The introduction of mathematics coursework into Lincolnshire secondary schools

This item was submitted to Loughborough University's Institutional Repository by the/an author.

Additional Information:

- A Master's Thesis. Submitted in partial fulfilment of the requirements for the award of Master of Philosophy of Loughborough University.

Metadata Record: https://dspace.lboro.ac.uk/2134/14121

Publisher: © Graham H. Nelson

Please cite the published version.
This item was submitted to Loughborough University as an MPhil thesis by the author and is made available in the Institutional Repository (https://dspace.lboro.ac.uk/) under the following Creative Commons Licence conditions.

For the full text of this licence, please go to:
http://creativecommons.org/licenses/by-nc-nd/2.5/
The Introduction of
Mathematics Coursework
into
Lincolnshire Secondary Schools

by

A Thesis submitted in partial fulfilment of the requirements for the award of Master of Philosophy of the University of Loughborough.

1988

(C) by Graham H. Nelson 1988
The Introduction of Mathematics Coursework into Lincolnshire Secondary Schools

Abstract

The National Criteria for GCSE Mathematics stated fifteen Objectives setting out essential mathematical processes in which candidates' attainment would be assessed from the year 1980. It also stated that by 1991 all schemes must include the assessment of coursework which would carry between 20% and 50% of the total assessment.

Representatives from all Lincolnshire secondary schools took part in a Phased Training programme for the MEG GCSE Mathematics scheme. The meetings highlighted a lack of expertise in this form of assessment together with anxiety about the changes in teaching strategy necessary. The author was seconded for one year as an In-Service Trainer working with the teachers and the pupils providing advice, encouragement and material support in order that GCSE coursework had a coordinated start in the County schools.

This thesis is a record of the In-Service Training programme as teachers attempted to come to terms with the changes in their role demanded by the new GCSE syllabus. It follows the development of a scheme of coursework aimed at the Lower School designed to introduce pupils to the art of Investigation and to the writing of accounts. It also attempts to clarify the assessment and moderation of coursework, two issues which were not understood in the early days of the new examination system.

The research method is a combination of case study, action research and observational techniques based on the activities of thirteen Cluster Groups established in the County and of the staff and pupils in a sample of eight schools. Detailed notes from observation of the interactions in the field with both teachers and pupils will provide illuminative evidence for the author's views on the successes and failures of the changes being made.

Keywords

Coursework
GCSE
INSET
Investigation
Moderation
Self Help Groups

Graham H. Nelson
Acknowledgements

The author wishes to acknowledge his debt to those teachers around the county who took part in the coursework trials and to the heads of departments of the schools visited during the study. Without their time, given freely in meetings out of school hours, their efforts and contributions the development would have been impossible. In addition the author is grateful to Mr T.J. Woodward for his help and encouragement in the early days of the study and to Mr A. Thomson and Dr. P. Lloyd, serving officers of EMREB and UCLES respectively, for their help in providing information when required.

Graham H. Nelson
Summary of the Thesis

Chapter 1 The Research Problem and Methods

| Introduction | 1 |
| 1.1 The National Criteria for Mathematics | 1 |
| 1.2 Aims of the Research | 4 |
| 1.3 The Research Methods | 6 |
| 1.4 Recording Information | 12 |
| 1.5 Interpreting Terminology | 14 |

Chapter 2 The "Cascade Model" of In-Service Training

| Introduction | 20 |
| 2.1 The Background of the Author | 20 |
| 2.2 The GCSE | 23 |
| 2.3 The Training Programme for GCSE | 24 |
| 2.4 Feedback from the GCSE Training Meetings | 32 |

Chapter 3 The Self Help "Cluster Groups"

| Introduction | 39 |
| 3.1 A Description of Lincolnshire Schools | 40 |
| 3.2 The Problems Facing Lincolnshire Teachers | 40 |
| 3.3 The Head of Department Conference 1986 | 44 |
| 3.4 A Suggested Plan of Action | 46 |
| 3.5 Establishing the First Self Help Groups | 48 |
| 3.6 A Typical Agenda of a Self Help Group | 50 |
| 3.7 The Independent Group | 53 |

Chapter 4 The Lower School Assignments

| Introduction | 57 |
| 4.1 Why Choose Investigations ? | 57 |
| 4.2 The First Trials at Yarborough High School | 60 |
| 4.3 Developing the Format of the Briefing Sheets | 63 |
| 4.4 The Investigation Algorithm | 66 |
| 4.5 Why Assess Lower School Assignments ? | 68 |
Chapter 5  Case Studies of Eight Schools

Introduction 76
5.1 Seatown Grammar School 76
5.2 Greenway Grammar School 80
5.3 Fielding Grammar School 82
5.4 Meadow Lane School 85
5.5 Montford Girls School 86
5.6 The Guild School 88
5.7 Freshman High School 91
5.8 Dragon High School 93

Chapter 6  Moderating GCSE Mathematics Coursework

Introduction 95
6.1 The Assessment of Coursework 96
  .1 The MEG Scheme of Assessment for GCSE 96
  .2 Support for the Department 96
  .3 The MEG Criteria for Assessment 96
  .4 Moderation Procedures 96
6.2 The Agreement Trial 105
  .1 Setting up the Trial 105
  .2 Sample Scripts for the Trial 105
  .3 Instructions to the Markers 105
  .4 Timetable for the Trial 105
  .5 Administration of the Trial 105
6.3 Methods Used in the Analysis 111
6.4 Data from the Agreement Trial 113
  .1 Script Summary 113 (Foundation)
  .2 Marks Awarded 113
  .3 Grades Awarded 113
  .4 Scattergraph 113
  .5 Marker Analysis 113
  .6 Script Summary 113 (Intermediate)
  .7 Marks Awarded 113
  .8 Grades Awarded 113
  .9 Scattergraph 113
  .10 Marker Analysis 113
6.5 Comments on the Agreement Trial 128
  .1 Foundation Level 128
  .2 Intermediate Level 128
6.6 The Discussion 135
6.7 The Interviews with the Markers 138
6.8 Conclusions from the Agreement Trial 141
6.9 Working with Other Trainers 145
Chapter 7 Other In-Service Training Activities

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>147</td>
</tr>
<tr>
<td>7.1 Observing Classroom Activities</td>
<td></td>
</tr>
<tr>
<td>.1 YHS Video</td>
<td>147</td>
</tr>
<tr>
<td>.2 LUT Video</td>
<td></td>
</tr>
<tr>
<td>7.2 A Baker Day</td>
<td>157</td>
</tr>
<tr>
<td>7.3 Practical Work in the Classroom</td>
<td>158</td>
</tr>
<tr>
<td>7.4 LOGO</td>
<td>160</td>
</tr>
</tbody>
</table>

Chapter 8 Summary

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>164</td>
</tr>
<tr>
<td>8.1 The Learning of Coursework Skills</td>
<td>165</td>
</tr>
<tr>
<td>8.2 Changes in Teaching Strategy</td>
<td>171</td>
</tr>
<tr>
<td>8.3 The Assessment of Coursework - Lower School</td>
<td>176</td>
</tr>
<tr>
<td>8.4 The Assessment of Coursework - GCSE</td>
<td>177</td>
</tr>
<tr>
<td>8.5 In-Service Training</td>
<td>181</td>
</tr>
</tbody>
</table>

Appendices

1. The Lower School Scheme of Coursework
2. The Record of School/Classroom Visits
3. A Record of the Interviews
List of Acronyms and their Meanings
(in the order of occurrence)

GCSE General Certificate of Secondary Education
INSET In-Service Training
SEC Secondary Examinations Council
MEG Midland Examining Group
EMREB East Midland Regional Examination Board
HMEB West Midlands Examination Board
NUJMB Northern Universities Joint Matriculation Board
YHS Yarborough High School
ESG Education Support Grant
GRIST Grant Related In-Service Training
GCE General Certificate of Education
CSE Certificate of Secondary Education
UCLES University of Cambridge Local Examinations Syndicate
LEA Local Education Authority
LUT Loughborough University of Technology
MEDU Microelectronics Education Development Unit
ATM Association of Teachers of Mathematics
MATS Mathematical Activity Tiles
Chapter 1
The Research Problem and Methods

Introduction
The Government announced on 20th June 1984 that a new system of examining based upon National Criteria, the General Certificate of Secondary Education (GCSE), would replace the existing system as from 1988. The National Criteria for the GCSE [1] were published in January 1985 and contained significant changes from the existing system of GCE and CSE. The two major changes were connected with the need to provide a system of differentiated assessment and the inclusion of a school-based-assessment component (coursework). These changes were to be supported by a major In-Service Training (INSET) Programme initiated at National level and aimed at the classroom teacher through a Cascade process.

1.1 The National Criteria for Mathematics
The statement of the National Criteria for GCSE Mathematics [2] laid down in some detail the Aims and Objectives which must be satisfied by any GCSE scheme submitted to the Secondary Examinations Council (SEC) for approval. In order to secure this approval it seems as though most of the six new Examination Boards quoted these Aims and Objectives, with minor changes in wording to preserve their individuality, in all the submissions that were accepted.
The Aims refer to those attributes and qualities which the course provision should develop in the pupil independently of any consideration of assessment. The Aims specified in the National Criteria for GCSE Mathematics which are most relevant to the coursework component are:

2.1 develop their oral, written and practical skills in a manner which encourages confidence.

2.10 develop the abilities to generalise and to prove.

2.13 conducting individual and cooperative enquiry and experiment including extended pieces of work of a practical and investigative kind.

The first fifteen of the Assessment Objectives laid down in the National Criteria for GCSE Mathematics are applied to the time-limited written examinations. Two further Assessment Objectives:

3.16 respond orally to questions about mathematics, discuss mathematical ideas and carry out mental calculations.

3.17 carry out practical and investigational work and undertake extended pieces of work.

can only be fully realised in the assessment of work carried out by candidates in addition to time-limited written examinations. Such additional work is usually referred to as coursework. Until 1991 all Examining Groups must provide at least one scheme of assessment which
considers these two objectives. From 1991 all schemes must contain the assessment of these two objectives in a coursework component which carries between 20% and 50% of the total assessment.

A recommendation of the Cockcroft Committee Report, called Mathematics Counts [3], (para 520) was that differentiated levels of assessment would be necessary to cater for the range of ability of those entering the new examination. Another recommendation of the Cockcroft Report (para 531-6) was that an element of classroom based Teacher Assessment should be included in any examination of mathematics. These recommendations were built into the National Criteria for GCSE Mathematics under Techniques of Assessment:

6.1 ....there must be differentiated elements which meet the educational needs of different groups of candidates.

6.4 ....from 1991 onwards all schemes of assessment must include a coursework element ...

There were two main reasons for postponing the introduction of coursework until 1991. One was that it would take some time to develop the new methods of assessment required. The second was to give teachers and pupils time to develop the coursework skills in the classroom. For all approved schemes there must be a coursework option available during 1988, 1989 and 1990.
1.2 Aims of the Research

To study, illuminate and interpret;

(i) the "Cascade Model" of In-Service Education and Training for GCSE Mathematics in Lincolnshire Secondary Schools (1987-88),

(ii) the Development and Introduction, into Lincolnshire Secondary Schools, of a scheme of Lower School Coursework,

(iii) the Introduction of GCSE Mathematics Coursework, into Lincolnshire Secondary Schools, and related INSET provision,

(iv) an INSET Exercise related to the Moderation of GCSE Mathematics Coursework.

The research was a highly interactive study in which the author had to cope with the dual, and sometimes conflicting, roles of being regarded as the instrument of change as well as the instrument of evaluation. The first problem was one of translating the National Criteria into educational practice and initiating changes to the school curriculum. Stenhouse [4] defined a curriculum as "...the means by which the experience of attempting to put an educational proposal into practice is made publicly available. It involves both content and the method, and in its widest application takes account of the problem of implementation in the institutions of the educational system." This definition is a very accurate
description of the activities involving the author during 1987/88. Curriculum change could not be enforced. By providing teachers with the opportunity to examine new ideas it was hoped that teachers would be encouraged to make changes.

The second problem was one of evaluating the changes observed in schools participating in the curriculum development described in this thesis. One approach to the evaluation would be through some form of measurement of the attainment of the Aims of the course as specified in the Assessment Objectives of the National Criteria for GCSE Mathematics and in particular the Midland Examining Group (MEG) Scheme of Assessment for Mathematics syllabus 1651 [5]. Since this could only be achieved in 1991 by most of the participants a more immediate and ongoing evaluation would be more appropriate to the needs of the teachers. Scriven [6] describes this as a formative evaluation in that "..the evaluation exercise serves as feedback and guide, influencing the shaping of the curriculum through the successive revisions of the development phase. " The style of illuminative evaluation proposed by Parlett and Hamilton [7] is more appropriate in the circumstances. "The aims of illuminative evaluation are to study the innovatory programme; how it operates; how it is influenced by the various school situations in which it is applied; what those directly concerned regard as its advantages and
disadvantages; and how student's intellectual tasks and academic experiences are most affected. It aims to discover and document what it is like to be participating in the scheme, whether as teacher or pupil."

1.3 The Research Methods

There were four principal methods of gathering data for this research.

A. Case Study

The case study is defined by Cohen and Manion [8] as "...the observation of the characteristics of an individual unit - a child, a clique, a class or a community." They further subdivide the method of observation into two categories:

i) participant observation - where the observer is engaged in the activity being observed. In view of the high profile of the training role it was impossible for the author to be anything other than open about the nature of this task when in contact with other teachers. When in contact with pupils the author was accepted as an "observer" in most classroom situations. The two roles of disguise described by Patrick and Parker [9] were not available although on one occasion the author was described as "one of us" (meaning a teacher). One advantage of participant observation is that over a period of time the relationships become more relaxed, less threatening and the activity is less influenced by the intervention. The disadvantages are that
the method is seen as being imprecise, subjective and selective by its critics. Imprecise because there is no measurement; subjective because it is one person interpreting the events and selective because the observer chooses what to record.

ii) non-participant observation - where the observer does not participate in the activity being observed. Cohen and Manion suggest that, perhaps, the best illustration of this as a case of a researcher sitting at the back of a classroom coding interactions between pupil and teacher. The author was only present as a non-participant observer during parts of some classroom sessions when the teacher was introducing or discussing the coursework activity with the class. The attention of the pupils was usually on the teacher and the author's interest was in the style of introduction to the coursework or the manner of intervention when things ground to a halt. When the author's presence in the formal situation did affect the proceedings it was commented on by the teacher, sometimes along the lines of "...so-and-so isn't usually that naughty/perceptive..." Usually the pupils were told that the visitor had come to see how they get on with the assignment. After two or three visits it was seen as quite normal to have two teachers in the room and the pupils relaxed into a more informal relationship.
B. Action Research

Cohen and Manion identify Action Research and its features in terms which closely relate to the training role model adopted during 1987/88.

"... Action Research is small-scale intervention in the functioning of the real world and a close examination of the effects of such intervention." Certainly the activities of the Phased Training programme fit this description as do the visits to schools where the specific purpose was to demonstrate an approach to coursework to the staff.

"... Action Research is situational - it is concerned with diagnosing a problem in a specific context and attempting to solve it in context."

"... Action Research is usually collaborative - teams of practitioners and researchers work together on a project."

"... Action Research is participatory - team members themselves take part directly or indirectly in implementing the research."

"... Action Research is self-evaluative - modifications are continuously evaluated within the ongoing situation, the ultimate objective being to improve practice in some way or other."

The work of the Self Help Groups (vide Chapter 3) around the county can be seen to fit these descriptions in the development of the scheme of Lower School coursework. Cohen and Manion go on to identify five categories for the
purpose of action research and specifically mention:

".. It is a means of in-service training, thereby equipping the teacher with new skills and methods."

".. It is a means of injecting additional or innovatory approaches to teaching and learning into an ongoing system which normally inhibits innovation and change."

It is certainly true from the author’s point of view that this form of research was instrumental in achieving change. Most of the teachers joined the Self Help Groups out of curiosity and from the wish to find out what help was available. They then faced pressure to attempt change because they were part of a group examining the need to make changes to the curriculum.

C. Statistical

In examining the use of the MEG Scheme of Assessment for coursework for the 1988 entry an Agreement Trial was conducted with a small group of teachers. The results are analysed in order to comment on whether the scheme is reliable and to help the participants recognise their lenity/severity in relation to others. The method of analysis is one which has been used for some time by the East Midland Regional Examinations Board (EMREB) for CSE Coursework Moderators and was accepted for use in all Phase 4 Training. It is also currently being recommended by MEG as the technique to use for internal moderation by departments.
D. Interview

Much of the evidence offered in this study is derived from conversations held with teachers and pupils. Powney and Watts [10] suggest that a conversation becomes an interview when it is "...initiated by the interviewer for the specific purpose of obtaining relevant research information and focused by him on content specified by research objectives of systematic descriptions, prediction or explanation."

They further define interviews as being in two categories – informant and respondent. In both cases the intention of the interviewer to seek information imposes some form of structure on the agenda for the conversation.

If the agenda is controlled by the interviewee then the interview is defined as "informant" and the intention is to "explore certain issues...in collaboration with the interviewer". This would be the case when the author visited departments and classrooms and in the Self Help Group meetings. Here the teachers and pupils were encouraged to express their own ideas and concerns either unsolicited or in response to a general query.

If the agenda is controlled by the interviewer then the interview is defined as "respondent". Following the agreement trial (vide Chapter 6) the author needed further information about the participants and their schools in order to evaluate the trial procedures and comment upon the results. There are two main features of a respondent
interview that were present in the five interviews held (vide Appendix 3). Firstly a common set of questions was prepared so that the author could concentrate on the main issues. Secondly the interview was controlled by the interviewer who was also seen to be recording the responses.

More information about the preparation, planning and conduct of the respondent interviews is given in the introduction to Appendix 3.

The table below shows the relationship between the various Research Methods and the activities.

<table>
<thead>
<tr>
<th>Research Method</th>
<th>Case Study</th>
<th>Action Research</th>
<th>Stat/cal</th>
<th>Interview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activity</td>
<td>Part/pt Observn</td>
<td>Non-part Observn</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phase 2/3/4 Training</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Self Help Groups</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Departmental Visits</td>
<td>*</td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Agreement Trial</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Other Activities</td>
<td>*</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

Other INSET related activities are referred to in Chapter 7 and include making videos of classroom activities, making a training video, a Baker Day with a Mathematics Department, In-Service Training on LOGO and working with
the West Midlands Examinations Board (WMEB) Trainers.

1.4 Recording Information

During the course of the study there were more than 100 hours of meetings with total attendance figures in excess of 600. In addition the researcher spent more than 40 hours in the classroom with pupils participating in coursework activities. Written material which was collected included; briefing sheets, mark schemes and copies of pupils coursework. Recording and filing information proved to be a major task during this study.

Field Notes:

From the early days of the Phase 3 Training meetings written reports were expected by the appropriate organising bodies so the researcher was partly, but not totally, prepared for the task of recording. As soon as the research was proposed a word processor was provided in order to keep a continuous record of the activities. During the Self Help Group meetings it was seen as quite normal for notes to be taken but it was difficult to record all that was said without slowing down the proceedings. A form of shorthand was developed for certain words and phrases and a regular agenda to the meetings helped to keep things in perspective. It would have saved time and been less stressful if a tape recorder could have been introduced to minute the meetings. Discussion with a colleague.
suggested that this would have been viewed as threatening so a recorder was not used. The notes of the meetings were written up as soon as possible after the event, usually the following day. When in the classroom a small notebook was used to record key words/headings for later transcription and its use was kept as unobtrusive as possible. Following these, and one-to-one meetings with teachers, a small portable recorder was used at the first available opportunity to lay down comments from the sessions. The order was not important as the notes were transcribed and reassembled the following day.

Following these, and one-to-one meetings with teachers, a small portable recorder was used at the first available opportunity to lay down comments from the sessions. The order was not important as the notes were transcribed and reassembled the following day. Cohen and Manion's suggestions for Field Notes in Observational Studies include: "Record the notes as quickly as possible after observation since the quantity of information forgotten is very slight over a short period of time but accelerates quickly as more time passes." This was found to be true and it was surprising to hear things from the tape recorder that had been forgotten overnight and would not have been recorded otherwise. Having the word processor made the writing of notes much easier than typing or handwriting.

Other Material:
Once the material from schools and the meetings started to accumulate it was necessary to devise a system of identifying the material for later use and reference.
1.5 Interpreting Terminology

Several phrases and words are used many times in the National Criteria and syllabi without definition so it is useful to state the interpretation put upon these in relation to this study. Terms such as coursework, practical work, activity lesson, investigations, assignments and problem solving are used almost indiscriminately by teachers to describe all activities which do not come under the banner of examination questions.

i) Coursework

This will be the term used to describe any activity by the pupil in years one to five which is largely their own work and about which they write an account. The more specific form of GCSE coursework is defined by the Examination Boards as:

"any internally assessed component specified by the examination syllabus ". The Cockcroft Report does not refer to the concept of coursework in the sense that teachers and Examination Boards use the word. It does, however, go into some detail about the experiences relevant to such work as does the report Mathematics from 5 to 16 [11].

ii) Oral Skills

Conventional examinations rely on the ability of the pupil to understand a written question and make an appropriate written response. Coursework activity should provide the
opportunity for a pupil to comprehend a spoken question and respond, either by further activity or by engaging in a dialogue about the question. Conversation is an important part of coursework activity because quite often the pupil will develop ideas as a consequence. In addition, children do not acquire the sort of articulate command of the mathematical language we would like without the influence of the teacher/pupil discussion. One of the points that all of the training attempted to stress was that when the pupils were engaged in coursework it was not to be regarded by the teacher as an opportunity to get on with some other task such as marking or preparation.

The report Mathematics from 5 to 16 (para 2.14) states that "...oral skills amongst older pupils are often neglected in schools as pupils are expected to play a more passive, listening role".

