. 172 - 180.

Government Reports (in chronological order)

1. Thomson Report (1918) Natural Science in Education, London, H.M.S.O.
2. Hadow Report (1926) The Education of the Adolescent, London, H.M.S.O.

3. Spens Report (1938) Secondary Education with Special Reference to Grammar Schools and Technical High Schools, London, H.M.S.O.
4. Norwood Report (1941) Curriculum and Examinations in Secondary Schools, London, H.M.S.O.
5. Beloe Report (1958) Secondary School Examinations other than G.C.E., London, H.M.S.O.
6. Crowther Report (1959) 15 - 18: A Report to the Central Advisory Council for Education, London, H.M.S.O.
7. Newsom Report (1963) Half Our Future, London, H.M.S.O.
8. Bullock Report (1965) The Demand for and Supply of Teachers 1963 - 1986, London, H.M.S.O.
9. Plowden Report (1967) Children and Their Primary Schools, London, H.M.S.O.
10. Rusholme Report (1971) Teacher Education and Training, London, H.M.S.O.
11. Houghton Report (1974) Report of the Committee of Inquiry into the pay of Non-university Teachers, London, H.M.S.O.
12. Waddell Report (1978) School Examinations I and II, London, H.M.S.O.

Department of Education and Science Publications
(in chronological order)

Department of Education and Science (1977) Curriculum 11 - 16, Working Papers by H.M. Inspectorate London, H.M.S.O. (First Publication).

Department of Education and Science (1977) 'School leavers, C.S.E. and G.C.E.' Statistics of Education, 2, London, H.M.S.O.

Department of Education and Science (1978) 'Teachers', Statistics of Education, 4, London, H.M.S.O.

Department of Education and Science (1978) Scales of salaries for teachers in primary and secondary schools, England and Wales, London, H.M.S.O.

Department of Education and Science (1979) Aspects of secondary education in England: a survey by H.M. Inspectors of Schools, London, H.M.S.O.

Department of Education and Science (1979) Mixed ability work in comprehensive schools, H.M.I. Series: Matters for Discussion, 6, London, H.M.S.O.

Department of Education and Science (1980) Standing Commission on Pay Comparability, 7, 'Teachers' (Cmnd 7880), H.A. Clegg (Chairman), London, H.M.S.O.

Department of Education and Science (1980) A view of the curriculum, H.M.I. Series: Matters for Discussion, 11, London, H.M.S.O.

Department of Education and Science (1980) Girls and science, H.M.I. Series: Matters for Discussion, 13, London, H.M.S.O.

Department of Education and Science (1981) Curriculum 11 -16 a review of progress by H.M. Inspectors of Schools, London, H.M.S.O.

Department of Education and Science (1981) The School Curriculum, London, H.M.S.O.

Department of Education and Science (1983) Science in Primary Schools, Discussion paper produced by H.M. Inspectorate Science Committee, London, H.M.S.O.

Secondary School Examinations Council and
Schools Council Publication
(in chronological order)

1. Secondary School Examinations Council (1963) Scope and Standards of the Certificate of Secondary Education, Seventh Report, London, H.M.S.O.
2. Secondary School Examinations Council (1963) The Certificate of Secondary Education, Examinations Bulletin No. 1, London, H.M.S.O.

3. Schools Council (1965) The Certificate of Secondary Education: Experimental Examinations - Science, Examinations Bulletin No. 8, London, H.M.S.O.
4. Schools Council (1966) Closer Links Between Teachers and Industry and Commerce, Working Paper No.7, London, H.M.S.O.
5. Schools Council (1971) A Common System of Examining at 16+, Examinations Bulletin No. 23, London, H.M.S.O.
6. Schools Council (1973) A Common System of Examining at 16+, Review of Examinations Bulletin No. 23, Pamphlet 12, London, Schools Council.
7. Schools Council (1975) G.C.E. and C.S.E.: a guide to secondary school examinations for teachers, pupils, parents and employers, London, Evans Methuen.
8. Schools Council (1976) Examinations: Their use in curriculum evaluation and development, Examinations Bulletin No. 33, London, Evans Methuen.
9. Schools Council (1976) Mode III Examinations in the C.S.E. and G.C.E., Examinations Bulletin No. 34, London, Evans Methuen.
10. Schools Council (1977) Mode Comparability in the C.S.E., Examinations Bulletin No. 36, London, Evans Methuen.

11. Schools Council (1981) The Practical Curriculum,
Advisory Document, London, Schools Council.
12. Schools Council (1981) Information Skills in the
Secondary Curriculum, Curriculum Bulletin, London,
Schools Council.