The survey by HM Inspectors of Schools 1979 stated that "...the potential of mathematics for developing precision and sensitivity in the use of language was underused." The Cockcroft Report (para 246) takes discussion to mean "...more than the short questions and answers which arise during exposition by the teacher" and goes on to state that being articulate "...develops as a result of opportunities to talk about mathematics, to explain and discuss results which have been obtained." This Aim has now taken on a new significance in that the assessment of
Oral Skills has been included in the draft proposals for the MEG Scheme of Assessment for 1991 [12].

iii) Generalisation and Proof

The Aim 2.10 taken from the National Criteria for GCSE Mathematics "...develop the abilities to reason logically, to classify, to generalise and to prove." caused much consternation at the Phase 2 meeting in Lincoln. The word generalise was associated with an algebraic context which is excluded at the Foundation level and the word prove was associated with the ideas of Euclidian Geometry. The only positive reference to this in the Cockcroft Report is in para 474 which states "Steps must be taken to develop powers of generalisation and abstraction, of logic and proof." This specifically refers to the provision for high attaining pupils while the National Criteria refers to all pupils. The report Mathematics from 5 to 16 (para 2.31) adopts a similar view of the complexity of this process. "Making, testing and modifying hypotheses are parts of the thinking processes at different levels within mathematics" and "Making and testing hypotheses' is often thought of as a general strategy of importance only for the more able, older pupils."

Evidence has been presented in the Self Help Group meetings suggesting that many pupils are able to understand the idea of using data to make a general hypothesis (usually expressed in words) and then perform a limited test of its
validity. This has also been seen in practice in the classroom by the author when working with Lower School pupils working on coursework (vide Chapter 5) and directly noted in the examples of coursework scripts contributed by teachers to the researcher.

iv) Extended Pieces of Work

While the intent is to blend in the coursework activity as part of the normal curriculum it is difficult on many occasions to relate the nature of the coursework to the classwork currently in progress. There is evidence from the researcher's discussions with pupils (vide Chapter 5) and from the Self Help Group reports that the pupils regard the discontinuity as less of a problem than the teacher, taking the change of activity in their stride and as providing a welcome variety. There is no doubt that in the early days of this study a great many teachers viewed coursework as an intrusion into their planned examination work. It was noted many times in the Phased Training programme that teachers used the phrase "getting in the way of examination work" and was reinforced by some teachers at Self Help Group meetings who were still disapproving of this demand on their time. This was in line with the observation in Mathematics from 5 to 16 (para 4.13) "...practical work, problem solving and investigative activities are time consuming and some schools will be concerned that their introduction will result in
unsatisfactory coverage of the content of the mathematics curriculum."

With GCSE coursework a balance had to be found which did not trivialise the work by minimising the time allowed for its completion and did not deter participants by overextending the time allowed. The six EMREB trainers (vide Chapter 2) discussed this at length and decided to recommend that coursework submitted for GCSE assessment should take between 10 and 15 hours of the pupils' time for completion. Such a recommendation was accepted as reasonable at the Training meetings and in the MEG draft syllabus for 1991 it states "Each of the four assignments should be of such a length as to require about twelve hours work." This was modified even further in September of 1988 when the draft proposals were revised to read "There will be three assignments chosen from a topic list of four, each assignment to take about three weeks of school mathematics time to complete."

In Lincolnshire, for the Lower School scheme of coursework, it seemed reasonable to take on board no more than four pieces of (assessed) coursework during each year and devote about one week of lessons to each one. This, it was thought, would be adequate preparation for the fourth and fifth year and was intended to be a notional minimum. The only dissensions from this view have been from the academic grammar schools who consider a double period (about 1 hour)
as sufficient time, with the script carrying little weight (vide Chapter 5). It was also hoped that schools would include similar activities as and when appropriate as part of the normal curriculum but in the event very few did.

v) Practical Work

The Cockcroft Report (para 247) lists the advantages of practical work but we have to refer to the section on primary years to find an explanation of the term. Practice in measurement (para 291), working with two and three dimensional shapes (para 292), graphical work (para 293), games (para 294) and life activities (para 296) are all given as examples of practical work. There is evidence that many teachers are reluctant to venture into this sort of classroom activity where apparatus and equipment (other than the formal geometric instruments) are involved (vide Chapters 3, 5 and 7)

vi) Problem Solving and Investigation

There does not seem to be a clear distinction between problem solving and investigations. Perhaps the comparison is that in problem solving it is the solution which is important and in investigation it is the method(s) of arriving at the solution. In the Lower School scheme of coursework that has been trialled (vide Chapter 4) the briefing sheets are referred to as investigations and each is based upon a particular problem.
Chapter 2
Training for Change

Introduction
This chapter is concerned with development of the "Cascade Model" of In-Service Training in Lincolnshire during the academic year 1987/88.

2.1 The Background of the Author
When the Secretary of State for Education, Sir Keith Joseph decided in 1984 to proceed with the new examination system the author was the Head of Mathematics and Computing at Yarborough High School in Lincoln, which is a purpose built Comprehensive school of about 1000 pupils including a Sixth Form of about 100. The department consisted of the author and six other teachers. One teacher was also Head of Commerce and taught three classes of mathematics and another was a Head of House teaching five classes of mathematics. The others were teaching only mathematics, with a minority provision of Information Technology for the first year. We were teaching to the Northern Universities Joint Matriculation Board (NUJMB) GCS O level and the EMREB CSE mode 1 with a special course for those not taking external examinations in mathematics.

The author had been involved with the EMREB since 1974 as a member of the CSE Assessment Committee which was responsible for the grading of all EMREB Mathematics
schemes together with the standards of mode 3 assessments submitted by schools. This involved a great deal of experience with coursework and standardisation procedures. Yarborough High School (YHS) had abandoned its own mode 3 mathematics a few years before largely because of the increasing demands on staff and pupil time. The Government initiatives in 1985 coincided with a planned review of my school mathematics curriculum. It meant that the review had to address the question of reintroducing coursework as well as considering the recommendations of the Cockcroft Report. When the National Criteria for GCSE Mathematics was published it was obvious there would have to be major revisions to the curriculum and teaching strategy. The way forward was to:

a) research more fully the proposed coursework requirement and develop a strategy for years one to five,
b) research more fully the nature of the coursework assessment and develop its use in years one to five,
c) design and implement a scheme of In-Service Training for the members of the department that would give them confidence and expertise.

The first plan of action was therefore directed at finding a solution to the problems at YHS. During the Autumn term of 1985 the author prepared some ideas for the introduction of coursework which were used as the basis for development. These took the form of simple investigations for a first
year class to try out to see whether they could write an account of the investigation and whether a scheme of assessment could be devised for their work.

Immediately following the Phase 2 Training meeting in January 1986 these ideas were discussed with the recently appointed Mathematics Inspector responsible for administering the Education Support Grant (ESG) in Lincolnshire. He was of the opinion that whatever model was proposed would be of benefit to other schools and the County should be supportive. The facilities of the new County Mathematics Centre at Horncastle and access to ESG and Grant Related In-Service Training (GRIST) funds were offered as evidence of this support. The author was appointed one of the Phase 3 Trainers for the Lincoln area and in conjunction with a colleague from an adjacent comprehensive school planned and ran the Phase 3 Training Day for all the mathematics teachers from six local schools. In view of this work, the previous experience with the EMREB and the initial planning the author was appointed as the Phase 4 GCSE Trainer for Lincolnshire. From January 1987 this involved secondment for one day a week for preparation and from September 1987 secondment for one year full time to continue the training role. For the year September 1987 to August 1988 the training role was to advise schools on the introduction of GCSE mathematics with particular reference to coursework and assist in their
2.2 The General Certificate of Secondary Education

From 1988 onwards GCSE assessment is in the hands of six Examining Groups covering England, Wales and Northern Ireland. The GCSE is not designed for any particular proportion of the ability range but for those candidates who are able to achieve the standards laid down for each grade. In the absence of any grade related criteria for mathematics the consensus seems to be that it will cover the amalgam of the old General Certificate of Education (GCE) and the Certificate of Secondary Education (CSE). Each Examining Group is made up of GCE and CSE Boards, each retaining their own identity with responsibility for the range of subjects divided up amongst the different Boards.

For the duration of this work the author has been involved with the MEG in the form of the EMREB and the University of Cambridge Local Examinations Syndicate (UCLES). While this is a new examination with a different syllabus, new criteria and standards of assessment it is necessary to relate the grades to be awarded from 1988 to those previously awarded at GCE and CSE level. MEG regulations state "The results of the GCSE examinations will be reported on a 7-point scale of grades: A, B, C, D, E, F and G. Candidates who fail to reach the minimum standard for G receive no grade. A subject receiving no grade will not be
recorded on the certificate. Grades A, B and C will maintain the standards of the former GCE O level grades A, B and C and the former CSE grade 1. Grades D, E, F and G maintain the standards of the former CSE grades 2, 3, 4 and 5."

The table below shows the intended comparison between the three certificates.

<table>
<thead>
<tr>
<th>Certificate</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCE</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>B</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>E</td>
</tr>
</tbody>
</table>

In an effort to ensure that this is achieved during grading, MEG regulations state "...it is the responsibility of the GCE representatives to satisfy themselves that the standards of grades A, B and C are maintained and the CSE representatives must satisfy themselves that the standards at grades D, E, F and G are maintained."

2.3 The Training Programme for GCSE; "Cascade Model"

Each Examining Group was charged with the responsibility, in cooperation with the Local Education Authorities (LEA's)
for ensuring that all centres received training for the new syllabi and schemes of assessment.

The model for this training was known as the "Cascade Model" and it was intended that as each layer was trained they became the trainers for the next stage in the heirarchy. The timetable for the "Cascade" was developed partly by the Examination Boards and partly by the Local Education Authorities:

Phase 1 .... during 1985 the Examining Groups appointed their own subject specialist to design their own Training Plan.

Phase 2 .... early 1986 these specialists would hold seminars for senior representatives of the subject from schools and the LEA.

Phase 3 .... mid 1986 these representatives would jointly organise further seminars for all the GCSE teachers of that subject.

Phase 4 .... later in 1986 more experienced representatives were appointed as trainers for the county in which they worked. The brief was specifically to deal with the conduct of the Schemes of Assessment for the subject. It is here that attention will be focussed on Mathematics by refering to the organisation of the Training Programme set up for Mathematics within the EMREB area of responsibility. This covered the counties of
Nottinghamshire, Derbyshire, Lincolnshire, Leicestershire, Northamptonshire and Cambridgeshire.

Phase 1 .... A Head of Mathematics was seconded for the year 1985/86 to plan the whole programme. This was a preparation unique to MEG in that the other Boards only provided a maximum of two days preparation for their subject specialists. The specialist worked with the Examinations Committee, the County Advisors/Inspectors and the EMREB Officer in preparing the "Cascade" programme. The main areas of concern were the introduction of the National Criteria, differentiation, coursework and the methods of assessment.

Phase 2 .... From January 1986 a series of seminars were held throughout the six counties. Heads of Departments were advised about the new syllabi and schemes of assessment. These meetings were affected by industrial action and in some places the attendance was down to about 25% of the possible figure. In many places the specialist did not receive a sympathetic hearing as a consequence and a reaction to the unrest in schools.

At the meeting in Lincoln there were 19 Heads of Departments and the reaction was not uncommon according to the Phase 2 trainer. There were reservations about the content of the Higher level syllabus, particularly from
those schools with a sixth form, but no worries about the format of the time-limited written papers. To try to convince this audience that the addition of an obligatory coursework component was an improvement, in the allotted 90 minutes, was a forlorn hope. The examples chosen to illuminate the issues were taken from the Shell Centre Study and generated more dissent than agreement about the value of coursework. It did not help to hear that three schools currently using the coursework option for the EMKPB Limited Grade CSE (syllabus 2) would find their submissions inappropriate to the new Criteria for Assessment for GCSE. There was also widespread disbelief that schools would be responsible for devising the coursework tasks and for the assessment of the completed scripts. At that time it was also, wrongly, assumed that a common assignment could not be set to a complete class of pupils.

Phase 3 .... Following Phase 2 in Lincolnshire, eighteen teachers were invited to attend a meeting at the recently opened Mathematics Centre in Horncastle. Most were not aware of the reason for the meeting until they arrived and were certainly not aware that they were to be the Phase 3 trainers until the meeting had been under way for some time. There was a reluctance to provide a common framework for all to work to, expressed as "I am not going to tell you what to do, you are the classroom experts" by the
convenor. The time was spent highlighting what was thought to be the main issues to address at Phase 3. Two people were allocated to each of nine centres around the county for the Phase 3 programme which was organised for two days during June 1986. On the first day all county secondary mathematics teachers were directed to the nearest centre where the Phase 3 trainers passed on information about the new examination and answered queries where possible. Only a few had previous experience of in-service provision and most felt inadequately prepared. The second day was spent in their own schools looking at the implications for their own department. It was felt by many that the two days had not been adequate preparation for the changes to be planned.

Phase 4 .... It was at this stage that a fourth Phase was envisaged by MEG to sell the GCSE with some very subject-specific training. In mathematics this was to be concerned with the content of the syllabus and the nature of the examination papers. On the recommendations of the Local Education Authorities, EMREB appointed six Phase 4 trainers, one for each county with the author appointed as the Lincolnshire trainer. The incentive was that the trainers were to be paid for the preparation and planning of the Phase 4. The trainers were called to a two day meeting at Loughborough University of Technology (LUT) in
September 1986 to work as a team and prepare a Coordinated Training Programme for the EMREB region. The meeting was highly structured by the EMREB Officer but almost fell apart because

i) the package of materials for the training meetings, promised in the contract, was not available. The six trainers were told it was their job to prepare the package,

ii) there was no access to the Chief Examiner, Coursework Moderator or Consultant for advice. At one stage the trainers were told they had no right to know the names of these people who were MEG appointees,

iii) there was no information on the moderation process as it had not then been published.

It was fortunate that the author had previously been appointed as a servicing trainer (by UCLES) for centres outside the MEG region (mainly private schools) and had received materials and advice at an earlier meeting in London. The guidance received about content, timetable and programme was passed to the EMREB trainers as a starting point. There had been no coordination or cooperation between the two organising bodies and the planning could not be completed in the two days at LUT. The Phase 4 trainers subsequently met at a later date in Leicester together with the Coursework Consultant who provided a great deal of
help. It was agreed to concentrate on the syllabus and assessment methods used in GCSE and leave the detailed study of the vexed question of coursework until a later date. Two of the EMREB trainers were full-time classroom teachers and received no assistance either in time or clerical help with the preparation of their copy of the training package. The rest were Advisory Teachers with back-up facilities available. From September 1986 responsibility for the training passed to the appropriate LEA in the form of an Inspector who was represented at the coordination meeting at LUT. Shortly before the planned training meetings with schools the LEA’s announced that Phase 4 was to be split into Phase 4A and Phase 4B. For Phase 4A a series of one day meetings were held during October 1986 at three centres in Lincolnshire and a representative from each secondary school was invited to attend. Only three schools failed to be represented and those who did attend, showed in a questionnaire, that they were well pleased with the proceedings. The trainers met again during the Easter vacation 1987 to plan the Phase 4B which was to be solely concerned with the coursework component, in particular with the choice of assignments and their assessment. Samples of coursework were collected by the trainers and examined for suitability for use on the Phase 4B training days. Each piece of work was assessed independently by the six trainers according to their
current interpretation of the criteria and without any reference to a level of entry. Discussion on the results revealed a high degree of agreement between five of the six trainers. The sample scripts chosen were at the Intermediate level and produced an agreed mark in the range 5 to 20 out of 20 (using a given Control Element mark). Having agreed on about ten scripts, photocopies were taken and supplemented with other material that fitted in with the sample for use at the training meetings. The report which went back to the EMREB stated that the Board would have to rely on the trainers’ interpretation of the Assessment Criteria being in agreement with that of the Moderator. What was not known at the time was that no Moderators had been appointed nor had any training for Moderators been planned. Phase 4B in Lincolnshire was organised in the same way as Phase 4A during July 1987 with the same high response from schools. The meetings concentrated on each teacher assessing 12 scripts and the results being analysed for severity, lenity, timidity and discrimination. The intention was to highlight

i) suitable/unsuitable scripts,

ii) the Assessment Criteria for syllabus 1651,

iii) a method of moderation.

There was no opportunity for a questionnaire after this Phase but there were a number of comments after each meeting indicating it had been a very profitable day for
those attending.

2.4 Feedback from GCSE Training Sessions

In June/July 1987 each of the six trainers submitted an independent report to the EMREB on the Phase 4 training meetings held in their county. All described common problems and asked for guidance in dealing with specific questions they felt unable to answer at the training meetings. Many of these questions related to the administration of the GCSE examination and answers were given by the Board for later use by the trainers. The reports were circulated amongst the six trainers by the Board and the following were noted across the East Midlands Region.

a) The change to the GCSE syllabus with a revised content and a new system of written papers was accepted by the majority of teachers with reservations about whether the level that would be achieved by the Higher level candidate would be an adequate preparation for the GCE A level candidate. The Board acknowledged it had no control over GCE A level syllabuses and offered the proposed GCSE Extension paper as a bridge although it had not then been approved by the SEC.

(b) Many schools were still unhappy about the imposition of school based assessment and were looking to the Mature GCSE syllabus. The hope was that, because it was aimed at
part-time students taking evening classes or home study, the coursework requirement would be difficult for MEG to implement. The Board pointed out that because of pressure of time it had not yet gained approval for the 1991 syllabus (Mature) but that it would have a coursework element for assessment in accordance with the National Criteria.

(c) School representatives were nervous of embarking on coursework assignments without direct support from the Board about suitability. There was considerable pressure for coursework moderators to be appointed early to schools and to act as advisors but the Board were not able to accede. The Board did, however, imply there was scope for feedback to the centres after decisions had been made on the moderation process so that centres would know whether adjustments had been made because

(i) teachers were out of step with MEG standards,

or (ii) inappropriate work had been set so the Assessment Criteria were not relevant,

or (iii) the Assessment Criteria had been incorrectly applied.

The MEG felt that the services of a Coursework Consultant, whose advice and guidance could be asked for when a centre was planning its coursework programme, would alleviate this concern.
(d) The problems of implementing the Control Element part of the Scheme of Assessment (vide Chapter 6) were acknowledged by the Board who by then had plans to replace this section in the 1991 proposals.

(e) There was a unanimous recommendation that further training meetings be provided for school representatives in order to improve the understanding of the assessment process.

From discussions with the other trainers, and from their reports, it was apparent that they had sufficient experience in their areas on which to build a foundation for GCSE coursework. It was also evident from these sources that a number of centres were preparing for coursework assessment in 1988 although in September 1987 MEG were not able to give a figure for the expected number of centres or the expected number of candidates entering for syllabus 1651. The number of centres in Lincolnshire intending to use syllabus 1651 was known from the Phase 4 training meetings and confirmed as 3 in April 1988. This was a very different picture to other five counties and highlighted the problems Lincolnshire teachers were facing. (A fuller analysis of the entries for 1988 is given in Chapter 8.)

(i) There were only 5 centres from Lincolnshire from a total of more than 100 centres across the EMREB area using a coursework option for CSE entries in 1987. All 5 centres were using the coursework.
option with limited grade candidates; only 1 centre was using the coursework option for the full range of CSE candidates. There were no mode 2 or mode 3 CSE schemes from centres in Lincolnshire. (figures from EMREB)

(ii) Of the 32 centres in Lincolnshire who used the bridging stage of the Joint GCE/CSE examination in 1987 only 1 used the coursework option.

(iii) Very few of the Lincolnshire secondary schools were doing work in the Lower School which could be developed into material suitable for GCSE coursework. All the school representatives at the training meetings saw this as a necessary development but, without experience within their own schools, were looking for positive advice and continuing guidance from an external body.

(iv) In June of 1986, during the Phase 3 Training meetings, there was unanimous agreement from the teachers taking part, that further INSET was necessary on planning, managing and assessing coursework for GCSE. Pupils who could be entered in 1988 would have to embark on coursework from September 1986 and the next Phase 4B of the training would not be completed until summer of 1987. Only one school admitted to contemplating a coursework submission in 1988 at the time of the Phase 3 training. The rest were both pleased that there was a period of grace until 1991 but not pleased that it would become compulsory as they
were unconvinced that the inclusion of a school-based component was the right way forward.

(v) The representatives who attended the marking trials held in Phase 4B, felt that there was a measure of agreement about the standards on the sample provided. This contradicted the analysis, performed on the day, of their grading which showed a wide variation in grades awarded to individual pieces of work. It is the author’s view that, as with the Agreement Trial conducted in February 1988 (vide Chapter 6), each representative believed he/she was right and others were out of step with the standards. There was still much concern expressed, particularly at the Phase 4B meeting, about how the sample related to the different levels of GCSE and the grades that a GCSE Moderator would award. The agreement was based more on the mathematical expertise of those attending who were the more experienced Heads of Departments than on the application of the MEG Scheme of Assessment. All were wanting to see scripts that had been submitted for GCSE and be advised on how the grade had been decided upon for scripts at each level.

(vi) One more area of concern raised at the training meetings was the time factor for GCSE coursework. The syllabus details for 1988 stated "..each of the five assignments should be of such a length as to require about two to three weeks work in total." In the draft proposals for 1991 it states "..each of the four assignments should
be of such a length as to require about twelve hours work."
Many representatives thought this would take too much time out from teaching to the written papers and the production of the scripts would place even more strain on the pupil. When the author raised this point with EMREB he was advised that it had already been considered and there was a MEG research project on "pupil overload". In addition it was claimed that "EMREB and MEG Panels will be taking very seriously their responsibilities not to publish syllabuses which make unreasonable demands". In addition there was universal concern at the amount of time it would take the teacher to assess five pieces of work for each pupil in a class of up to thirty. This was emphasised at each of the Lincolnshire Phase 4B training meetings where there were several reported instances of representatives, or their colleagues, teaching 4 GCSE classes on their current timetable.

The comment recorded at the Lincoln Phase 2 training meeting, "Whoever dreamed this up has forgotten what it is like to teach a class of kids." was echoed in many forms by some representatives at the Phase 4 meetings and by some teachers attending the Self Help Group meetings.

The background to the introduction of GCSE mathematics in Lincolnshire was one of anxiety, resentment and lack of confidence in the ability to make GCSE successful. Many teachers felt under pressure to implement changes they
regarded as being imposed without consultation and with an inadequate time allowance for training. One teacher commented that "If any industrial or commercial organisation expected its employees to implement changes of this magnitude and significance with so little time for training it would go out of business. It's always the same in education, no money, no time and rely on the teacher's social conscience to make it work for the kids sake."

Hilary Radnor [13], in her study of the impact of the introduction of the GCSE at LEA and school level, commented "For the vast majority of teachers, the changes in assessment necessitate change in the curriculum to meet the criteria to be assessed. They also imply changes in the materials teachers use, the organisation of their courses and their teaching strategies. The training programme gave the teachers the idea of what the final product was expected to be but did not address itself to the fundamental problem of what teachers would need to do to make the change; that is, their need to alter their belief systems and their teaching and learning strategies." The fact that Phase 4 went on during the first year of the entry cohort for 1988 meant increased pressure to leave the date of entry for the coursework option until 1991. It also gave time for schools to benefit from the extra ESG and GRIST funding during 1987/8 in the form of a one year secondment for further GCSE Mathematics support.
Chapter 3

The Self Help "Cluster Groups"

Introduction

When the Phased Training programme was developed by the Examining Board and the LEA they decided to organise the meetings for school representatives on a regional basis. The venues chosen were central to the group of schools participating which was then referred to as a "Cluster Group". In Lincolnshire, with 69 county secondary schools and a number of private schools there were three such "Cluster Groups". At each meeting, with one representative per centre, the author, as trainer, found the average attendance of 28 too large. The introduction of smaller "Cluster Groups", each involving the mathematics teachers from a few local schools, was discussed by the author with the LEA representative. It was seen as a means of establishing a new chain of communication between schools and of encouraging cooperation between teachers. With the author acting as coordinator of the new "Cluster Groups" they could be used as a vehicle for continuing In-Service Training and for developing a scheme of Lower School coursework (vide Chapter 4) across the county. The "Clusters" were called Self Help Groups as a means of identifying the approach to the work.
3.1 A Description of Lincolnshire Schools

Lincolnshire is a strange mix of types of secondary schools. The County is essentially an area of selection using 15 Grammar Schools, 33 Secondary Modern Schools and 21 Comprehensive Schools as shown in the table below. Of the nine 11-16 comprehensives, six exist in locations where there are grammar schools operating. Of the eleven 11-18 comprehensives nine are in, or close to, Lincoln itself with no grammar schools nearby.

Types and numbers of secondary school in Lincolnshire 1988.

<table>
<thead>
<tr>
<th>Category</th>
<th>Age range</th>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern</td>
<td>11-16</td>
<td>Mixed</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>3</td>
</tr>
<tr>
<td>Grammar</td>
<td>11-18</td>
<td>Mixed</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Boys</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Girls</td>
<td>4</td>
</tr>
<tr>
<td>Comprehensive</td>
<td>11-16</td>
<td>Mixed</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>11-18</td>
<td>Mixed</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>14-18</td>
<td>Mixed</td>
<td>1</td>
</tr>
</tbody>
</table>

In addition to the 69 county secondary schools there are a small number of private schools, most of whom took part in the Phased Training programme and the Self Help Groups. In some cases these schools were charged a fee by the Lincolnshire Education Committee for the training provided.

3.2 The Problems Facing Lincolnshire Teachers

The training programme up to and including Phase 4A had
shown what GCSE was intended to achieve but had given no
clues as to how the new curriculum was to be put into
practice. Discussion with teachers, advisory teachers and
inspectors who participated in the Phased Training
programme and with the other 5 EMREB trainers highlighted
three problems involved in the introduction of coursework
to the classroom.

i) A more precise definition of the nature of
coursework was needed.

Teachers wanted to be told what would be "A good piece of
coursework." By this they meant "Would it be approved of by
the Board?" "What would it consist of?" "What would the
pupils be expected to do?" "What resources would it
require?" "What would be suitable for Higher level? Foundation
level?". Exemplar material to illustrate what would be suitable was considered essential but it would
have to illustrate the five categories of coursework and
cover the three levels of entry (vide Chapter 6). GCSE
coursework would not become available for scrutiny until
1988 and teachers would have to be content to view material
from the Joint 16+ examinations with no expert comment on
its suitability. Another side to this problem was that
teachers needed to understand their role in the classroom
and in the conduct of the coursework. Common questions at
all training meetings were concerned with the consequences
of the involvement of teachers, parents and friends in the
conduct of the assignments. "Can such intervention be monitored?" "Is it fair to all pupils if some have outside help?"

ii) Teachers need to be prepared for this new role in school as coursework assessors.

The difficulty here was that, in Lincolnshire, only five schools were involved in coursework (for the CSE Limited Grade syllabus 2) and this work had been declared unsuitable for GCSE by the Phase 2 trainer. The Phase 2 trainer was, at the time, a member of the same CSE mode 3 Grading Committee as the author. In his view the majority of the work submitted to the committee would not meet the new Criteria for Assessment for GCSE coursework (MEG). He commented that "Most of the work I see is repetitive, number crunching calculations from worksheets with no original work by the pupils." In the county there was no experience or expertise in this new area of responsibility which could be drafted into the training arena. At the Phase 4A meetings, teachers expressed the view that they ought to understand the Scheme of Assessment in the interests of their pupils but felt resentment at being appointed unpaid examiners for the Board. It was felt that the Scheme of Assessment was flawed in that it would not be a suitable instrument for the assessment of all topics at all levels of entry so its validity and reliability were in question. It was also thought to be unsatisfactory in that
the people who had devised the scheme had not given enough information as to how it was to be interpreted. For example the two main questions which were referred to the Board after training meetings addressed the problems of content ("How much is enough?") and accuracy ("Is a little done perfectly worth more than a lot with some errors?"). The phrase "I am worried about..." opened many a remark by teachers indicating a lack of confidence in this new role as assessor.

iii) How are pupils to be prepared for this form of assessment?

At GCSE pupils will be expected to provide evidence that they have satisfied the Assessment Objectives 3.16 & 3.17 from the National Criteria. The pupils will need to have acquired these skills by the time they enter the fourth year of secondary school as the evidence will be assessed at a standard which makes no allowance for skill improvement during the five terms of the course. This means a piece of work completed by a pupil in the first term of the fourth year will be compared on equal terms with that of the work completed by a more experienced pupil in the second term of the fifth year. As the evidence will be principally in the form of a written script then this is another skill they will have to acquire by the time they start the fourth year. Not only will they have to be able to write an account of the assignment but it will have to
be in a form that can be assessed by the coursework criteria. One teacher expressed this at a subsequent Self Help Group meeting "We used to teach the kids how to jump through the exam-paper hoop, now we have to teach them how to jump through the coursework hoop as well". Trying to identify coursework skills at the training meetings produced as many ideas as there were teachers.

3.3 The Head of Department Conference 1986
In December 1986 a two-day residential conference was organised for all Heads of Mathematics Departments in Lincolnshire secondary schools. Because of the size of the audience the county was divided into two regions for attendance with the programme being identical for both meetings. The author was asked to address the assembly on "GCSE and Coursework". As there was none to work with and it was known that most schools had elected to wait until 1991 the theme had to be work with the then, current, first year (those pupils who had entered secondary school in September 1986).

i) What to do : simple examples of coursework that enabled the pupils to develop skills relevant to GCSE assessment were given as examples.

ii) The classroom : suggestions as to how to introduce the assignment and manage the group while it is under way.
iii) The account: why bother with a formal written account and what form it could take?

iv) Assessment: assessment is important for two reasons; firstly it helps the pupil develop the skill of communication and secondly it helps the teacher understand a different system of marking using specified criteria.

v) Resources: there was a display of books and materials available, together with an extract from one of the BBC Schools Television programmes called Mathematical Investigations.

vi) Practical: several different examples of first year work on Perimeters together with the original worksheet were circulated, a section of which is shown below.

A snake is made by joining triangles together

<table>
<thead>
<tr>
<th>Unisnake</th>
<th>Duosnake</th>
<th>Trisnake</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

What is the perimeter of each snake up to "ten"?
Think of a name for each snake.
Can you predict the perimeter of a snake with 27 triangles?
Are you right?

The audience were given ten minutes to devise a mark scheme they might use. The different mark schemes proposed by members of the audience were considered before turning to the version used at YHS and the discussion was startling
in both the intensity and the variety of views held. Here were about thirty Heads of Departments, nominally the most experienced mathematics teachers in the county, showing what seemed to be twenty different approaches to marking a simple assignment. Nothing achieved consensus and most versions seemed to generate heated argument. Only about six or seven schemes attempted to define positive criteria that could be recognised in a written script. The YHS version came in for much criticism, particularly over the failure to award marks for completing a specific, though trivial, task and for insisting upon the need for ten drawings when five would have sufficed. It was agreed at both meetings that this was an area that should be developed on a county basis with help from the advisory service. The idea of developing Cluster Groups to work on this as an aspect of In-Service Training was suggested, and welcomed, at both meetings although no immediate plans were made by the teachers present.

3.4 A Suggested Plan of Action

In the review of the Head of Department Conference the author took up the proposal of continuing the In-Service Training with the recently appointed Lincolnshire Inspector for mathematics. This Inspector had planned the Conference and was also responsible for administering the Education Support Grant (ESG) money. The central problem
was one of opening up lines of communication with the teachers in the county. By developing a network of small Cluster Groups around the county it was hoped that teachers would feel less isolated. The meetings would be open to all teachers of mathematics not just the Head of Department from a particular school. In the early stages the author would act as advisor and it was hoped that eventually the groups would be self supporting. Such meetings had not been held in the county for many years and the ESG Inspector felt there would be other benefits apart from GCSE training. It was proposed, in answer to the problems identified in 3.2 parts i), ii) and iii):

i) One purpose of the meetings would be to keep teachers aware of developments in GCSE and to help define the nature of coursework more clearly. As a member of the GCSE training team for EMRKB the author was in a position to participate in the selection of illustrative pieces of coursework for training purposes. In the absence of direct guidance from those who designed the MEG scheme we would have to apply our own interpretation of the coursework requirements and become the experts.

ii) By conducting trial marking of selected scripts and analysing the results teachers may be better able to understand and apply the Criteria used in the MEG Scheme of Assessment. Teachers at the Phased Training meetings recognised that, just as there is a skill in marking
written examination papers to a specific scheme, there is a skill in assessing written coursework according to new and untried criteria. It was proposed to improve familiarity with this type of assessment by developing assessment criteria for use with a scheme of Lower School coursework.

iii) By encouraging schools to implement a scheme of coursework in the Lower School, starting with the current first year, the pupils would hopefully begin to acquire these coursework skills. As work had already begun with the first year intake in 1986 at YHS, this would provide a foundation for development over the next three years until that cohort would start their fourth/fifth year GCSE course.

3.5 Establishing the First Self Help Groups

In January 1987 a letter was sent to all the Heads of Mathematics in and around Lincoln inviting them to Yarborough High School to a meeting to discuss the setting up of a Self Help Group. Ten of the twelve schools invited were represented and it was at this meeting, after much discussion it was agreed that

i) in order to keep the numbers attending the meetings down to about 10/12 there would two groups in the Lincoln area, one serving schools to the north of the city and one serving the south,

ii) the meetings were to be open to all teachers who
wished to attend,

iii) attention was to be focussed on the current first year intake as they were to be the 1991 GCSE entry cohort,

iv) a piece of coursework would be tried by all the schools in that group and the results discussed at the subsequent meeting,

v) the intention was to plan a scheme of work for the Lower School (years 1, 2 and 3) which would prepare them for the GCSE coursework scheme,

iv) each piece of work would be assessed, in order that both pupils and staff understood the GCSE Criteria by 1989.

Shortly after the inaugural Lincoln meeting the ESG team set up two other Groups, in Gainsborough and in Bourne, with similar aims and the author was invited along to act as advisor. Other Self Help Groups were started by the author making direct contact with teachers who agreed to act as host schools for a pilot meeting with a view to establishing a Self Help Group in the area. All those contacted were very keen to participate and eventually there were thirteen Self Help Groups around the county. Each group adopted the same aims and policy as the two Lincoln groups which meant the development was uniform across the county. Until July 1987 one of the ESG teachers assisted with the administration of the Self Help Groups as the author was still working full time at YHS and did not have the resources. The other problem to be faced was that
all the meetings were held after school in the local area and this meant the author had to travel distances of up to 50 miles immediately after school finished in order to attend. This continued until the start of the one year secondment in September 1987.

3.6 A Typical Agenda of a Self Help Group

i) A discussion of general points concerning the administration of the previous assignment.

ii) Each school would then give a summary of its experience of trialling the assignment with comments by the individual teachers concerned covering:

- ability level
- method of presentation
- materials used/provided
- amount of help given/needed
- problems and successes
- evaluation of the task
- class reaction

iii) Each school then placed scripts on the table for everyone to examine. This was found to be a very valuable exercise, particularly in the early stages when most teachers seemed convinced that pupils in other schools were achieving better standard of work. They had no evidence for this and was clearly a lack of confidence on their part. It soon became clear there were very few differences even across the Grammar/Modern divide and most of those were associated with the teacher's own attitude to coursework. Teachers became less interested in seeing scripts from
other schools and in some meetings this part was eventually abandoned and more emphasis placed on discussing part (ii) above.

iv) Another piece of coursework in the form of a Briefing Sheet and Assessment Grid was presented for the Group to try before the next meeting. Discussion centred on the anticipated problems and in some cases on what the answer should be.

In all the group meetings the contribution from the author was low key and restricted to maintaining the agenda (when in the chair) and asking questions to promote further discussion. In no meeting was there criticism and all those participating contributed to constructive improvements in the Lower School scheme of coursework. The ideas and comments from each meeting were relayed as relevant to other groups, in particular when there were interesting or novel approaches to an assignment by a pupil.

Several features emerged during the growth of these groups that are relevant to future developments. Initially teachers were very reluctant to be the centre of attention and in particular to have their school's work scrutinised by other teachers. This stemmed from a lack of confidence and a belief that other teachers were "better at it" than they were. There were visible signs of relief when it was realised similarities existed in the work of different schools ("Your kid's work is no different to mine.") As the
confidence that comes from practice increased the discussion intensified, more ideas and opinions were forthcoming and the teachers were less inclined to spend time looking at scripts. In addition more variations on both the Briefing Sheets and Assessment Grids provided were in evidence as schools began to adapt to their own house style. There were several instances of inter-school cooperation taking place over these assignments where schools agreed a common variation, trialled at the same time and marked each others scripts before the next Self Help Group meeting. In the early days of the meetings the author was regarded as the "Expert" and, as arranged, gave positive on-the-spot guidance which was found reassuring. Quite often these were personal interpretations and the judgement had to be relied upon as the Board had no opinion/advice to offer. A detailed record of all the Self Help Group meetings has been kept. This record is available from the author on request and has been used as reference material. With the exception of one particular group (see 3.7) there has been a fairly common programme for all the meetings. With this one exception, most of the Briefing Sheets were trialled by the Groups which started early in 1987. Self Help Groups were started at Alford, Boston, Bourne, Gainsborough, Grantham, Horncastle, Lincoln (North), Lincoln (South), Ruskington, Skegness and Sleaford.
When a Briefing Sheet had been trialled by four Groups it was revised to take account of the comments and suggestions made at the meetings. For all of the first trials the target group was meant to be the 1986/87 intake as these pupils were the GCSE entry cohort for 1991 when coursework becomes an obligatory part of the assessment process. Some teachers who attended the meetings did not teach such a year group so the material was tried out on a different year group in order to gain experience. It was interesting to note that teachers from different Self Help Groups reported that it did not matter which year group it was, the problems were the same - one extra year of classroom mathematics had not changed the starting point for coursework skills. The revised Briefing Sheet was then available for use and further comment by Groups which started later and with the following intake 1987/88. Other activities were tried which were not presented in a Briefing Sheet format and generally failed through lack of interest or willingness to try open activities. Only one School tried to conduct and formally assess assignments of their own design and were notable in their success.

3.7 The Independent Group
This was the only group organised by a Head of Department from a local Secondary Modern School and the role of the author changed to observer rather than a leader. The Head
of Department, recently appointed, had a lot of experience of integrating coursework into the whole mathematics curriculum. The acting Head of Department had been using the Limited Grade CSE with coursework option and was preparing some pupils for the GCSE coursework option in 1988. The departmental strategy was to adopt a curriculum which was based totally on coursework activity without a supporting text/scheme.

All the members of the department were active in the preparation of materials and development of ideas for this approach. The Self Help Group operated as an extension of the departmental In-Service Training programme. The department meet every two weeks to try out mathematical ideas and in early 1987 the meetings were opened up to other schools in the area. After the first two meetings the numbers of visiting teachers fell drastically and only recovered for a short while following a direct approach by the author to three of the other local schools. Teachers from the local Grammar Schools did not like this approach and found the meetings "Somewhat intimidating". At each meeting a new idea was proposed and the object of the meeting was to get the teachers to try for themselves the mathematics involved.

For example:

1. Using a 10 by 10 number square think up mathematical questions or investigations.
The eight teachers who tried this found 18 different approaches and spent two hours discussing them.

2. Here is the answer to a question. What was the question?

[The author found this approach a refreshing change and attempted to introduce the idea to one or two of the other groups with no success.]

On every occasion the participants became very involved in the mathematics and the intention was that each teacher would go back to their own school and try the idea in their own classroom. The reporting back did not happen and it is not clear what follow up there was in other schools. The reluctance to get involved was illustrated on one occasion when some teachers, not possessing peg-boards in their own school, could not follow up as anticipated. When spares from the host school were offered on free loan they were

page - 55
declined! It seemed as though the visitors were there to see what happened but were not convinced that this open-ended approach was the direction they wanted to take in their own school. Certainly the teachers from the grammar schools reported they were not keen on spending their time after school working in the way described. It was, however, an activity the teachers at the host school enjoyed; "Doing rather than watching" was how it was described on one occasion.
Chapter 4

The Lower School Assignments

Introduction

There are two aspects to this curriculum development. One is the design of a Lower School scheme of coursework which will provide a pupil with the opportunity to develop sufficient expertise in preparation for the GCSE coursework in years four and five. The second is a consideration of the assessment process by both pupil and teacher so that the pupil might demonstrate the objectives laid down in GCSE and the teacher may fulfil his/her responsibility for internal moderation. These two aspects are dealt with in the chapter as separate issues although in practice this is difficult to achieve.

4.1 Why Choose Investigations?

It was agreed in the early days of the Self Help Groups that investigations were to be used as a vehicle for introducing coursework to the Lower School. Several factors were involved in the decision:

1) Detailed worksheets containing lists of instructions or calculations were not suitable. This was subsequently taken up as a major issue both in the Phased Training programme and by the GCSE Coursework Moderators in all their reports. Schools which adopted such a directed approach for the 1988 entry found that their pupils were
penalised in two of the criteria – Design/Strategy and Clarity/Presentation (vide Chapter 6).

ii) Funding for GCSE Mathematics varied considerably from school to school but in most places was directed at replacing or supporting the text scheme currently being used. By the time schools became involved in the Self Help Groups programme the funds had been committed to other items leaving little or no money for further apparatus or materials. Whatever scheme was devised had to be inexpensive.

iii) A balance of time had to be found for this work which neither trivialised it nor made it unwieldy. Initially it was suggested that one week of mathematics lessons would satisfy this criteria and that about four assessed pieces of work per year would be a good starting point.

iv) There had to be a visible association between the skills being developed for coursework and those used for the examinations. Examples which came to mind were collecting and tabulating data, graphical work, formulae.

v) Any assignment would have to be suitable for the complete ability range. This was to be the most difficult problem until it was found possible to devise a basic Investigation that would tax the less able and yet be capable of extension by the top sets. This sat nicely with
the Cockcroft principle of "...differentiation should be by extension".

vi) Problem Solving would require different tasks for different ability levels involving differentiation by task rather than by extension. There was also the view that the process of solving would be ignored by the majority of pupils who would rely on the skills and abilities of more able pupils sharing their discoveries. This was reinforced at the Phase 2 Training meeting in Lincoln where some teachers analysed a problem using algebraic techniques and others gave up interest in the process once the solution was available.

vii) The assignment would have to be seen as a credible piece of mathematics by the pupils, the parents and the teachers. In considering Games most teachers appreciated that the finer points of strategy require planning and decision making. They expressed doubts that these would be appreciated by others who might view Games as "play mathematics". During the Phase 3 Training meeting in Lincoln a simple game of strategy involving two competitors was available for teachers to consider. The author was watching when, from a group of three teachers working at the game, one decided on a strategy for winning every time and explained it to the other two teachers. All three teachers immediately lost interest and moved on to something else. In discussing the activities later in the
Phase 3 meeting the credibility of the game (and games in general) was criticised as a vehicle for teaching planning and decision making. "Well I've solved it, now what do we do?" "What do the kids do with it?" "What has it got to do with maths?" "Once someone has shown them how to win there is nothing more to do." "What do you do if a kid has seen it before and knows the answer?"

viii) It was important that the assignment should be capable of being the subject of a written account which could demonstrate that the process was as important as any conclusions. Developing the skill of communication necessitated having suitable material with which to practise. Games and Problem Solving did not appear to offer the same opportunities as investigations.

4.2 The First Trials at Yarborough High School

During 1986/87 the author's second year set had been doing some elementary algebra about the time of the first trial of the assignment now called Perimeters. The assignment offered openings for algebra which were relevant to the pupils' experience. It was also possible to extend the idea to other shapes so the whole class, with its spread of ability, should be occupied for however long it took for the weakest to complete the first stages. The assignment (vide Chapter 3 section 3) was introduced using chalk/talk. The pupils were told that an account of what they did,
together with any results, would be needed. The time allowed was one week of lessons and one homework. Several points emerged from this trial that were relevant to the development of the briefing sheets for this and other investigations.

i) The same questions, from the pupils, kept recurring because they had not been given enough information or clear enough instructions on the blackboard.

ii) It was found necessary to keep drawing the pupils' attention to mathematics they already knew and were not applying; such as the need to label drawings and present numerical information in tabular form. This was one problem previously experienced by the author in that pupils are reluctant to use a known body of knowledge or skills in new situations.

iii) At the end of the first lesson most pupils were able to express and use a simple rule based on triangles and they were starting on square patterns. At the end of the second lesson all had finished the triangle patterns and some were working on pentagons. The last thirty minutes and the homework were directed at writing up the script from the rough notes they had made.

iv) The scripts were uninformative which, on reflection, was a consequence of the author not providing enough guidance. It was disappointing that no pupil offered an algebraic relationship and very few could give a general
and articulate explanation; although all could calculate correctly. The post-mortem was conducted in great spirit by the pupils and ended with a sample script being dictated by the author for future reference. The enthusiasm and interest shown by the pupils was tremendously encouraging. It was decided at a departmental meeting to adopt a worksheet format which would give the basic information about the task and also some guidelines on its completion. It would also ensure that all members of the department would present the task in the same way. It was further decided that the author, as Head of Department, would trial each assignment prior to its use by others in the department. During the year 1986-87 five assignments were trialled with the first year classes at YHS. Four were considered successful by the department and one was discarded as inappropriate. In order that all the teachers in the department experienced this new coursework activity some of the assignments were trialled with second year classes. Before each trial the department would meet to discuss the worksheet prepared by the author. After each trial the department would meet again to compare notes and review scripts from all the classes. There was some concern expressed that scripts from the author’s class were, almost invariably, more comprehensive than others. The problem centred upon the nature of the conversation with the pupil. In order to give other teachers an insight into the manner
of providing guidance to pupils in the classroom, three lessons were videoed (vide Chapter 7).

4.3 Developing the Format of the Briefing Sheets

The original versions of the worksheets were written in a format that was associated with the author’s own style of teaching and language. This was evident at the Head of Department Conference at Horncastle (vide Chapter 3 section 3) where the style of the worksheet for Perimeters brought instant criticism e.g.:

Calling the polygon strings snakes.
Asking for personal names for each string.
Asking questions that apparently only needed a yes/no response. (In the classroom the pupils knew what was expected of them.)

As the worksheets were trialled in other schools the criticisms were raised again and it was apparent that what was suitable for use in one school did not suit the style of teachers in other schools. To obviate this the sheets were written in a style that can only be described as bland and impersonal but which provoked less controversy and was apparently more acceptable to a general audience. The next problem encountered as the worksheets met a wider audience was the suggested methodology. Not all teachers agreed with the proposed method of investigation. Some thought too much assistance was given in the worksheet, some thought too little. Where this was the case the school actually rewrote the original version in a form that was very often highly
structured. This was encouraging as they were beginning to develop their own ideas on coursework and show more confidence about work that had originally been a source of anxiety. The more formal approach to the investigation as a process developed slowly. In the early work the pupils were expected to do too much data collection before arriving at a rule. The Self Help Group meetings helped to clarify this point and it was agreed that, for Lower School pupils, it was sufficient to look for five or six examples before considering a rule. The rule was then to be tested outside the range of the examples (but not so far away as to be a tedious unnecessary exercise) to see if it worked. If it still worked then it was reasonable for these pupils to assume that it was a valid rule for all cases. A more consistent style of presentation developed which was acceptable to the vast majority of participating schools and was free of methodology. The format was a duplicated sheet called a Briefing Sheet which could be used by the Teacher as a basis for a chalk/talk introduction or photocopied and issued to the class for their use. The structure of the Briefing Sheet adopted a common approach regardless of the topic under investigation.

stage 1  A statement of the situation in the form of drawings and words.

stage 2  The pupil is asked to find a rule expressed in words. The author’s reason
behind the insistence on a word version was that all could benefit from this form of articulation and the more able could extend to the algebraic form. This was also a reference to the GCSE Aim 2 .."to read and write about mathematics in a variety of ways."

stage 3

The rule was to be tested on data outside the range of data already collected. The test was usually expressed in the terms "by calculation and by drawing". This order was considered important as there were numerous examples reported of pupils drawing first and the calculation then giving the same answer regardless of accuracy.

stage 4

The rule was then to be applied to a situation well away from stages 2 and 3. Ideally it would be far enough away to discourage the answer being found by drawing. This did not work every time as, despite contrary instructions on this point to the pupils, parents at one school complained at the length of time it took their child to draw ALL 630 lines on a 36 pointed Magic Rose!

In addition to these four stages on the basic assignment
there were added notes for the teacher on the conduct of the assignment together with suggestions on how to extend it for the more able pupil. In the event of it being given as a worksheet to the pupils the methodology could be discussed by the teacher with the class before they start. Some schools are still rewriting these Briefing Sheets in their own house style.

4.4 The Investigation Algorithm
During the Phase 2 training meeting in Lincoln a sheet from the Shell Pack [14] was made available to the group for discussion. Because it gave valuable guidance on how to proceed with an investigation it was later adopted, in a simpler form, by the author as an algorithm (vide Appendix I) for inclusion with the Briefing Sheets. It was reported at several Self Help Group meetings that, after a class had attempted two or three investigations, the pupils were able to appreciate the strategy demonstrated in the algorithm and use that strategy when dealing with new a new investigation. The author has also recorded instances of pupils deliberately resorting to the algorithm when faced with a new investigation. The algorithm is given below with observations of its use in classrooms with the investigation Perimeters.

Try some simple cases: Pupils knew the best way is to start with the simplest case viz -
1 triangle.

Be systematic: Pupils understood the process of an ordered progression through 1, 2, 3 triangles etc. Early assignments had only two variables but when there were three the pupils could still demonstrate this systematic approach.

Representation: Pupils knew that drawings and diagrams had to be labelled with information.

Make a table: Pupils had few problems with this after the third assignment. Tabulation techniques were extended to include difference tables which proved a popular innovation with both teachers and pupils.

Spot a pattern: It is still difficult for pupils to appreciate the difference between a pattern (which is taken to be a relationship between, usually adjacent, terms in the same sequence) and a rule (which is taken to be a mapping between two sequences).

Find a rule: This is always asked for in words
and the extension is to the algebraic form for the more able pupil.

Check your rule: Pupils understood this to be just a check on the reliability of their rule.

Some other schools have adopted the same policy of issuing the Algorithm Sheets to be retained by the pupil in their folder of coursework.

4.5 Why Assess Lower School Assignments?

When discussing the assessment of coursework at the Head of Department Conference it was acknowledged there was an almost total lack of expertise amongst the teaching population in Lincolnshire in using the GCSE (MEG) scheme of assessment for coursework. Some form of In-Service Training was considered essential if the scheme was to be applied with any success. It would not be sensible to practice with GCSE candidates and their submissions. Little damage would be done if the training were based on Lower School work where the use of criteria for assessment of coursework could be developed over a period of three years. When the trials for a scheme of Lower School coursework began at YHS in 1986 there were two main reasons for the author’s decision to formally assess each assignment.

1. To help in the evaluation of the assignment as
a vehicle for acquiring coursework skills.

2. To use the assessment process as an In-Service Training exercise for the department.

Since then other reasons have been advanced by teachers at the Self Help Group meetings to reinforce the need for assessment.

3. Teachers have reported that pupils complain when pieces of written work are returned unmarked. It seems that some form of assessment is expected by the pupils.

4. A completed Assessment Record Form attached to the script is a reminder to the pupils of what is considered to be good practice. Teachers have reported that pupils do refer to this when writing up a new investigation.

5. A complete set of Assessment Record Forms will chart the acquisition of coursework skills. This way it is possible to monitor a movement from a very simple set of criteria towards those used for GCSE coursework.

In 1986, when the first assignment was trialled with a second year class at YHS, it was the author’s intention to use the Assessment Criteria for GCSE coursework since they were specified in such detail. When the completed scripts were handed in it was quickly realised these criteria were unworkable in these circumstances because

1. pupils had not been prepared to write scripts which might be assessed by this scheme,

2. the ideas of Design and Strategy (vide Chapter 6)
were inappropriate to early assignments as the author specified the method to be used. The author spent some time trying to modify the GCSE criteria without success and eventually these scripts were returned to the pupils with a subjective mark out of ten in each case. [At the first Self Help Group meeting at Bourne it was discovered that the teachers there had experienced exactly the same problem in trying to apply the GCSE criteria.] As the author conducted the post mortem with the second year class it became apparent that the "ideal" script was being described as a record of recognisable, positive achievements. For the next trial with the same class, as it was with a similar assignment, a marking outline was written on the blackboard to act as a reference for the pupils. The resulting scripts were far superior to those from the first trial. A colleague was able to identify the differences as
i) the second scripts were more comprehensive, containing more information than the first set,
ii) the presentation was much improved both in the lay-out and the general appearance,
iii) the rule was expressed with a much improved use of language.
A standard marking form, subsequently called the Assessment Record Form, was produced by the author to be completed and attached to the script. It was found
quite easy after the second assignment to mark each script using this format. The pupils were also impressed and spent some time comparing notes on the marks awarded in the different sections. This mark scheme was later used by the other teachers in the department when they tried the assignment for the first time. Subsequently, with the first trial of a new assignment at YHS, the mark scheme was devised by the author after inspecting what the pupils had written and was an attempt to balance this with what had been asked for. This mark scheme was then used on the first set of scripts before being used by the rest of the department. For the first few assignments there was an extra factor in the YHS mark scheme. Teachers were asked to give an impression grade, A to E, on first picking up the script. It was very satisfying for the author to discover that there were sufficient numbers of scripts in which the impression grade did not match the final mark for teachers in the department to agree that objective marking was necessary even though it took longer to implement. The problem of how to compare scripts from different ability levels was a difficult one to solve. There was no wish by the teachers in the department to design a different mark scheme for different levels of ability. Nor was there any wish to use the same mark scheme to cover the very wide range of work done. It was decided that a single mark
scheme for the basic investigation would be used as a basis for comparison. If a pupil extended the work beyond the basic investigation then a Bonus Grade was to be awarded on a scale of A, B or C only. In the interest of simplicity it had to be a mark scheme that could be picked up and assimilated after marking a few scripts and had relatively few decisions for the teacher to make. As far as possible this meant marking out of 20 for consistency and comparability with a maximum individual mark of two or three to achieve reliability. By pruning the criteria to a minimum this meant the time taken by the teacher to mark a set of scripts was also a minimum.

The experiences of the teachers at YHS, described above, were relayed to teachers attending the Self Help Group meetings. The assignments and mark schemes devised at YHS were offered for further trials and were accepted by all the Groups as a starting point. Gradually, as the teachers taking part in the Group trials became more experienced, there was much reinforcement of the original thinking behind the mark schemes.

Motivation of the less able pupil was one problem raised by teachers at the early Group meetings. To increase this motivation the mark schemes were developed so that those pupils who responded to advice in the classroom would achieve half marks. It was felt this would improve motivation in that pupils who normally regarded
themselves as being weak were getting a score above their expectations and not too far away from those they regarded as clever. There are many instances of teachers reporting at the Self Help Group meetings that this tactic had been successful in raising the level of enthusiasm for investigative mathematics with the less able. The Bonus Grade was only used by the more able to discriminate between themselves. This was confirmed by many teachers listening to conversations between pupils on receiving their marks. The disadvantage was that the value of the score as a discriminator was reduced considerably. As time went on many teachers began to comment at the Self Help Group meetings that they regarded the marking scheme as a tool for teaching good coursework skills rather than a ranking device. The author came to the same conclusion.

4.6 Developing the Format of the Mark Schemes

With few exceptions schools accepted and agreed with the development of the mark schemes as outlined in 4.5. With each of the Briefing Sheets an Assessment Record Form was provided. This could be photocopied and attached to the script. During the discussions on the implementation of the marking schemes at the Self Help Group meetings there were still questions asked about each section as teachers were not clear about what was expected in each section. For example "What is worth 2 marks in the section labelled
table of results?" It seemed necessary for the author to provide detail in the form of a breakdown of some of the sections as well as some of the answers to the relationships. This caused another problem in that some teachers took the breakdown literally and tried to mark according to the detail and found themselves taking far too long. It was stressed at all the Group meetings that the mark scheme offered was only a model which schools could adopt if they so wished; its advantage was that it had been tried and found reasonable. It was also made clear at the Group meetings that if schools did not agree with the content or structure of the YHS scheme then they were at liberty to design their own but they were asked to make it available for discussion at the Self Help Group meeting. Some schools did revise or modify the YHS scheme either because they wanted one which took less time to use or because they felt more detail should be provided for the pupils' benefit. It was interesting to note that in all cases the differences were confined to the number of sections in the scheme. Only one school marked out of of a total of ten. "I mark everything out of 10" was the response to the obvious question although the teacher in question agreed that marking out of 20 gave more opportunity for discrimination.

The mark scheme was used in different ways by different schools. Some decided to issue the Assessment Record Form
to the pupils along with the Briefing Sheet on the grounds that this way the pupils would know exactly what was expected of them by way of the written account. At the other end of the spectrum some pupils knew nothing of the scheme of assessment until they received their marked script. All teachers at the Group meetings were convinced of the benefit of discussing the assignment and the scripts with the class after the marking had taken place. A few teachers took the trouble to talk to individual pupils about their work as opposed to a general class discussion.

4.7 Publication of the Final Set of Assignments
During the period of this study a series of eight investigations were trialled and produced in a final form considered suitable for general issue to the schools taking part. The Briefing Sheets, Notes and the Assessment Record Form were prepared by the Micro Electronic Development Unit (MkDU) in Lincoln and the set is included as Appendix 1. Each of the schools which took part in the Self Help Groups was sent a set and permission was given to photocopy as required by the school. The eight investigations are intended for use with the years one and two. More time is needed to develop the material suitable for year three but the eight were offered as a starting point for schools in the preparation for GCSE coursework in 1991.
Chapter 5
Case Studies of Eight Schools

Introduction
During the one year secondment the author was invited into fifteen of the County secondary schools to attend class and talk in detail with members of the department. What follows is a summary of the visits to eight of these schools which provide a variety of approaches and attitudes to the introduction of GCSE coursework. This sample includes three Grammar Schools, three Secondary Modern Schools and two Comprehensive (11-18) Schools. Six of the schools are mixed entry, one is a boys Grammar and the last a girls Secondary Modern. The names have been changed. A more comprehensive report on all the school visits made during the years secondment is to be found in Appendix 2.

5.1 Seatown Grammar School
This is an old established mixed Grammar School of about 400 students with a mathematics department of four experienced graduate teachers operating in a newly built suite of designated mathematics classrooms. The initiative for the visits came from the Headmaster who also rearranged the timetable on the first occasion so the author was able to spend two hours in discussion with the whole department. The discussion revealed attitudes and prejudices which the author found were shared by many other grammar school...
teachers involved in this study.

The discussion started with the fact that, despite the school being represented at the Phase 2, 3, 4A and 4B training meetings, the whole department admitted to being very unsure how to select, administer, support and assess coursework activity. Following the Head of Department Conference the department had attempted two investigations, Perimeters and Regions, with first year classes. Both attempts at introducing coursework activities had been failures in their view. When pressed on this issue, it transpired that

i) with Perimeters no help or guidance had been given to the pupils which effectively made the assignment a test,

ii) Regions (a complex investigation more suited to Higher level GCSE pupils) had proved too difficult for both pupils and the teacher who made the decision to abandon the assignment after two lessons.

The teachers were initially against giving any advice to the pupils as they felt this was "...telling the pupils what to do". The word "cheating" was mentioned by two of the department in this context. They also felt quite strongly that Perimeters was far too easy and this was why Regions had been used (without being tried by the teacher first).

"These are grammar school children so we don't want anything too easy for them." The whole department then declared their opposition to the imposition of coursework
assessment for GCSE but accepted that they had to come to terms with the development. “Although we won’t be around for much longer” (impending retirement of one teacher). The teachers were anxious to see how coursework activity could be managed in the classroom. It had been arranged for the author to take two classes on investigation the following day and the rest of the discussion was concerned with the two lesson plans. A long time was spent explaining the author’s approach (to conversation with the pupils) with reference to the relevant Aims and Objectives from the National Criteria. Several situations, anticipated in the classroom the following day, were outlined along with proposed responses.

The first class was a group of 24 first year pupils who had done no investigational work before. After being introduced by the Head of Department the author introduced the investigation Perimeters to the class. The lesson lasted for one hour and all the pupils completed the basis investigation and were writing up their account when the lesson ended.

The second class was a group of 23 second year pupils who had done Perimeters and Regions in their first year. They remembered very little of the assignments but were quicker to respond to the introduction of the algorithm by the author. The investigation Squares (vide Appendix 1) was completed, without any extension work, by the majority of
the class in the one hour lesson.
In both lessons the four teachers were in the background during the introductory discussion and explanation with the pupils. The teachers circulated as the pupils got on with the assignment and they were able to sit in on conversations between the author and individual pupils. The pupils themselves were very capable mathematically and able to appreciate and use the relationship quickly. The pupils seemed a little bemused by the presence of five teachers in the classroom and somewhat amused when surrounded by the author and two or three teachers for a conversation but it did not prevent them from achieving a great deal. Although the pupils were articulate they found it difficult to express their ideas in a suitable word form without help. In discussion after the two lessons this difficulty was a surprise to the department but not to the author. The main method of teaching employed by the department appears to have been based on a good relationship with the pupils but using chalk/talk rather than any form of extended dialogue between the teacher and pupil. It was difficult for the teachers to distinguish between telling the pupils what to do and guiding them through a conversation. The pupils believed that everything was either right or wrong and that being wrong meant failure. The scripts seen in the two lessons contained no descriptive work, consisting of a set of drawings, a rule, and a formula with some answers to
calculations.
On visiting the school again the following term the scripts from Perimeters and Squares had not been marked and there had been no attempt to pursue the extensions in either case. On this occasion the author observed lessons taken by two teachers on Chessboard (vide Appendix 1) and Squares. The idea of rearranging the tables to get the pupils working in small groups was tried and found to be successful but they were replaced at the end in formal positions "...for an ordinary lesson". The pupils were enthusiastic and enjoyed the assignments, completing the basic work in the one hour lesson. Nevertheless the assignment was given no more time in order to extend the problem and allow the pupils to stretch their imagination. Coursework had to be accepted as the future form of assessment but only lip-service was being paid to the Aims of GCSE and this form of assessment. The teachers at this school stated they would be happier if coursework was an option which they would then decline to use.

5.2 Greenway Grammar School
This is a very small mixed Grammar School under threat of closure during 1987/88 with one full time mathematics teacher and two others (Head and Deputy) teaching some classes. The invitation was from the head of department and the author was asked to demonstrate "...this coursework
thing as I don't know what to do." during "...the last week of term as nothing much happens." The building was very old and the facilities were poor by comparison with other schools. The room was small with little storage space and individual tables which the author arranged into groups before the class arrived. The room was crowded as it had been decided to take all 25 of the first and second year pupils together for a whole afternoon. The class and the teacher had been re-timetabled especially for the visit. The author did not have too much time to brief the head of department about the assignment, Perimeters, or the conduct of the session. The pupils were quick, talkative and competitive and achieved a great deal during the two hour session. The pupils coped with the work very well considering they had not done anything like it before. In the full afternoon available they wrote up reasonable accounts but with considerable assistance. During the session with the pupils and the discussion afterwards it was apparent that the teacher had not appreciated the idea of strategy in dealing with investigations. In the discussion after the session the head of mathematics expressed some surprise that the scripts were to be assessed and was not familiar with the idea of marking to specific criteris. The author spent some time discussing this and the Assessment Record Form. The head of department did use the mark scheme at a later date and reported
surprise at finding that not all the pupils received full marks.

On a subsequent visit to observe the same group the following term the head of mathematics took charge but was very directive with no class discussion taking place. There was evidence to suggest that the scheme of assessment for GCSE coursework was not understood at that stage. It was evident that some of the pupils had learned a lot and remembered much of the techniques from the first assignment. These pupils were able to demonstrate to the author that they had applied some form of planning or strategy at the start of the assignment. The view was expressed by the teacher that it would be much better if the coursework was an option as "..I will never get through the exam work in time." There was certainly a suggestion that this teacher would like to be "..out of it before we have to do coursework." The head of department had participated in the Phased Training meetings but had not furthered or promoted the "Cascade" process in school.

5.3 Fielding Grammar School

The author had known the head of mathematics for some time prior to this secondment and the opposition to GCSE coursework was no surprise. This is a very old and very traditional boys Grammar School with a selected student population of around 450. All three teachers in the
and the mathematics department are graduate mathematicians and the
department has achieved high standards in external
examinations over many years. At the Self Help Group
meetings the department had forcibly expressed the view
that coursework was not for them or their pupils as "...it
got in the way of the examinations, particularly O level."
The school experience from the Joint GCE/CSE examination in
1986 and 1987 led them to believe that the standards of the
external examination were lower than GCE and this was not
welcomed. The department had participated in the trials of
the Lower School scheme through the local Self Help Group
but it was evident from the meetings that the assignments
were afforded little time or energy in class, generally a
one hour lesson and a homework for completion with no
extensions taking place. The author was invited into the
school to watch a first and then a second year class
doing an investigation. The classrooms were new and
designated for mathematics with small numbers in each group
(about 20). Strict discipline was expected and followed
with no talking allowed in the classroom except when
questions were asked by the teacher. Total attention on
what the teacher was saying was expected.
The introduction to the investigation was conducted in
exactly the same way as the teacher conducted the rest of
the mathematics lessons. There was a short exposition,
followed by the Briefing Sheet instructions being written
on the blackboard by the teacher to be copied, in silence, by the pupils into their exercise books for reference. Further detailed notes on exactly what to do were written onto an adjacent board, again to be copied by the pupils. When they did actually get on with the investigation the pupils were able to cope with the mathematics very well. What they did find difficult was expressing their ideas either in conversation or in writing. The style of very firm classroom management and exposition by the teacher is the policy of a department which judges its success by external examination results. Whether this style will produce the same results when coursework is submitted is a matter for conjecture. Coursework has not found favour with these teachers who would prefer it to be an option they can decline for their pupils. The time that has to be devoted to each GCSE assignment has been questioned by the staff at this school as well as the number of assignments for submission, all of which "..take away time from the teaching the examination work." The teachers have also questioned "..the value of the mathematics" seen in the GCSE samples offered for their inspection, "..nothing of any substance " being the comment. One of the teachers, when being advised that MEG were contemplating 3 assignments for submission said "Oh, in 1986 they wanted 5, in 1987 they said it would be 4, in 1988 they are talking about 3 so ..1989 ..2, 1989 ..1. At this rate it will suit
us."

The author found one teacher at this school a little more enthusiastic about coursework than the others and it was at this teacher's request the author made another visit to try an assignment with a third year group. A report of this is to be found in Chapter 7 section 3.

5.4 Meadow Lane School

This is a small rural Secondary Modern School of about 275 students each receiving about 2 hours 20 minutes of mathematics per week. The department consists of two full time teachers and two others teaching some mathematics (one of them the French Assistant). The department had tried some investigations through participation in the Self Help Group scheme before the visits took place but only with the two full time teachers of mathematics. The visits were requested partly arising from a feeling of geographic isolation and partly because the two teachers felt they wanted support and confirmation that what they had been doing was along the right lines. There were two designated mathematics classrooms with tables which could be arranged in small groups. One introduction given by the Head of Department used the OHP to great effect. This focussed the attention of the pupils on the main issue very quickly. The pupils needed little introduction other than five minutes class discussion before getting on with the investigation
in a very organised way. During all the sessions the pupils were very communicative and remarkably articulate. Their teachers were convinced this was a consequence of previous coursework sessions when they had deliberately set out to develop this aspect. Any inhibitions the pupils may have had with visitors did not last for long and it was interesting to listen and help while they used a limited vocabulary very effectively to explain their mathematical ideas. A suggestion to rearrange the tables so that the pupils could work in groups was taken up by one teacher who felt it meant that any conversation/explanation could be with four/six pupils instead of two and could thus save some time and prevent mistakes accumulating in pupils' work.

The department has adopted a scheme of Lower School coursework in order to prepare the pupils for the more detailed work of GCSE coursework and the two teachers were convinced they had seen a change in the attitude and approach of their pupils. "They are more prepared to try and to talk and they will now try to explain what they are doing." Certainly the teachers in this department have adopted the practice and spirit of GCSE and have a deal of confidence in coursework.

5.5 Montford Girls School

This is a Girls Secondary Modern School of about 450 pupils
with a three form entry and three full time mathematics teachers (all Cert. Ed. qualified) and a fourth (Cert. Ed.) who teaches some mathematics classes. The visits were arranged as a natural follow from contact between the author and the head of department during the Phased Training meetings. On the first visit the head of department was observed using Perimeters while the rest of the department did the same investigation with their classes. A meeting with the rest of the department at the end of the session highlighted a deal of anxiety about the outcome in terms of the written work the pupils had done. It was regarded by the teachers as being of very poor quality and they did not know how it could be improved. The teachers had also thought that it was to be a single lesson and felt their pupils had not accomplished very much in the one hour lesson. It transpired that a lot of this could have been avoided if there had been a departmental discussion and briefing over the introduction, the management and the time available for the assignment. The teachers all reported that the pupils claimed to have enjoyed themselves and had, with a struggle, managed to find a mathematical relationship. This was their first assignment, apart from one lesson the previous year, and their ability to discuss and explain was very limited. A big problem for all the department was that the rooms were furnished with old boxed sloping-lid desks arranged in rows
which prevented group working and made access to some pupils very difficult. The teachers were keen to try the assignments with the pupils but were unsure about the amount of direction to give. "When do you stop talking and tell them what to do?" Also there was a question over what the teacher can expect by way of an account/script from pupils such as theirs which they regarded as of limited ability. The local Self Help Group did not start up until later in the year and this gave them some evidence when they were able to scrutinise work from other schools.

On later visits the improvement in the attitude of the pupils to the work and the quality of both the written work and the verbal exchanges was noticeable to the author and commented upon by the teachers. Certainly the commitment to coursework was present but a lack of confidence in how to organise the approach to GCSE coursework was evident.

5.6 The Guild School
For most of the contact with this school it was going through the trauma of developing as a merger of two small Secondary Modern Schools and using old premises while a new purpose built complex was being constructed. Despite this their resources were the most impressive seen in a county mathematics department. The departmental policy was that the curriculum should be based upon learning through coursework activities. Text books were limited to single
reference copies in a departmental library. Staff prepared worksheets and activity materials using the departmental photocopier, colour printer, book binder, stencils and other graphic materials in collections relating to themes such as Patterns, Games, Movements, Problems and Investigations as opposed to the normal expression of a curriculum in terms of content (as per list 1 and 2 of the National Criteria for GCSE Mathematics). The head of department is very critical of the way in which mathematics is taught in other schools and of the MEG GCSE scheme and is looking to move towards using the GCSE proposals put forward by the Association of Teachers of Mathematics (ATM) [15] which involve continuous assessment of coursework activities. Departmental meetings are held every two weeks when the staff try out mathematical ideas for themselves before engaging with the pupils. The local Self Help Group based on this format was very poorly attended except for the six teachers from the host school and one other teacher. Others who attended regarded the meetings as intimidating and not the best use of their time. Perhaps it was a little beneath their dignity to sit and do mathematics in a class atmosphere. In the classroom the pupils treated any visitors with a degree of informality which could be disconcerting. The pupils who had been engaged in coursework for the previous two years were confident in what they were doing and were well able to
account for what they were doing. It was also interesting that they were able to demonstrate the ability to plan ahead when dealing with an assignment. One class in particular had cooperated in a massive statistical investigation involving the neighbourhood and the need for some form of pedestrian crossing over the adjacent main road. The school had entered about 20 candidates for the GCSE coursework option in 1988 and were preparing to enter a greater number in 1989 but was not yet geared up to the whole cohort taking coursework. As they recognised the departmental approach was a new one they had arranged for special events designed to explain to parents exactly what the department was hoping to achieve and how it related to GCSE work. The meetings were well attended and the parents were impressed with the level of the work on display despite it not fitting in with their concept of what should be taught in a mathematics lesson. This was seen as a valuable public relations exercise and could be one idea adopted by other schools. The pupils were very communicative with visitors and although not being highly articulate they were well able to discuss what they were doing and their ideas. The need to present a written script was not emphasised until the pupils reached the fourth and fifth year (when the style was distinctly chatty) as this was not regarded as important by the department. Nor was there any emphasis on assessing the work done by the pupils
in any comparative sense for exactly the same reason. The Lower School scheme being trialled by the other County schools was regarded as being far too formal and restrictive. Because the idea of 100% coursework is so radical it is regarded as eccentric by most of the established heads of department who hear of it. The scheme is in its infancy and will have to face much criticism before its success is recognised.

5.7 Freshman High School

The school is a purpose built Comprehensive established in 1971 on a new site in an area supported by other Comprehensive Schools, most with Sixth forms. Setting takes place from early in the first year and covers the full ability range. Classes tend to be larger than in other schools discussed in this chapter and are taught by a team of six full time mathematics teachers. It was here that most of the development work was done in 1986/87 for the Lower School scheme used with the Self Help Groups. It was also here that a GCSE specific In-Service Training programme was organised for the mathematics department as part of the "Cascade" process following on from the Phase 2 and Phase 3 meetings. In the past the department had used a mode 3 CSE scheme with a coursework element but had been using GCE O level together with CSE syllabus 1 and syllabus 2 and a special Alternative Curriculum for the less able
pupils who were not considered suitable for entry to external examinations. The teachers in the department were very willing to try the coursework and meetings were held before each assignment to brief and discuss the materials and approach. After applying the mark schemes these were also discussed with a view to modification and improvement and teachers had the opportunity to examine the scripts from other classes. One thing was different from many other schools in that a week of mathematics lessons was given over to each assignment and this gave the more able and quicker pupil the chance to extend the investigation with some very impressive and revealing results. The use of video recordings made in the classroom (vide Chapter 7) were found to be useful in the discussions as it was the only way in which several teachers could see a colleague in action and proved to be informative about what can be expected of the pupils. The next stage in the In-Service programme will be trial marking of GCSE coursework to give the teachers confidence and expertise in readiness for the 1991 GCSE assessment. During the latter stages of 1987/88 some of the investigative work produced by the Lower School compared very favourably with the work submitted for GCSE in 1988. These pupils demonstrated that investigative skills exist, can be learned and put to use in a new situation. Because they were given the opportunity to extend an investigation many pupils became more creative
and some began to adopt the "What-if" approach. Certainly their expressive skills, both oral and written, were noticeably better than their predecessors at all levels.

5.8 Dragon High School
This school is officially a Secondary Modern School operating in the same catchment area as two local single sex Grammar Schools but has a good intake which feeds into a common Sixth Form unit. There are nine teachers working in the department and only four with formal mathematics qualifications which is not unusual in this County. The author was invited to attend a departmental meeting which was to discuss the introduction of assessed coursework as part of the forthcoming school year examinations. At the meeting the head of department said "We are entering a new era and we are going to have to experiment." Not all the teachers are convinced about the value of coursework and some are even less convinced that the time spent on coursework is a valuable use of teaching time. One of the team, although a probationer, has developed considerable expertise in preparing, introducing and managing coursework assignments. With the support of the head of department some ideas are presented for use with the whole year group and some are prepared for use if the individual class teacher wishes to use them. Very few of the optional ideas are used by the rest of the department. One of the Self
Help Groups was based at this school and they trialled most of the investigations shown in Appendix 1. It was the extra work done by the probationer teacher that was most revealing. During the course of this secondment the author encountered only two examples of ideas from the Distance Learning Material [15] prepared by MEG actually being tried by a school. One was the Limping Seagulls which is a paper folding activity producing no scripts and the other was the Cereal Packet problem tried here with a class of 34 second years pupils. Despite their age, a combination of previous experience in coursework and excellent management by the teacher produced a classroom atmosphere that was alive with activity and enthusiasm and a set of completed scripts that would have scored highly at Intermediate GCSE. It was after these classroom sessions that the author became even more convinced that if the teacher believed then coursework can be both exciting and mathematically productive.
Chapter 6

Moderating GCSE Mathematics Coursework

Introduction

It is written into the Scheme of Assessment for the MEA GCSE Mathematics syllabus 1651 that teachers will be responsible for assessing the work of their candidates. It is also a requirement that the marks will be moderated internally by the teachers within a particular centre before they are moderated externally by the Examination Board. The marks, after moderation, will then be combined with the marks obtained by the candidate in the time-limited written papers before grades are awarded. What follows is a detailed examination of the process of moderation and a description of how such moderation might take place in a school. The description is based upon an INSET exercise conducted with teachers involved in the submission of coursework for the 1988 GCSE entry.

Moderation is the process of aligning standards of assessment between different examinations, different components in an examination, different teachers at a particular school and between different schools responsible for the assessment of coursework. Moderation can take two general forms:

i) Statistical, involving some general scaling factor based on the performance in a different component.

ii) Inspection of samples of work, usually by some
third party which results in the original assessment being adjusted into line with the Examination Board view of an acceptable standard.

It is the second of these two forms which is applied to the MEG GCSE mathematics coursework assessment (syllabus 1651). This process of external moderation is new to the majority of teachers in the county as are the procedures associated with internal moderation and was viewed with some misgivings by the teachers at the Phase 4 meetings.

6.1 The Assessment of Coursework

6.1.1 The MEG Scheme of Assessment for GCSE

Cockcroft suggested different schemes for the written papers (para 528) and for the main Mathematics scheme MEG offered two versions, using three pairs of written papers, for assessment in 1988. The papers were differentiated according to the level of entry with grades being awarded as shown in the table below.

<table>
<thead>
<tr>
<th>Level</th>
<th>Intended Target Group</th>
<th>Grades Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>Higher</td>
<td>grades A,B,C</td>
<td>grades A,B,C,D</td>
</tr>
<tr>
<td>Intermediate</td>
<td>grades C,D,E</td>
<td>grades C,D,E,F</td>
</tr>
<tr>
<td>Lower</td>
<td>grades E,F,G</td>
<td>grades E,F,G</td>
</tr>
<tr>
<td>Syllabus Code 1650 (written papers only)</td>
<td>Component</td>
<td>Level</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>Short answer paper</td>
<td>Paper 1</td>
<td>Foundation</td>
</tr>
<tr>
<td></td>
<td>Paper 2</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Paper 3</td>
<td>Higher</td>
</tr>
<tr>
<td>Extended answer paper</td>
<td>Paper 4</td>
<td>Foundation</td>
</tr>
<tr>
<td></td>
<td>Paper 5</td>
<td>Intermediate</td>
</tr>
<tr>
<td></td>
<td>Paper 6</td>
<td>Higher</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Syllabus code 1651 (with a coursework component)</th>
<th>Component</th>
<th>Level</th>
<th>Duration</th>
<th>Weighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short answer paper</td>
<td>Paper 1</td>
<td>Foundation</td>
<td>1 hr 30 mins</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Paper 2</td>
<td>Intermediate</td>
<td>2 hr</td>
<td>50%</td>
</tr>
<tr>
<td></td>
<td>Paper 3</td>
<td>Higher</td>
<td>2 hr</td>
<td>50%</td>
</tr>
<tr>
<td>Extended answer paper</td>
<td>Paper 4</td>
<td>Foundation</td>
<td>45 mins</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Paper 5</td>
<td>Intermediate</td>
<td>1 hr</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Paper 6</td>
<td>Higher</td>
<td>1 hr 15 mins</td>
<td>25%</td>
</tr>
<tr>
<td>Coursework assignments</td>
<td>Paper 7</td>
<td>Foundation</td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Paper 8</td>
<td>Intermediate</td>
<td></td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>Paper 9</td>
<td>Higher</td>
<td></td>
<td>25%</td>
</tr>
</tbody>
</table>

The coursework components are offered as an alternative to the second half of the second paper at each level.

In the syllabus, published in 1986, for assessment in 1988, the coursework component was to be assessed in the form of five pieces of work called assignments with candidates choosing one from each of the five categories

1. Practical Geometry.
2. Everyday Application of Mathematics.
3. Statistics and/or Probability.
4. An Investigation.
5. A Centre Approved Topic.

The only reference to the relationship between the content for the time-limited written papers and the coursework is in the MEG syllabus booklet where it states that the coursework scheme "...should make important contributions to
learning through practical work and through applications of mathematics across the curriculum."

6.1.2 Support for the Department

MEG provided a list of eight suggestions for titles in each of the five categories and complicated the issue somewhat by adding that some topics could fit into more than one category. There was no further guidance on how to present the assignments or on how long pupils would be expected to spend on each assignment or what mathematical opportunities an assignment should offer the candidate. While the Board deemed it reasonable to present sample examination papers to illustrate assessment by time-limited written papers it did not do the same for the coursework component. The reason given by the Board was that there was no material available within the Region which met their GCSE Criteria for Assessment. The only material available came from CSE mode 3 schemes which were largely unsuitable and from the Joint GCE/CSE examinations where the Chief Coursework Moderator had commented that they were of poor quality.

The only advice which a school might seek was through a Coursework Consultancy Service introduced by MEG. The route to this advice raised much amusement when the service was explained to teachers at the Phase 4A Training meetings. Before a school embarks upon a piece of coursework with any group they are advised to complete a Submission Form giving details of the assignment and send
the Form to the Home Board (in Lincolnshire almost entirely EMREE). The Submission Form would then be forwarded to the Administering Board for MEG mathematics (UCLES) who would then forward it to the appointed Coursework Consultant. After adding comments on the suitability of the assignments and on any anticipated problems the Form would return to the school by the same route. At the time of the Phase 4 training the Board's Officer was quite cheerfully claiming the time lag had been cut down to two months!

In early 1988 MEG sent to all its centres copies of two booklets [16], printed in June 1987, entitled

GCSE Mathematics - a discussion on coursework
Examples of Coursework - 10 photocopied examples

Both were meant to be used as a Distance Learning Package by departments doing In-Service Training. The author has encountered only two schools that have used the discussion book and none who have used the book of coursework examples. When these were referred to at a Self Help Group meeting early in 1988 an experienced head of department said "I treat that sort of thing as junk mail. I want someone to stand in front of me and tell me what is good and bad and then I can question them and make up my own mind about what to do." No other exemplar material was available to Lincolnshire secondary schools until that date.

page - 99
6.1.3 The MEG Criteria for Assessment of Coursework

The syllabus gives the criteria together with some guidance to teachers marking coursework in the form of a table shown below.

<table>
<thead>
<tr>
<th>Classification of assessment</th>
<th>Maximum mark</th>
<th>Guidance for marking</th>
</tr>
</thead>
</table>
| OVERALL DESIGN AND STRATEGY                  | 4            | 4—A well-defined problem, appropriate use of techniques, well-stated conclusions, strong personal contribution.  
|                                              |              | 2—Routine approach, satisfactory techniques, some statement(s) of conclusions, average help needed.  
|                                              |              | 0—Trivial or poorly stated problem, unsuitable techniques, a lack of conclusion, even with considerable help. |
| MATHEMATICAL CONTENT                         | 4            | 4—Commendable use of concepts and methods showing a good range of knowledge: development of these concepts and methods as the work progresses.  
|                                              |              | 2—Appropriate concepts and methods without development or refinement, showing competence in a limited range of techniques.  
|                                              |              | 0—inadequate for the assignment.                                                     |
| ACCURACY                                      | 4            | 4—Careful and accurate work including, where appropriate, computation, manipulation, construction and measurement with correct units.  
|                                              |              | 2—Some errors, but not sufficient to invalidate the work.                           |
|                                              |              | 0—inaccurate work.                                                                  |
| CLARITY OF ARGUMENT AND PRESENTATION         | 4            | 4—A cleanly-expressed contribution with effective use of mathematical language, symbols, conventions, tables, diagrams, graphs etc.  
|                                              |              | 2—Adequate presentation, average use of appropriate language, symbols, conventions etc. |
|                                              |              | 0—Disorganised, untidy work, poorly expressed.                                     |
| CONTROLLED ELEMENT                           | 4            | 4—Demonstrates knowledge and understanding of the assignment, can apply the learning in a different situation.  
|                                              |              | 2—Has shown some learning of mathematics, with a limited ability to use it.         |
|                                              |              | 0—The assignment has not contributed to mathematical learning.                      |
The MEG classification for the assessment of the coursework component contains five criteria, each worth a maximum of 4 marks. The total of 20 for each of five assignments would be converted to account for 25% of the final assessment.

The five criteria

- Overall Design and Strategy
- Mathematical Content
- Accuracy
- Clarity of Argument and Presentation
- Controlled Element

are to be applied at the level of entry which means that, for the same assignment, 4 out of 4 is possible for Foundation level, for Intermediate level and Higher level for each of the criteria. This was part of the differentiated assessment scheme as proposed in the National Criteria. What is not available is a description of the expected performance at each grade so teachers have no idea of the standard of work produced by a candidate awarded say a grade D. There has been much time spent by the Examination Boards trying to define the different GCSE grades in terms of subject-specific grade criteria with little success. The MEG response to this is to say that all a particular school has to do is to ensure that their rank order is correct and leave the adjustment to GCSE standard in the hands of the Coursework Moderators. This adjustment will not affect the ranking within a school but could produce some radical alterations to the teacher’s marks.
which will further reduce confidence in this form of assessment.

The Control Element created many problems and has been replaced in the 1991 draft syllabus by a Teacher Assessment of Oral Skill. The Control Element was intended to check

i) the authenticity of the candidate's work;
ii) the extent of the candidate's learning and its retention;
iii) the depth of understanding of the mathematics involved;
iv) the ability to apply the learning to a different situation.

The Board offered several ways of achieving this but insisted that the evidence be available for moderation.

i) An oral exchange between the candidate and the teacher.
ii) A timed or untimed written test.
iii) A parallel investigation, piece of work or practical test.
iv) A written summary.

Using a tape recorded interview presented the teacher and the moderator with technical and logistical problems that were difficult to resolve. Firstly the teacher has to have the resources to conduct a tape recorded interview. This includes the recording equipment and a suitable room as the interviews cannot be recorded against the background noise of a normal classroom. This was also thought by teachers at the training meetings to mean that the mathematics teacher would have to be released, along with the pupils, from their normal timetable to conduct the interviews; a luxury previously only available to English and foreign language teachers in their experience and creating yet another
disruption to school life. The tapes would have to be catalogued and indexed very carefully in readiness for the Board asking for the evidence for external moderation of selected pupils' work. At the receiving end the external moderator would need compatible playback equipment. The moderator would have to listen to a recording for one pupil which might last for several minutes on each assignment; a task which would take far longer than reading through a script from a 15/30 minute test.

Using the other alternatives were thought by teachers at the Lincolnshire training meetings to extend the time necessary for the assignment without achieving anything related to the GCSE Aims.

The majority of schools used a short test paper as a Control Element in the 1988 submissions.

6.1.4  Moderation Procedures

There are three stages in the procedure leading to the award of a GCSE grade.

i) The classroom teacher is charged with the responsibility for applying the scheme of assessment to the scripts submitted by his/her pupils. A major cause of apprehension reported in the last two years has been that this scheme lacks the objectivity associated with the marking of examination papers in mathematics. Teachers find themselves with a scheme for allocating marks but with no comparison with which to judge their interpretation of that
ii) The school is charged with the responsibility for producing a single valid and reliable order of merit which reflects the relative attainment of all the candidates in that subject. Ideally internal moderation will compare the different interpretations and align the standards of different teachers within a school. The simple Agreement Trial conducted at the Phase 4B training meeting was demonstrated for two reasons.

a) To give teachers an opportunity to examine GCSE type coursework, to assess and compare assignments and to compare their ideas with their colleagues.

b) To show how internal moderation might be exercised in their own school.

The teachers at the training meetings concentrated on the first aspect and there is evidence that Lincolnshire teachers submitting coursework candidates in 1988 did not moderate in any formal way (vide Appendix 3). The MEG Examiner no.2 [17] recommended that "...teachers should concentrate on assessing work in accordance with the syllabus criteria and getting the internal moderation right. It is likely that, by virtue of the information and training that teachers have had, the standards applied by the centre will at least be close to those set by MEG." The three schools in Lincolnshire entering candidates in 1988 had no contact with any representative of MEG able, or
prepared, to offer specific advice on the marking or internal moderation of their coursework other than that given at the Phase 4B Training meeting.

iii) The Board then takes the responsibility for the moderation between schools. The MEG regulations for 1988 state the purpose of moderation to be "...to bring the marking of an internally assessed component in all participating centres to an agreed standard. Although moderation is concerned with the level and spread of marks, it is normal to include a check on the suitability and quantity of work submitted." The procedure for external moderation adopted by MEG for mathematics syllabus 1651 is referred to as postal and based upon the work of a sample of candidates being sent to external moderators. These moderators were appointed in April 1988; marks from the centres had to be available by 20th May and the training day for the new moderators was the 21st May. One has to ask whether MEG was leaving teachers in the wilderness and ignoring the moderation until the last possible moment? In their defence it has to be said that they did not know, with any certainty, the number of moderators they would need until entries were completed in March 1988.

6.2 The Agreement trial
6.2.1 Setting up the Trial
In December 1987 MEG anticipated about 300 candidates from
six schools in Lincolnshire entering GCSE mathematics syllabus 1651 in 1988. In conversation between the author and some of the teachers concerned it was agreed that it would be a useful exercise to bring them all together. The 4th February 1988 was set aside for a meeting at the Mathematics Centre in Horncastle. The purpose of the meeting was to let each teacher see the work that was being submitted by other schools and compare it with their own and to consider the application of the scheme of assessment. There was no other similar meeting taking place anywhere in the MEG Region. By January 1988 only three of the six schools still intended to enter candidates for coursework assessment and there were only six teachers involved. In order to make a viable group EMRKB were asked for the names of schools near the Lincolnshire border who might be interested in the Agreement Trial. The head of mathematics at each of the five schools suggested was contacted by the author. Only two schools still intended to use the coursework assessment and they were able to send a representative. Later checks on the entries from MEG revealed that there were originally in excess of 15000 provisional entries for 1651 in November 1987 which dwindled to 9545 candidates in June 1988. One head of department spoken to in January explained that his department had been doing coursework with three groups of pupils until the previous week, before deciding to abandon
it because they were "...concerned about the assessment and did not want to risk their pupils." In the end there were eight people at the meeting, six of whom were teachers with an entry class in 1988, one researcher from the Shell Centre at Nottingham University and a head of department with considerable experience in coursework.

6.2.2 Sample Scripts for the Trial

Each teacher was asked to bring a representative sample of their class coursework. Each sample was to have a loose cover sheet giving details of the script including the level and marks already allocated by that teacher. On arrival the 50 scripts were separated into Intermediate level (24) and Foundation level (26) by the author. Each level was then divided into the five categories; Practical Geometry, Everyday Mathematics, Statistics/Probability, Investigation and Centre Approved Topic. For each level a sample of twelve scripts was selected by the author after checking the titles and the marks on the cover sheets. The intention was that each sample should include two scripts from each of the five categories. The other two scripts, making a total of twelve in the sample, were chosen by the author because the titles were interesting and different. Each sample was then re-checked and one or two scripts changed to ensure a good spread of marks across the twelve scripts. The cover sheets were then removed from the scripts which were then placed in labelled folders for safe
keeping as they were originals for submission in June that year. More time to prepare the sample would have been an improvement had it been possible. As it turned out those attending thought the sample was suitable. From the cover sheets a Script Summary (6.4.1) was prepared ready for issue later in the day.

6.2.3 Instructions to the Markers

Each Marker was issued with a folder containing the instructions and paperwork for the day. Each folder contained

1. two Blank Assessment Record Forms (page 115) for recording the marks awarded in each of the five Criteria for each of the scripts in each sample,
2. a photocopy of the scheme of assessment (page 100) for the coursework component taken from the 1988 syllabus 1651 for reference,
3. two blanks of the Table of Marks Awarded (as page 117) to be completed at the end of the Agreement Trial as a summary of all the marks awarded by those present,
4. two blanks of the Table of Grades Awarded (as page 118) to be completed at the end of the Agreement Trial as a summary of all the grades awarded by those present,
5. a script summary giving a list of titles in each sample (pages 116 & 122).

In addition there was a page of notes from the author as follows:

page - 108
Agreement Trial 4th February 1988

A. Purpose of the day:
   a) To gain experience and confidence in assessing GCSE coursework.
   b) To compare different viewpoints on standards of assessments related to grades.

B. Please remember:
   a) We are here to express our opinion on our own and on other peoples coursework and to listen to other peoples opinion on the same pieces of work.
   b) Such opinions are not to be expressed or taken as criticisms of another School or Teacher.
   c) Any perceived leniency, severity, timidity or indiscrimination in marking is not to be seen as a fault. It is there in order to help each Teacher see themselves in relation to others and to help in the moderation process.

C. Procedure
   a) Scripts have been selected by me from the sample you have brought with you and each has been given an indentifying letter/number.
   b) Each script is an original and must therefore be treated with respect - no coffee stains and keep in the folder at all times. You may keep notes of scripts for later if you wish.
   c) You are to mark each script to your current understanding and interpretation of GCSE Scheme of Assessment. The Control Element mark will be given to you from the cover sheets as some are based on interview or conversation.
   d) Record your marks on your own Assessment Grid. You have separate grids for Foundation and Intermediate levels.
   e) Please do not discuss your views on the scripts at this stage. You may ask for clarification if necessary but you can really only judge on the evidence in front of you.

The author organised the introductions and went through the page of notes with the teachers taking part.
6.2.4 Timetable for the Trial

9.15 am Coffee, claim forms and introductions
9.30 am Procedure for the trial
9.45 am Assessment of scripts
12.30 pm Lunch
1.30 pm Assessment of scripts
2.15 pm Collation of results
2.30 pm Discussion
3.30 pm Depart.

6.2.5 Administration of the Trial

Thankfully there were no problems except the shortage of time. The markers worked through the 24 scripts in random order. All found the documentation straightforward. Two commented that the pace to complete by 2.15 pm was fast but could see no alternative if they were to examine both Foundation and Intermediate levels. One commented further that "It is a good job I have recently marked all my scripts and am in tune with the marking scheme or it would take me a lot longer." By design each sample contained scripts from each school and it was hoped that some time could be saved as the teachers concerned did not have to re-mark their own scripts. During the morning session each marker was given the Control Element mark (out of 4) for each of the 24 scripts. This meant that each marker was only awarding marks from a possible maximum of 16 for each script. As each marker completed a sample they handed in
their Assessment Record Form for collation. Two tables of results were prepared by the author for each sample; one showing the marks awarded and one showing the suggested grades.

6.3 Methods used in the Analysis

The technique for comparing the standards of assessment by the markers is one which was developed and used by EMRKB in training and evaluating their coursework moderators for CSE. It is not an attempt to quantify the degree of severity/lenity. It does, from practice, highlight the relative perceptions of the different moderators against the consensus. In the past this information has been restricted to the Chairmen of the Assessment Committee dealing with that moderator. In the future it will be essential for each teacher to appreciate his/her own standards compared to the consensus. The analysis would have had more strength if it had been possible to gather more people to the exercise. Eight took part in this Trial but ten is the number that EMRKB recommend, partly because it makes the calculation of averages much easier for other subject teachers and partly because they have found that ten is the optimum number for one officer to manage number. There is no statistical significance in the recommended number.
Mean mark

For each script the mean of the marks from the eight markers was calculated to one decimal place.

Range

Two ranges were calculated. It must be remembered that each marker was really only allocating from 16 of the possible 20 marks as the Control Element mark was fixed for each of the scripts.

Script Range: for each script the Script Range was calculated as the difference between the highest and lowest mark awarded for that script. These Ranges varied from 2, which suggests a high degree of agreement, to 10 which suggests a wide divergence of opinion. This is emphasised by the fact that these are from a possible range of 16.

Marker Range: the twelve scripts were tabulated in three groups of four (e.g. 11, 12, 13 and 14). For each group of four scripts the Marker Range was calculated as the difference between the highest and the lowest mark awarded to the group of four scripts. These three Marker Ranges were added to give a Sum of Ranges for each marker. The mean Sum of Ranges for the eight markers was calculated. A low Sum of Ranges compared to
the mean indicates the marker has not recognised the differences in standard between the pieces of work. A high Sum of Ranges indicates the marker tends towards extremes, perhaps indiscriminate?

Grand Totals
The Grand Total for each Marker is the total of the marks awarded for the twelve scripts. The mean of these Grand Totals was calculated. A high Grand Total compared to the mean Grand Total indicates they have awarded significantly higher marks and may be considered lenient. A low Grand Total compared to the mean Grand Total indicates they have awarded significantly lower marks and may be considered severe.

Scattergraphs
In addition the author prepared two simple scattergraphs showing the relationship between the mark awarded and the estimated grade for each of the 96 assessments made at each sample. These were used as the basis for a discussion on what the grade boundary marks should be, in the view of those present, at the end of the Agreement Trial.

6.4 Data from the Agreement Trial
What follows is a tabulation of the information drawn from the two samples of scripts and the marks/grades awarded by the eight markers who took part in the Trial. With the
exception of the Marker Analysis this was all available to the participants during the trial. The Marker Analysis is an attempt to highlight the main characteristics of the markers in terms consistent with those used by the EMREB in its assessment of moderators.

Blank Assessment Record Forms page 115

FOUNDATION level
6.4.1 Script Summary page 116
6.4.2 Marks Awarded page 117
6.4.3 Grades Suggested page 118
6.4.4 Scattergraph page 119
6.4.5 Marker Analysis pages 120/121

INTERMEDIATE level
6.4.6 Script Summary page 122
6.4.7 Marks Awarded page 123
6.4.8 Grades Suggested page 124
6.4.9 Scattergraph page 125
6.4.10 Marker Analysis pages 126/127
Blank Assessment Record Forms for completion by the eight markers.

### FOUNDATION level sample

<table>
<thead>
<tr>
<th>Script Criteria</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarity and Presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Element</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total Marks out of 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade Suggested</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### INTERMEDIATE level sample

<table>
<thead>
<tr>
<th>Script Criteria</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design and Strategy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical Content</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarity and Presentation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Element</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Total Marks out of 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade Suggested</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6.4.1 Script Summary showing the information collated from the cover sheets provided by the class teacher.

**FOUNDATION level sample**

<table>
<thead>
<tr>
<th>Script</th>
<th>Category &amp; Title</th>
<th>Gde</th>
<th>D/S</th>
<th>M/C</th>
<th>Acc</th>
<th>C/P</th>
<th>C/E</th>
<th>T/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>P/G Games</td>
<td>E</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>F2</td>
<td>P/G Logo</td>
<td>G</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>F3</td>
<td>E/D Holidays</td>
<td>F</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>F4</td>
<td>E/D Holidays</td>
<td>E</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>13</td>
</tr>
<tr>
<td>F5</td>
<td>S/P Traffic survey</td>
<td>E</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>F6</td>
<td>S/P Traffic survey</td>
<td>E</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>14</td>
</tr>
<tr>
<td>F7</td>
<td>Inv Magic Numbers</td>
<td>F</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>F8</td>
<td>Inv Counters</td>
<td>F</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>F9</td>
<td>C/A Wrapping Paper</td>
<td>G</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>F10</td>
<td>C/A Wallpaper</td>
<td>G</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>F11</td>
<td>S/P Horses</td>
<td>E</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>19</td>
</tr>
<tr>
<td>F12</td>
<td>E/D Holidays</td>
<td>F</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>17</td>
</tr>
</tbody>
</table>

Note: P/G -- Practical Geometry  
E/D -- Everyday Applications  
S/P -- Statistics / Probability  
Inv -- Investigation  
C/A -- Centre Approved topic

Gde -- grade suggested by the class teacher  
D/S -- Design & Strategy  
M/C -- Mathematical content  
Acc -- Accuracy  
C/E -- Control Element  
T/20 -- Total mark out of 20 for the assignment

Number of proposed grade E's - 4  
F's - 5  
G's - 3

Page - 116
6.4.2 Table of Marks Awarded showing the marks awarded during the Trial together with the computed Means, Ranges, Totals and Sums.

**FOUNDAITION level sample**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Script</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M7</th>
<th>M8</th>
<th>C/T</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td></td>
<td>11</td>
<td>14</td>
<td>9</td>
<td>12</td>
<td>14</td>
<td>10</td>
<td>10</td>
<td>5</td>
<td>16</td>
<td>10.6</td>
<td>5</td>
</tr>
<tr>
<td>F2</td>
<td></td>
<td>11</td>
<td>9</td>
<td>11</td>
<td>17</td>
<td>13</td>
<td>10</td>
<td>10</td>
<td>7</td>
<td>14</td>
<td>11.0</td>
<td>8</td>
</tr>
<tr>
<td>F3</td>
<td></td>
<td>7</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>4</td>
<td>4</td>
<td>7</td>
<td>13</td>
<td>7.5</td>
<td>7</td>
</tr>
<tr>
<td>F4</td>
<td></td>
<td>15</td>
<td>13</td>
<td>11</td>
<td>14</td>
<td>17</td>
<td>7</td>
<td>11</td>
<td>9</td>
<td>13</td>
<td>12.1</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>44</td>
<td>46</td>
<td>38</td>
<td>53</td>
<td>55</td>
<td>31</td>
<td>35</td>
<td>28</td>
<td>56</td>
<td>41.3</td>
<td>5.9</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F5</td>
<td></td>
<td>12</td>
<td>16</td>
<td>10</td>
<td>15</td>
<td>14</td>
<td>10</td>
<td>11</td>
<td>8</td>
<td>16</td>
<td>12.0</td>
<td>6</td>
</tr>
<tr>
<td>F6</td>
<td></td>
<td>14</td>
<td>14</td>
<td>11</td>
<td>16</td>
<td>17</td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>13.8</td>
<td>5</td>
</tr>
<tr>
<td>F7</td>
<td></td>
<td>13</td>
<td>10</td>
<td>10</td>
<td>13</td>
<td>18</td>
<td>12</td>
<td>10</td>
<td>7</td>
<td>11</td>
<td>10.6</td>
<td>6</td>
</tr>
<tr>
<td>F8</td>
<td></td>
<td>15</td>
<td>14</td>
<td>11</td>
<td>17</td>
<td>18</td>
<td>14</td>
<td>13</td>
<td>15</td>
<td>15</td>
<td>14.6</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>54</td>
<td>54</td>
<td>42</td>
<td>61</td>
<td>59</td>
<td>50</td>
<td>46</td>
<td>42</td>
<td>56</td>
<td>51.0</td>
<td>4.6</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>3</td>
<td>6</td>
<td>1</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>F9</td>
<td></td>
<td>6</td>
<td>7</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>3</td>
<td>8</td>
<td>11</td>
<td>7.5</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>F10</td>
<td></td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>9</td>
<td>10</td>
<td>5</td>
<td>7</td>
<td>5</td>
<td>10</td>
<td>6.9</td>
<td>5</td>
</tr>
<tr>
<td>F11</td>
<td></td>
<td>15</td>
<td>16</td>
<td>9</td>
<td>13</td>
<td>17</td>
<td>15</td>
<td>12</td>
<td>13</td>
<td>19</td>
<td>13.8</td>
<td>8</td>
</tr>
<tr>
<td>F12</td>
<td></td>
<td>12</td>
<td>14</td>
<td>12</td>
<td>17</td>
<td>16</td>
<td>12</td>
<td>15</td>
<td>14</td>
<td>17</td>
<td>14.0</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>39</td>
<td>43</td>
<td>34</td>
<td>46</td>
<td>54</td>
<td>38</td>
<td>37</td>
<td>40</td>
<td>57</td>
<td>41.4</td>
<td>9.1</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>9</td>
<td>10</td>
<td>6</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>12</td>
<td>9</td>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Sum/T  |        | 137| 143| 114| 168| 168| 119| 118| 110| 169 | 133.0|       |
| Sum/R  |        | 20 | 21 | 11 | 21 | 21 | 28 | 22 | 21 | 17  | 19.6 |       |

*Note:* the eight markers are labelled M1 to MB.
- C/T is the mark from the cover sheet provided by the Class Teacher.
- Mean is the average of the marks awarded to the script by M1 to MB.
- Range is the highest mark less the lowest mark.
- Total is the sum of the marks for the group of 4 scripts.
- Sum/T is the sum of the 12 marks awarded by each marker.
- Sum/R is the sum of the 3 Ranges for each group of 4 scripts.
6.4.3 Table of Grades showing the grades suggested by the markers together and some illustration of the distribution.

**FOUNDATION level sample**

<table>
<thead>
<tr>
<th>Marker Script</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M7</th>
<th>M8</th>
<th>C/T</th>
<th>Range of letters</th>
<th>Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>G</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>G</td>
<td>G</td>
<td>U</td>
<td>E</td>
<td>U-E</td>
</tr>
<tr>
<td>F2</td>
<td>G</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G-E</td>
<td>3</td>
</tr>
<tr>
<td>F3</td>
<td>U</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>F</td>
<td>U</td>
<td>U</td>
<td>G</td>
<td>F</td>
<td>U-F</td>
<td>3</td>
</tr>
<tr>
<td>F4</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>U</td>
<td>G</td>
<td>G</td>
<td>E</td>
<td>U-E</td>
</tr>
<tr>
<td>F5</td>
<td>G</td>
<td>E</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>G-E</td>
<td>3</td>
</tr>
<tr>
<td>F6</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>F</td>
<td>G</td>
<td>E</td>
<td>E</td>
<td>G-E</td>
<td>3</td>
</tr>
<tr>
<td>F7</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>G</td>
<td>F</td>
<td>G-F</td>
<td>2</td>
</tr>
<tr>
<td>F8</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>F-E</td>
<td>2</td>
</tr>
<tr>
<td>F9</td>
<td>U</td>
<td>F</td>
<td>G</td>
<td>U</td>
<td>F</td>
<td>U</td>
<td>U</td>
<td>G</td>
<td>6</td>
<td>U-F</td>
<td>3</td>
</tr>
<tr>
<td>F10</td>
<td>U</td>
<td>F</td>
<td>G</td>
<td>G</td>
<td>F</td>
<td>U</td>
<td>U</td>
<td>U</td>
<td>6</td>
<td>U-F</td>
<td>3</td>
</tr>
<tr>
<td>F11</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>G</td>
<td>E</td>
<td>E</td>
<td>G-E</td>
<td>3</td>
</tr>
<tr>
<td>F12</td>
<td>G</td>
<td>E</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>G-E</td>
<td>3</td>
</tr>
</tbody>
</table>

| number of E's | -  | 7  | -  | 5  | 7  | -  | -  | 4  | 4  |     |
| F's           | 5  | 5  | 9  | 4  | 5  | 4  | 2  | -  | 5  |     |
| G's           | 4  | -  | 3  | 2  | -  | 4  | 7  | 6  | 3  |     |
| U's           | 3  | -  | 1  | -  | 4  | 3  | 2  | -  |     |

**Note:**
- The eight markers are labelled M1 to M8.
- C/T is the grade from the cover sheet provided by the Class Teacher.
- Spread is the number of different grades in the Range of Grades suggested. A Range of U-E includes U, G, F and E which is a Spread of 4.
The graph shows the relationship between the grade suggested and the mark awarded for each of the 12 scripts by each of the 8 markers.

The boxes (outlined) indicate the grade boundaries suggested by the markers after discussion.
6.4.5 Marker Analysis - FOUNDATION level sample

This examines each marker's response to the sample in terms of spread, severity/lenity and the relationship between the mark awarded and grade suggested for each script. [The marks awarded to each grade letter have been tabulated by reference to 6.4.2 and 6.4.3.]

<table>
<thead>
<tr>
<th>Marker M1</th>
<th></th>
<th>Comment -</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td></td>
<td>Found no scripts worthy of an 'E'.</td>
</tr>
<tr>
<td>F</td>
<td>13 14 15 15 15</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>11 11 12 12</td>
<td>Severe at the top end of the range.</td>
</tr>
<tr>
<td>U</td>
<td>6 6 7</td>
<td>Consistent transfer between mark and grade.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marker M2</th>
<th></th>
<th>Comment -</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td></td>
<td>Found no scripts worthy of a 'G' or 'U'.</td>
</tr>
<tr>
<td>F</td>
<td>13 14 14 14 14 16 16</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>6 7 9 10 10</td>
<td>Generous at the lower end of the range.</td>
</tr>
<tr>
<td>U</td>
<td></td>
<td>Consistent transfer between mark and grade.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marker M3</th>
<th></th>
<th>Comment -</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td></td>
<td>Inconsistent transfer between mark and grade.</td>
</tr>
<tr>
<td>F</td>
<td>9 10 10 11 11 11 11</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>6 7 7 9 12</td>
<td>Did not discriminate.</td>
</tr>
<tr>
<td>U</td>
<td>6 7 7 9 12</td>
<td>Severe at the top end of the range.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marker M4</th>
<th></th>
<th>Comment -</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>15 16 17 17 17</td>
<td>Good discrimination.</td>
</tr>
<tr>
<td>F</td>
<td>12 13 13 14</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>9 10</td>
<td>Consistent transfer between mark and grade.</td>
</tr>
<tr>
<td>U</td>
<td>7</td>
<td>Slightly generous across the range.</td>
</tr>
<tr>
<td>Marker</td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>--------</td>
<td>----</td>
<td>----</td>
</tr>
<tr>
<td>M5</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M6</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>M7</td>
<td>13</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>M8</td>
<td>12</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>
6.4.6 Script Summary showing the information collated from the cover sheets provided by the class teacher.

**INTERMEDIATE level sample**

<table>
<thead>
<tr>
<th>Script</th>
<th>Category &amp; title</th>
<th>Gde</th>
<th>D/S</th>
<th>M/C</th>
<th>Acc</th>
<th>C/P</th>
<th>C/E</th>
<th>T/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>P/G Tennis</td>
<td>E</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>12</td>
<td>C/A Critical Path Analysis</td>
<td>C</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>13</td>
<td>S/P Roll a Penny</td>
<td>C</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>14</td>
<td>Inv Mystic Rose</td>
<td>E</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>15</td>
<td>Inv Nets of shapes</td>
<td>E</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>16</td>
<td>C/A Logo</td>
<td>D</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>17</td>
<td>C/A Fibonacci numbers</td>
<td>C</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>18</td>
<td>E/A Dancing</td>
<td>D</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>19</td>
<td>P/G Wheels and Gears</td>
<td>C</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>15</td>
</tr>
<tr>
<td>110</td>
<td>S/P Fitness survey</td>
<td>E</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>111</td>
<td>E/A Skating Trip</td>
<td>D</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>112</td>
<td>P/G Tesselations</td>
<td>C</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>20</td>
</tr>
</tbody>
</table>

*note: P/G -- Practical Geometry  
E/D -- Everyday Applications  
S/P -- Statistics / Probability  
Inv -- Investigation  
C/A -- Centre Approved topic  

Gde -- grade suggested by the class teacher  
D/S -- Design & Strategy  
M/C -- Mathematical content  
Acc -- Accuracy  
C/E -- Control Element  
T/20 -- Total mark out of 20 for the assignment  

Number of proposed grade  
C's -- 5  
D's -- 3  
E's -- 4  

page - 122
6.4.7 Table of Marks Awarded showing the marks awarded during the Trial together with the computed Means, Ranges, Totals and Sums.

**INTERMEDIATE level sample**

<table>
<thead>
<tr>
<th>Marker</th>
<th>Script</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M7</th>
<th>M8</th>
<th>C/T</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>8</td>
<td>9</td>
<td>18</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>2</td>
<td>10</td>
<td>7.6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>16</td>
<td>14</td>
<td>5</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>16</td>
<td>13.3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>11</td>
<td>14</td>
<td>12</td>
<td>11</td>
<td>12</td>
<td>10</td>
<td>8</td>
<td>9</td>
<td>12</td>
<td>10.9</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>13</td>
<td>14</td>
<td>11</td>
<td>13</td>
<td>10</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>18</td>
<td>11.8</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58</strong></td>
<td><strong>57</strong></td>
<td><strong>49</strong></td>
<td><strong>57</strong></td>
<td><strong>54</strong></td>
<td><strong>40</strong></td>
<td><strong>52</strong></td>
<td><strong>59</strong></td>
<td><strong>62</strong></td>
<td><strong>53.3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td><strong>12</strong></td>
<td><strong>9</strong></td>
<td><strong>6</strong></td>
<td><strong>9</strong></td>
<td><strong>5</strong></td>
<td><strong>9</strong></td>
<td><strong>11</strong></td>
<td><strong>6</strong></td>
<td><strong>9.0</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>7</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>13</td>
<td>9</td>
<td>7</td>
<td>8</td>
<td>13</td>
<td>9.3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>13</td>
<td>13</td>
<td>10</td>
<td>14</td>
<td>12</td>
<td>11</td>
<td>18</td>
<td>16</td>
<td>15</td>
<td>13.4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>18</td>
<td>17</td>
<td>18</td>
<td>14</td>
<td>19</td>
<td>19</td>
<td>17.6</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>11</td>
<td>15</td>
<td>11</td>
<td>16</td>
<td>12</td>
<td>18</td>
<td>13</td>
<td>16</td>
<td>15</td>
<td>13.0</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58</strong></td>
<td><strong>57</strong></td>
<td><strong>49</strong></td>
<td><strong>57</strong></td>
<td><strong>54</strong></td>
<td><strong>40</strong></td>
<td><strong>52</strong></td>
<td><strong>59</strong></td>
<td><strong>62</strong></td>
<td><strong>53.3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td><strong>12</strong></td>
<td><strong>9</strong></td>
<td><strong>6</strong></td>
<td><strong>9</strong></td>
<td><strong>5</strong></td>
<td><strong>9</strong></td>
<td><strong>11</strong></td>
<td><strong>6</strong></td>
<td><strong>9.0</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>12</td>
<td>11</td>
<td>10</td>
<td>12</td>
<td>14</td>
<td>11</td>
<td>5</td>
<td>8</td>
<td>15</td>
<td>18.4</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>110</td>
<td>18</td>
<td>13</td>
<td>7</td>
<td>11</td>
<td>10</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>9.0</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>111</td>
<td>8</td>
<td>12</td>
<td>9</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>12</td>
<td>6</td>
<td>11</td>
<td>10.3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>18</td>
<td>19</td>
<td>17</td>
<td>19</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>28</td>
<td>18.3</td>
<td>2.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>58</strong></td>
<td><strong>57</strong></td>
<td><strong>49</strong></td>
<td><strong>57</strong></td>
<td><strong>54</strong></td>
<td><strong>40</strong></td>
<td><strong>52</strong></td>
<td><strong>59</strong></td>
<td><strong>62</strong></td>
<td><strong>53.3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td><strong>12</strong></td>
<td><strong>9</strong></td>
<td><strong>6</strong></td>
<td><strong>9</strong></td>
<td><strong>5</strong></td>
<td><strong>9</strong></td>
<td><strong>11</strong></td>
<td><strong>6</strong></td>
<td><strong>9.0</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum/T</strong></td>
<td><strong>146</strong></td>
<td><strong>163</strong></td>
<td><strong>148</strong></td>
<td><strong>154</strong></td>
<td><strong>154</strong></td>
<td><strong>137</strong></td>
<td><strong>131</strong></td>
<td><strong>132</strong></td>
<td><strong>163</strong></td>
<td><strong>144.6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sum/R</strong></td>
<td><strong>112</strong></td>
<td><strong>108</strong></td>
<td><strong>118</strong></td>
<td><strong>123</strong></td>
<td><strong>118</strong></td>
<td><strong>108</strong></td>
<td><strong>114</strong></td>
<td><strong>112</strong></td>
<td><strong>123</strong></td>
<td><strong>112</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**note**
- Markers are labelled M1 to M8.
- C/T is the mark from the cover sheet provided by the Class Teacher.
- Mean is the average of the marks awarded to the script by M1 to M8.
- Range is the highest mark less the lowest mark.
- Total is the sum of the marks for the group of 4 scripts.
- Sum/T is the sum of the 12 marks awarded by each marker.
- Sum/R is the sum of the 3 Ranges for each group of 4 scripts.
6.4.8 Table of Grades showing the grades suggested by the markers together and some illustration of the resulting distribution.

**INTERMEDIATE level sample**

<table>
<thead>
<tr>
<th>Marker Script</th>
<th>M1</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M7</th>
<th>M8</th>
<th>C/T</th>
<th>Range of letters</th>
<th>Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>F</td>
<td>F</td>
<td>U</td>
<td>U</td>
<td>E</td>
<td>U-E</td>
<td>3</td>
</tr>
<tr>
<td>12</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>C</td>
<td>E-C</td>
<td>3</td>
</tr>
<tr>
<td>13</td>
<td>D</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>C</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>C</td>
<td>F-C</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>D</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>E-D</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>U</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>U</td>
<td>F</td>
<td>E</td>
<td>U-D</td>
<td>4</td>
</tr>
<tr>
<td>16</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>C</td>
<td>D</td>
<td>D</td>
<td>E</td>
<td>E-C</td>
<td>3</td>
</tr>
<tr>
<td>17</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>D-C</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>C</td>
<td>E</td>
<td>F</td>
<td>D</td>
<td>D</td>
<td>D</td>
<td>F-C</td>
<td>4</td>
</tr>
<tr>
<td>19</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>E</td>
<td>D</td>
<td>E</td>
<td>U</td>
<td>F</td>
<td>C</td>
<td>U-D</td>
<td>4</td>
</tr>
<tr>
<td>110</td>
<td>E</td>
<td>D</td>
<td>F</td>
<td>E</td>
<td>E</td>
<td>F</td>
<td>U</td>
<td>U</td>
<td>E</td>
<td>U-D</td>
<td>4</td>
</tr>
<tr>
<td>111</td>
<td>U</td>
<td>E</td>
<td>F</td>
<td>D</td>
<td>E</td>
<td>F</td>
<td>E</td>
<td>F</td>
<td>D</td>
<td>U-D</td>
<td>4</td>
</tr>
<tr>
<td>112</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>C</td>
<td>D-C</td>
<td>2</td>
</tr>
</tbody>
</table>

| number of C's | 3  | 3  | -  | 3  | 3  | 2  | 2  | 2  | 5  |
| D's           | 4  | 4  | 3  | 3  | 4  | -  | 3  | 2  | 3  |
| E's           | 3  | 5  | 7  | 5  | 5  | 5  | 2  | 4  | 4  |
| F's           | -  | -  | 2  | 1  | -  | 5  | 1  | 4  | -  |
| U's           | 2  | -  | -  | -  | -  | -  | 4  | 2  | -  |

**Note**
- Markers are labelled M1 to M8.
- C/T is the grade from the cover sheet provided by the Class Teacher.
- Spread is the number of different grades in the Range of Grades suggested. A Range of U to E includes U, F and G which is a Spread of 3.
The graph shows the relationship between the grade suggested and the mark awarded for each of the 12 scripts by each of the 8 markers.

The boxes (outlined) indicate the grade boundaries suggested by the markers after discussion.
6.4.10 Marker Analysis - INTERMEDIATE level sample

This examines each marker's response to the sample in terms of spread, severity/lenity and the relationship between the mark awarded and grade suggested for each script. [The marks awarded to each grade letter have been tabulated by reference to 6.4.2 and 6.4.3.]

**Marker M1**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mark</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>16 18 19</td>
<td>Inconsistent transfer between mark and grade.</td>
</tr>
<tr>
<td>D</td>
<td>11 12 13 13</td>
<td>Discriminated well.</td>
</tr>
<tr>
<td>E</td>
<td>8 10 11</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>7 8</td>
<td></td>
</tr>
</tbody>
</table>

**Marker M2**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mark</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>14 19 19</td>
<td>Inconsistent transfer between mark and grade.</td>
</tr>
<tr>
<td>D</td>
<td>13 14 14 15</td>
<td>Discriminated well.</td>
</tr>
<tr>
<td>E</td>
<td>9 10 11 12 13</td>
<td>Generous across the range.</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Marker M3**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mark</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>15 17 17</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>10 10 11 11 11 12</td>
<td>Discriminated well.</td>
</tr>
<tr>
<td>E</td>
<td>7 9</td>
<td>Consistent transfer between mark and grade.</td>
</tr>
<tr>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Marker M4**

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mark</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>16 18 19</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>13 13 14</td>
<td>Discriminated well.</td>
</tr>
<tr>
<td>E</td>
<td>9 11 11 11 12</td>
<td>Consistent transfer between mark and grade.</td>
</tr>
<tr>
<td>F</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comment - Did not realise Int. grades included C's. Discriminated well. Consistent transfer between mark and grade.
<table>
<thead>
<tr>
<th>Marker M5</th>
<th>Comment - Inconsistent transfer between mark and grade. Did not discriminate well. Generous at the lower end of the range.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 12 17 19</td>
<td></td>
</tr>
<tr>
<td>D 12 13 14 14</td>
<td></td>
</tr>
<tr>
<td>E 10 10 10 11 12</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marker M6</th>
<th>Comment - Poor discrimination. Consistent transfer between mark and grade.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 17 18</td>
<td></td>
</tr>
<tr>
<td>D 11 11 12 12</td>
<td></td>
</tr>
<tr>
<td>E 9 9 9 9 10 10</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marker M7</th>
<th>Comment - Inconsistent transfer between mark and grade. Severe at the lower end of the range. Good discrimination.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 18 19</td>
<td></td>
</tr>
<tr>
<td>D 11 13 14</td>
<td></td>
</tr>
<tr>
<td>E 12 12</td>
<td></td>
</tr>
<tr>
<td>F 9</td>
<td></td>
</tr>
<tr>
<td>U 5 6 6 7</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Marker M8</th>
<th>Comment - Consistent transfer between mark and grade. Severe at the lower end of the range. Good discrimination.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C 18 19</td>
<td></td>
</tr>
<tr>
<td>D 16 16</td>
<td></td>
</tr>
<tr>
<td>E 10 12</td>
<td></td>
</tr>
<tr>
<td>F 8 8 8 9</td>
<td></td>
</tr>
<tr>
<td>U 2 6</td>
<td></td>
</tr>
</tbody>
</table>
6.5 Comments on the Agreement Trial

6.5.1 Analysis of the Results

What follows is the sort of comment and analysis which could be made by a head of department following an internal moderation exercise organised along the lines of the Agreement Trial. The analysis examines first the scripts chosen for the trial then the marks awarded to the scripts and lastly considers the responses of the markers.

6.5.2 Foundation Level

i) The Sample (table 6.4.1)

The marks for the sample scripts given by the class teachers were a good spread from 10 to 19 out of 20 with marks of 10, 11, 11, 13, 13, 14, 14, 15, 16, 16, 17 and 19. The grades proposed by the class teachers covered the intended Foundation level Target Group (vide 6.1.1) with 4 grade E's, 5 grade F's and 3 grade G's. There were no grade U's and none were expected. The marks and grades were taken from the cover sheets which were not available to the markers although one or two may have been known where the marker was also the class teacher. The impression gained during the trial suggested to the author that, from experience, it was a reasonable sample to use. When the markers were interviewed after the exercise (vide 6.7) all but one thought the sample was a fair representation. The following comments on scripts, grades and markers are all made on the basis that the sample did present a fair range.
of standards for entry at Foundation level GCSE.

ii) Scripts and Marks (table 6.4.2)

In order to save some time on the day the eight markers were advised that, when they encountered a script from their own school, marks from the original cover sheet could be transferred. Despite this suggestion 7, of the 12 scripts in the sample, were awarded a different mark by the class teacher/marker during the trial.

Individual assessments by the 8 markers produced marks from 3 (script F9, marker M7) to 18 out of 20 (script F8, marker M5). The mean marks for the 12 scripts were a good spread from 6.9 to 14.6 with means of 6.9, 7.5, 7.5, 10.6, 10.6, 11.0, 12.0, 12.1, 13.0, 13.8, 14.0 and 14.6 suggesting that the markers recognised a range of standards within the sample.

It is significant that the mark on the cover sheet was, in every case, higher than the mean mark for the script. In 4 cases the difference between the class teacher’s mark and the mean mark was 4 or more. This suggests that the class teacher is more lenient with their own pupils than they are with others.

The 7 assessments (from the 96) recorded as being 17 or more out of 20 were all made by two markers (M4 and M5), from the same school, who were not involved with Foundation level pupils. These two markers were seen as lenient throughout the trial, both in discussion and from
the analyses (6.4.5 and 6.4.10).

The 6 assessments (from the 96) recorded as being 5 or less out of 20 were made by three markers (M6, M7 and M8) who were seen as severe throughout the trial, both in discussion and in the analyses (6.4.5 and 6.4.10). Only one of the three had a GCSE entry class and two had worked together in the past.

iii) Grades and Marks (tables 6.4.3 and 6.4.5)

It transpired that only one marker (M8) had applied a definite scale to convert the marks awarded to a grade. Two markers (M3 and M6) were inconsistent in their conversion in that they had awarded different grades for scripts with the same mark (table 6.4.5).

They had all (but one) assessed the work by two standards - a mark out of 20 based on the five criteria and, separately, an impression of the grade it should be given. Three of the markers had used only two of the four available grades E to U and only two had used the full range of available grades. Five of the twelve scripts (13 of the 96 assessments) had been judged as grade U by one or more of the markers.

The scattergraph 6.4.4 shows that marks of 6 and 7 had been graded F, G and U and the mark of 12 had been graded E, F and G. In addition all of the marks from 9 to 16 were spread across two grades. Looked at from the other dimension each grade spanned 7 or more marks.
The Sum Totals for the eight markers were spread from 110 to 168 with a mean value of 133.

<table>
<thead>
<tr>
<th>Marker</th>
<th>M8</th>
<th>M3</th>
<th>M7</th>
<th>M6</th>
<th>M1</th>
<th>M2</th>
<th>M4</th>
<th>M5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum Total</td>
<td>110</td>
<td>114</td>
<td>118</td>
<td>119</td>
<td>137</td>
<td>143</td>
<td>160</td>
<td>168</td>
</tr>
</tbody>
</table>

consistently severe consistently lenient

In previous agreement trials, conducted by EMREB for CSE coursework moderators, the samples were scripts which had already been awarded marks and grades at CSE. In those CSE trials the mean Sum Total was found to be almost identical to the Sum Total of the actual marks awarded at the CSE grading meeting. For this trial the actual GCSE marks awarded were not known so the mean Sum Total was taken to represent GCSE standard. In the interests of achieving a common standard of moderation for CSE coursework EMREB recommended that a narrow spread of Sum Totals is acceptable. In this trial the equivalent acceptable Sum Totals would be from 121 to 145 which represents a consistent difference of 1 mark out of the 20 for each of the 12 scripts in the sample. With this descriptor, only two of the eight markers, M1 (Sum/T 137) and M2 (Sum/T 143), would be acceptable. Removing the most severe and lenient markers from the calculation alters the mean slightly but does not increase the number of markers considered acceptable. The fact must remain that there was a very wide range of opinion as to GCSE standards at Foundation level expressed by the eight markers.
The Sum of Ranges for the eight markers were spread from 11 to 18 with a mean of 19.6.

Marker    M3   M1   M6   M2   M4   M5   M8   M7  
Sum of ranges 11  20  20  21  21  21  21  22  

Seven of the eight markers discriminated well between the twelve scripts (table 6.4.5). One marker (M3) saw very little variation in the standards of the twelve scripts seemingly regarding all scripts of very poor standard as the corresponding Sum Total was 114.

6.5.3 Intermediate Level
i) The Sample (table 6.4.6)

The marks for the sample scripts given by the class teachers were a good spread from 7 to 20 out of 20 with marks of 7, 10, 10, 11, 12, 13, 15, 15, 15, 16, 19 and 20. The grades proposed by the class teachers covered the target group with 5 grade C’s, 3 grade D’s and 4 grade E’s. There were no grade F’s proposed although this grade is available at Intermediate level (vide 6.1.1). (Candidates expected to achieve grade F should be entered for Foundation level.) The marks and grades were taken from the cover sheets which were not available to the markers although one or two may have been known where the marker was also the class teacher. When the markers were interviewed after the exercise (vide 6.7) all but one thought the sample was a fair representation. The following comments on scripts, grades and markers are made on the basis that the sample did represent a fair range of
standards for entry at Intermediate level.

ii) Scripts and Marks (table 6.4.7)

Despite the suggestion that there was no need to re-mark scripts from their own school, 6 of the 12 scripts in the sample were awarded a different mark by the class teacher/marker during the trial.

Individual assessments by the eight markers produced marks which ranged from 2 (marker M8, script I1) to 19 (scripts I7 and I12) out of 20. Six of the eight markers found scripts they judged worthy of 19 out of 20. The mean marks for the 12 scripts were a good spread from 7.6 to 18.3 with marks of 7.6, 9.0, 9.3, 10.3, 10.4, 10.9, 11.8, 13.0, 13.3, 13.4, 17.6 and 18.3 suggesting the markers recognised a range of standards within the sample.

It is significant that the mark on the cover sheets was higher than the mean mark for 10 out of the 12 scripts in the sample. This suggests the class teacher is seen as being more lenient with their own pupils although this is less marked than with the Foundation level sample.

Three markers (M2, M4 and M5) were regarded as being lenient in marking; M4 and M5 were also lenient in marking at Foundation level.

The same two markers (M7 and M8) who were severe at Foundation level were also severe at Intermediate level.

Two of the scripts (I7 and I12) received almost universal acclaim with only one marker disagreeing on I7. There was
general agreement that these two scripts were exemplary but it was significant that no marker gave them 20/20 during the trial.

It was disconcerting to find that three of the scripts (11, 16 and 19) were awarded marks which had a range of 8 or more out of a possible 16 marks available to the Marker. This represents a very wide divergence of opinion.

iii) Grades and Marks (tables 6.4.8 and 6.4.10)

As with Foundation level only one marker (M8) had applied a definite scale to convert the marks awarded to a grade. Four markers (M1, M2, M5 and M7) were inconsistent in their transfer between mark and grade and these did not include those who were inconsistent at Foundation level. Over the two samples only one marker (M8) had been totally consistent in the conversion.

Two of the markers had used all five of the available grades; four of the markers had used only three of the five available grades. The author believes that one marker did not appreciate that grade C was available at this level.

Five of the scripts (8 of the 96 assessments) were judged as grade U by one or more of the markers; one marker (M7) in particular being responsible for grading four of the twelve scripts as grade U.

The scattergraph 6.4.9 shows that almost all the marks from 7 to 17 were spread across two grades and from the other dimension each grade in the target group spanned 6 or
iv) Markers (table 6.4.7)

The Sum Totals for the eight markers were spread from 131 to 163 with a mean value of 144.6.

<table>
<thead>
<tr>
<th>Marker</th>
<th>M7</th>
<th>M8</th>
<th>M6</th>
<th>M3</th>
<th>M1</th>
<th>M4</th>
<th>M5</th>
<th>M2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum Total</td>
<td>131</td>
<td>132</td>
<td>137</td>
<td>140</td>
<td>146</td>
<td>154</td>
<td>154</td>
<td>163</td>
</tr>
</tbody>
</table>

severe

Using the same reasons expressed in 6.5.2 part iv) Sum Totals in the range 133 to 157 would be acceptable. With this sample five of the eight markers came within that range and the other three could not be considered to be significantly out of step. This suggests there was much more agreement between the eight markers at Intermediate level.

The Sum of Ranges showed that all the markers were able to discriminate well against a mean value of 24.5.

<table>
<thead>
<tr>
<th>Marker</th>
<th>M5</th>
<th>M6</th>
<th>M2</th>
<th>M3</th>
<th>M4</th>
<th>M1</th>
<th>M7</th>
<th>M8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of Ranges</td>
<td>18</td>
<td>20</td>
<td>22</td>
<td>22</td>
<td>23</td>
<td>27</td>
<td>31</td>
<td>33</td>
</tr>
</tbody>
</table>

The Marker (M3) who did not discriminate and was found to be severe at Foundation level was close to the consensus at Intermediate level (table 6.4.10).

6.6 The Discussion

At the start of the discussion each marker was given a copy of the Tables of Marks Awarded (6.4.2 and 6.4.7), the Tables of Grades (6.4.3 and 6.4.8) and the Scattergraphs (6.4.4 and 6.4.9) to examine. There was unfortunately little time to discuss anything other than three main
points which emerged.

1. "What is the mapping between marks and grades?"
The aims and objectives for GCSE and the scheme of assessment were considered and the following assertions agreed by the markers.

i) Candidates in the Target Group should be attaining between half and full marks.

ii) Candidates awarded the Target Grade (Higher-B, Intermediate-E, Foundation-F) should be attaining two thirds of the marks available.

iii) Candidates awarded the highest grade in the Target Group should be attaining three quarters of the marks available.

With these in mind the markers proposed grade boundaries for GCSE coursework as follows:

<table>
<thead>
<tr>
<th>FOUNDATION level</th>
<th>marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>grade standard</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>17 18 19 20</td>
</tr>
<tr>
<td>F</td>
<td>13 14 15 16</td>
</tr>
<tr>
<td>G</td>
<td>9 10 11 12</td>
</tr>
<tr>
<td>U</td>
<td>0 to 8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTERMEDIATE level</th>
<th>marks awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>grade standard</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>17 18 19 20</td>
</tr>
<tr>
<td>D</td>
<td>13 14 15 16</td>
</tr>
<tr>
<td>E</td>
<td>10 11 12</td>
</tr>
<tr>
<td>F</td>
<td>7 8 9</td>
</tr>
<tr>
<td>U</td>
<td>0 to 6</td>
</tr>
</tbody>
</table>
The Scattergraphs (6.4.4 and 6.4.9) then had boxes drawn around the suggested grade boundaries. The number of *’s within the boxes were counted and the figures highlighted the divergence of opinions.

Foundation level 6.4.4
Of the 96 assessments 52 were within the agreed grade descriptions (boxes) and 44 were outside. All the 44 outside the agreed grade descriptions had been awarded a better grade. This seemed to suggest that the grade boundaries be lowered but no concrete proposal was made.

Intermediate level 6.4.9
Of the 96 assessments, 78 were within the agreed grade description. Of the 18 which were outside the agreed grade descriptions 11 had been given a better grade and 7 had been given a lower grade. This seems a reasonable distribution as none were more than one grade away from the agreed grade.

2. "I can’t help noticing that two people have marked consistently harder than the rest."
The reason given for this was because the two markers (M7 and M8) did not believe that the sample contained work which conformed to GCSE criteria. The general criticism by these two markers was that there was little evidence of personal contribution by the candidates and that detailed worksheets had obviously been used.

3. "What do we do now?"
The markers were all agreed that they believed they "knew" what grade each piece of work was worth. That is not to say that they agreed with each other. The best way forward seemed to be to look at all their pieces of work and consider whether in the light of the days experience a different interpretation of the assessment criteria could produce a mark which would place the script in the bands that had been proposed for that grade (page 136). It was also suggested, by the author, that where there was more than one teacher involved in a submission then they should sit down and moderate each others scripts before completing the entries so that the rank order was correct. Two or three of the class teachers were noticeably dismissive about this suggestion as they thought the time involved was excessive.

6.7 The Interviews with the Markers
Following the Agreement Trial five of the eight markers who participated were interviewed using a common set of questions. The interview was designed to enquire into the background and teaching experience of those markers. It was also used to gauge opinion as to the value of the agreement trial as an In-Service Training exercise. A record of the interviews is given in Appendix 3. Three of the participants could not be interviewed as they worked out of the county and resources were limited. Nevertheless they
expressed favourable comments about the value of the exercise and the discussion before they left the Mathematics Centre at the end of the day.

The markers who participated had generally a long experience in teaching of between 12 and 20 years apart from one teacher who was in her probationary year. There were three graduate mathematicians and two were Cert.Ed qualified. With the exception of the probationer all had some experience of teaching all levels of ability with entrants to GCE and CSE examinations.

The reason given by those interviewed for attempting the 1988 entry for the coursework option to GCSE varied from a spirit of adventure to career ambitions. Only one school where an interviewee worked had previous experience of coursework with their own mode 3 CSE so most were first time entrants. No school had adopted coursework throughout the mathematics department, preferring to allow individual teachers to decide for themselves. Even then it was not necessarily the whole class that were entered for the coursework option. The programme of coursework appears to have been organised by the teacher concerned rather than being part of an overall departmental plan. Only two of the five markers interviewed had direct contact with the GCSE Phased Training programme and there was no evidence that the intended Cascade Training had taken place within any department. The GCSE Phased Training programme appears not
to have reached beyond those who attended the meetings except via the normal conversation between colleagues. The support of the Coursework Consultancy Service (vide 6.1.2) had not been used except by one school who received advice on the Control Element.

There is evidence from the interviews that no formal internal moderation had been applied by the departments involved. The nearest to any form of comparison and agreeing of standards is that in two cases teachers looked at each other's work. One marker who was not available for interview stated at the end of the agreement trial that he intended to formally moderate subsequent to the agreement trial so the scripts provided by him for the trial may have been remarked by the time they were submitted to MEG for external moderation. The author was aware during the interviews and from later conversations that the method used in the agreement trial is a technique new to most teachers. The interviewees expressed concern at the time needed to conduct the trial properly being far more than they can expect to be granted in school.

All thought the sample of work used in the trial was a fair sample although one interviewee thought the quality of the mathematics seen in the scripts was poor, commenting in particular on the absence of extended mathematics, trigonometry, algebra and equations. "There are a lot of gimmicky things dreamed up for coursework." There were no
significant differences noted between schools apart from a confident "Ours were better" and some questions as to the length of time that had been allowed for some of the assignments. The wide range of marks awarded for particular scripts surprised none of the markers and was expected by most. "It is the first of its kind." "Nobody knew what they were doing with this mark scheme of the Board." In spite of this there were no indications that any of those interviewed had any intention of revising the marks already awarded in the light of what they had learned during the trial. This was a fact the author found surprising.

The format of the trial day and the techniques used in the analyses found favour with all those interviewed who thought it should be repeated with a wider audience as part of a continued support from the Board or the LEA. One benefit was the opportunity to see what other schools were doing in coursework and to gain confidence from discussion with others "In the same predicament." The criticism rested with the lack of time to consider individual scripts after the overall analyses. Most of those interviewed were certain that this would have been a very worthwhile and illuminating extension.

6.8 Conclusions from the Agreement Trial

The author gained the opinion from discussion with the class teacher/markers who took part in the Trial that each
one was convinced they had the right marks and grades for their own pupils - before and after. This was even though they knew the mean mark from the eight markers was lower than the class teacher’s mark for 22 out of the 24 scripts in the two samples. The impression was that each of the markers believed it was the others who were too severe. The two markers who did not have a GCSE entry class were critical of the standard of work shown in the samples. The Board’s stated view is that provided a school produces a correct rank order of candidates then tendencies to leniency/severity will be corrected by the external moderation process as will timidity, although less perfectly. The teacher should be concerned with reliability by applying consistent standards of marking over a period of time and between groups. The teacher should be concerned that the work done by the pupils is valid in that it is a true assessment of the objectives being tested. Judging by the responses of these teachers in interview they had reached their decisions on standards without outside assistance. The final arbiter on coursework standards is the Chief Coursework Moderator and through him the Team Leaders and through them the Coursework Moderators assigned to each school. Ideally the team of external moderators should have a very high degree of reliability in that all should award the same grade to a submission as the Chief Coursework Moderator. This can only be tested by some
similar form of Agreement Trial. One must ask if this has taken place.

It is agreed, by all the teachers the author has discussed this with, that the flaw in the system is the lack of communication between the external moderator and the head of department. Moderators are not allowed, by their contract, to communicate with a head of department except in conducting the administrative part of their duties. A head of department cannot discuss with his/her appointed moderator the quality of the coursework submission from the department. He/she cannot receive praise, criticism or advice on the departmental interpretation of the coursework scheme unless the school is in a position to appeal against the moderator's decision. The school must be notified if the marks awarded by the department have been altered by more than $10$ (out of $100$) and the appeal can be considered on two grounds only. The first is if the school claims to have submitted work in previous years of a comparable standard without penalty. The second is if the school alleges the moderator has exceeded his/her brief or failed to carry out his/her duties in accordance with MEG instructions. Schools may, therefore, have their proposed coursework marks for the whole submission reduced by as much as $10$ out of $100$ on a regular basis without ever being able to take action. It is like running a race and simply being told that you finished.
The Agreement Trial demonstrated there was no agreement on standards between the eight markers, six of whom were teachers actually submitting candidates for the coursework option in the first year. The Agreement Trial also showed the differences were across an unacceptably wide range and were in excess of the sort of minor adjustment the external moderators should be expected to make. From the meetings held where teachers have seen coursework there is a strongly held view that three things should happen:

i) GCSE grade boundaries should be published, in general terms, as guidance for teachers marking coursework.

ii) In-Service Training should concentrate on

   a) the choice of coursework assignments suitable for the level of entry,

   b) giving teachers advice and guidance on marking GCSE coursework to encourage the familiarity with standards of grading.

iii) The external moderator should be allowed and encouraged to communicate with the school certainly until about 1994. Teachers have expressed the view at Self Help Group meetings that after three or four years of such a dialogue they will feel much
more confident in assessing coursework.

6.9 Working with the Other Trainers

The group of six trainers working in the East Midlands area of MEG drew their advice from the EMREB. The expertise and techniques in moderation were based on the practices developed over many years with EMREB CSE assessments. Until GCSE there had been little coordination between any of the five constituent Examination Boards of MEG (EMREB, Oxford and Cambridge Schools Examination Board, Southern Universities' Joint Board for School Examinations, WMEB and UCLES). During the introduction of GCSE through the phased training programme each of the five sets of trainers operated independently and under different circumstances. Chance discussion between the author and the leader of the WMEB trainers revealed the WMEB had no mechanism for advising on internal moderation procedures. The author was subsequently invited to a meeting of the WMEB trainers in February 1988 as an observer. The discussion revealed that the WMEB was about to embark on its Phase 4B programme of meetings (covering assessment and moderation processes) in March 1988. The author was asked to provide details of the methods demonstrated at the EMREB Phase 4B meetings. The agreement trial process was outlined and provoked a deal of interest among the WMEB trainers and the author was asked to provide resource materials for a similar exercise in the
West Midlands. Working with the leader of the WMEB trainers the author provided the necessary documentation and advice on interpretation/analysis with sample data from the Horncastle agreement trial. The WMEB used examples of coursework from their own region to use in the Phase 4B meetings. Some modification to the marking schedule was made but the method was accepted and used by the WMEB trainers.

After each West Midlands Phase 4B meeting the participant teachers were asked to evaluate the methods demonstrated. One comment in particular, passed to the author by the WMEB trainers' leader, was very encouraging and revealing. A head of department had written, following the trial marking and analysis "...I was never sure before whether I was marking properly or whether there was disagreement on interpreting the classes (classification). I now know that I understand the criteria but I am marking too stiff." It suggests that the method did help one teacher compare her standard of assessment to that of other teachers. This satisfied the objectives of the agreement trial proposed by the author at the Horncastle meeting (vide page 109 A a and b). The WMEB trainers' leader reported general satisfaction with the content and administration of their Phase 4B training programme.
Chapter 7

Other In-Service Training Activities

Introduction
During the period of the introduction of GCSE 1986-88 the author was fortunate in being involved in several In-Service Training initiatives. These were additional to the development of the lower school scheme of coursework and the introduction of GCSE coursework in Lincolnshire secondary schools and in some way complementary to the training role proposed by the ESG mathematics Inspector (vide 2.1).

7.1 Observing Classroom Activities

"What do I do when it is a coursework lesson?"
"What do I say when they get stuck or I see them going wrong?"

These and related questions were raised with the trainer at the Lincoln Phase 2 meeting in February 1986. Representatives at that meeting could find no identifiable role for the classroom teacher with the problem solving exercises demonstrated. No specific answer was available at the time as no classroom practice was being suggested by MEG. The questions persisted at the Phase 3 meetings although the main interest was still centred on administration of the new examination system rather than the practicalities of managing coursework in the classroom.
At the Phase 4 meetings, when coursework became an issue, more information had become available to the author from a variety of sources; work undertaken at YHS, association with the other five EMREB trainers and the published MEG GCSE mathematics syllabus. In an effort to answer the questions about the teacher's role in the classroom the author described situations which might arise and how they might be dealt with in the classroom. It was evident to the author that such descriptions could not replace first hand observation of how an assignment may be introduced to a class or how assistance might be given to a pupil in keeping with the aims 2.1, 2.2 and objectives 3.16, 3.17 of the National Criteria. There are two major handicaps to a teacher sitting in with another class to find out exactly how a colleague deals with a particular piece of mathematics coursework in the classroom.

i) The observer has to be free of commitment for the periods of the lessons in question. This inevitably means some cover is required and it is not generally available. If there are several observers then the problem becomes almost impossible to resolve.

ii) Both teacher and pupils tend to behave differently when there are visitors to the classroom unless they are accustomed to the intrusion and the role of the visitor(s) is accepted.
The problem of establishing custom and practice in dealing with coursework at YHS had to be resolved in October 1986 when coursework was being reintroduced in the lower school (vide 4.2). Initially the author, as at the training meetings, attempted to prepare other teachers in the department by description and explanation. In reviewing the scripts of all the pupils after a piece of coursework it was observed that scripts from the author's class were thought to be more comprehensive than others. The teachers in the department expressed reservations about giving too much help to pupils, either in the introduction to the assignment or in conversation and, in the author's view, were reluctant to engage in a dialogue. It was not possible for all of the department to observe a coursework session directly and yet it seemed important for them to see the author in action. The solution proposed was that a week of coursework lessons be videod and then used as a basis for discussion.

The YHS Audio Visual Technician arranged to attend a week of mathematics sessions with one class while they undertook an assignment. As the Technician was not a mathematician the lesson plan was explained and some general principles were agreed with the author. The introduction was to be recorded in full from the back of the classroom and discussions with individual pupils would be arranged so
that the camera had a good view. The tables and chairs were rearranged before the lesson to make space for the camera in a rear corner of the classroom. This gave the widest angle of view and necessitated least movement of the camera to cover the introduction and class discussion. A dry run with the camera before the lesson highlighted one or two technical problems which were soon resolved.

At the start of the lesson one of the girls asked permission to be absent on religious grounds. It was not a good idea for her to miss the assignment so the Technician arranged for her to sit under the camera in the corner and not to be included in table-side conversations. The class quickly forgot about the camera during the introduction as did the girl sitting underneath who kept putting up her hand to contribute to the discussion. When the class were engaged in the investigation the author moved from table to table talking to individual pupils. These were filmed in close-up by the Technician who set up the camera nearby.

At the end of the week there was about 2 hours of recording on tape. As it was not reasonable to expect the department to view all the film it was edited by the author to leave about 15 minutes of selected highlights. After watching the video, teachers in the department expressed the view that they had a better understanding of the nature of the conversation with the pupil but felt they had approached the introduction to the assignment in a similar way to the
author. They also expressed some reservations about the quality of the conversations with the class observed (which was a top set) and it was thought that with less able pupils the approach would have to be more directed. The author was asked to repeat the exercise with a middle and a low ability class. This was done. Two of the pupils from the low ability class were interviewed in the classroom (on video) as a Control Element (vide 6.1.3). The depth of understanding these two pupils showed in the interview about the rule discovered in the investigation was unexpectedly high. These films were also shown to the department after editing and were felt to be as valuable as the first. After trying a subsequent investigation all the teachers in the department expressed more confidence in dealing with coursework in the classroom. Sections from two of the films were also shown at the Phase 4B training meetings to show how the author approached the question of what to say in the classroom and what to do when the pupils are faced with a problem they cannot resolve. Needless to say they provoked a deal of discussion and some disagreement. Two short sections showing how a Control Element may be assessed were also shown at the Phase 4B training meeting to illustrate a method of using a standard response sheet to record a scripted interview with a pupil. This was well received by those attending. It has to be accepted that the resulting videos are very
amateurish both in camera control and in sound quality but the editing was used to present a much better impression of the issues in the classroom. It takes a lot of time to plan, present and edit such a video but there are several advantages to its use in In-Service training within a department.

i) In trialling a new assignment all teachers can see what one class achieved and thus make the revision and production of materials more efficient. The YHS team said that it had more impact as they knew both the presenter (the teacher taking the lessons) and some of the pupils.

ii) It is a permanent record which can be retrieved for later use with teachers who are new to the school or new to coursework.

iii) It removes the closed-box idea of a mathematics classroom; particularly if different teachers act as presenters with their own class. At YHS one young teacher, in his second year of teaching, improved his confidence by having one of his own lessons recorded and editing the resulting video.

iv) Looking forward to 1991 when the Assessment of Oral Skills will be required, the use of such videos would be an ideal training medium in school.

7.1.2 LUT Video

On many occasions during 1986/88 colleagues expressed doubts as to the suitability of Practical Geometry in the
list of topics (vide 6.1.1); particularly in respect of the suggested titles offered by MEG in the syllabus 1651 document.

Simple surveying.
Scale drawing, maps.
Model making.
Construction of curves.
Spirals.
Geometry in nature.
Packaging.
Wheels and gears.

Teachers at the training meetings, and at some of the Self Help Group meetings, criticised a lack of opportunity for computation in the topics suggested (above). In general they felt that only one skill, or area of knowledge, could be developed in each topic and this would inhibit the more able pupil. In addition many could not see a relationship between the contents of the published examination syllabus and the topics listed in the Practical Geometry list. It seemed, to the author, that some teachers were trying to equate the mathematics of geometrical coursework with the mathematics of the examination papers rather than with the aims of the course and the scheme of assessment. In order to relate the aims of the coursework to particular aims of the course the author produced and presented a video on Practical Geometry. The pupils were "borrowed" from a colleague at YHS and the materials were the Mathematical Activity Tiles (MATS) supplied by the Association of Teachers of Mathematics. The video was recorded using the facilities at LUT. A copy of the video may be obtained on
request from the author.

The fifteen third year pupils involved in the recording were selected by their class teacher. While the pupils had a good standard of mathematical ability they had not been part of the groups trialling the lower school scheme of coursework at YHS so they had no previous experience of investigation. As there was a limited time available for the completion of the recording it was necessary to plan and prepare in much more detail than with the early recordings at YHS. The lesson plan was discussed with the staff at the LUT studio so they were able to organise the technical side of the recording.

The objectives for the lesson were

1. to demonstrate the use of the MATs in constructing a polyhedron,

2. to encourage the pupils to discuss and describe the construction and completion of their models (aims 2, 10, 13)

3. to devise a system of recording a description of each polyhedron in terms of the tiles used and number of faces, edges, vertices (aims 5, 7)

4. to investigate the relationship between the number of faces, edges and vertices (aims 10, 15)

The aims are taken from the 1988 MEG syllabus 1651.

The introduction, by the author, was a discussion on polyhedra followed by a demonstration on the use of Copydex adhesive in joining the tiles. The pupils were then set the task of planning and constructing their own polyhedron using the full range of tiles available. The author moved
among the class talking to individuals about their design and any problems. At the beginning of the lesson the pupils were a little short of confidence, partly because practical work of this nature was a new experience and partly because they were in an unfamiliar classroom with video cameras watching them work. (This was revealed by the pupils on the return journey to Lincoln.) When the models were completed the class discussed the recording of the details of each model and then completed a table of results for 12 different models chosen and numbered by the author. A large master table was prepared and used as a basis for investigating the relationship between the number of faces, edges and vertices. It was evident that many of the pupils had already devised a rule to explain the relationship while completing their own table of results. The final task was for the pupils to test the rule on all of the shapes in the table. The rule, known as Euler’s theorem, is that for any polyhedra

\[ F + V - E = 2 \]

where \( F \) = number of faces
\( V \) = number of vertices
\( E \) = number of edges.

On the return journey the pupils were suggesting designs for more complex polyhedra and deciding, in abstract, whether Euler’s theorem was still true in cases where the shape was irregular or concave. They were all shown the unedited and the edited versions at a later date. The 150 minutes of recording from two cameras was edited
into a 15 minute Training Film with commentary and captions. The commentary was intended to explain the proceedings to an audience of teachers and to identify problems which might be faced if/when they tried a similar lesson. The captions were there to highlight the appropriate aims and objectives taken from the National Criteria. The sound quality was poor as the microphones were directional, being part of the camera unit and picking up too much background noise which covered the conversations held with the pupils as they worked.

The video was shown to some of the Self Help Groups and received a mixed reaction. Most were interested to watch what was a new activity with new materials (the ATM tiles) in use. (Checking with the ATM at a later date revealed that there are only a handful of ATM members teaching in Lincolnshire secondary schools.) When given the opportunity to try, for about five/ten minutes, to use the Copydex to join a few tiles together only the members of one Self Help Group accepted. The same reluctance, on the part of teachers, to get involved in practical work was experienced by the author on other occasions. Even when a box of ATM tiles and Copydex were offered for trial in schools only one school accepted the offer. The references to the National Criteria were largely ignored by those who saw the video. Indeed two people asked what were the captions for.
7.3 "A Baker Day"

In preparation for, and in support of training for, GCSE the Secretary of State for Education, Mr K. Baker, set aside three extra days for In-Service training of teachers in secondary schools in the year 1987-88. In the year 1988-89 there will be five such "Baker Days". The organisation of the In-Service training on these days is at the discretion of individual Lincolnshire schools. The head of mathematics at one Lincolnshire secondary school arranged for his department to use the facilities of a local Centre for Industry and Science on the training day in January 1988. The author was asked to participate in the programme for the day and to lead one of the sessions.

Four members of the department each presented a half hour item on some topic of interest and the author, as arranged with the head of department, presented some ideas on the "An Introduction to Algebra through Coursework." The assignment Perimeters was put to the audience without worksheets and they were asked for a rule expressed in words for polygon strings which were based on

- triangles
- squares
- pentagons
- hexagons

Most coped admirably, not having seen the exercise before, apart from one who did not understand the word Perimeter. By the time they reached hexagons they were insisting on
expressing their rule in algebraic form by substituting a letter for parts of the rule in words. This was then suggested as a better way to introduce, or let the child discover, algebraic terminology as a way of formulating an algorithm. It was accepted as a more interesting alternative to the more common approach "If n is 3 then 2n has the value 2 times 3". The discussion was cut short through lack of time but was beginning to centre on the ability level of the pupil who could cope with this input. One teacher, who was not a trained mathematics teacher, commented afterwards that "Looking at the several separate ideas together put the algebra in context".

7.3 Practical Work in the Classroom

As reported in chapter 5 and elsewhere there was stiff opposition to the introduction of coursework in any form by teachers from grammar schools. At one school, however, there was one young teacher who was not quite so opposed to the change. Through the head of department he asked if the author would take one of his classes to demonstrate how a coursework lesson on practical mathematics could be organised. In discussion with the teacher it seemed to the author that one assignment in particular would be suitable for the teacher. It was an assignment the author had not yet had the opportunity to try and had not, to his knowledge, been tried elsewhere in the county. In the
Appendix 2 to the report Mathematics from 5 to 16 an example is given in some detail. The pupils are given a square piece of paper 16cm by 16cm and asked to construct the net of an open-topped cuboid. After being asked to find the capacity of their cuboid the pupils are then asked to investigate the dimensions of other cuboids, made from the same size paper, in order to decide upon those dimensions of the net which give the cuboid the greatest capacity.

The only suitable class available was a third year class who had done little coursework before but were apparently a lively group. The mathematics department did not have either the squared paper or the scissors required and the author had to borrow the Art department guillotine to make up the 16cm squares before the lesson. The department did not consider the lack of resources to be a problem for the future.

According to the teacher the class were well versed in the use of a calculator and in drawing graphs and this was found to be the case as the lesson progressed. The pupils, like the YHS pupils described in 7.1.2, were lacking in confidence early in the lesson particularly when they were asked to use the scissors to make the net of an open-topped cuboid. It may have been the fact that the author was a newcomer but they were certainly less forthcoming and articulate than other pupils with experience in discussion encountered by the author. These pupils certainly knew how
to effect the processes but found it difficult to explain the procedures. Nevertheless their mathematical skills enabled them to discover the dimensions of the cuboid with a maximum capacity by the end of the lesson. They did this by the combined use of a calculator and graph work producing an answer correct to 2 decimal places. They were asked to write an account of their work for homework. The scripts the author saw later showed a high level of computational ability, together with excellent graphs but there was little or no description of the procedures involved in the work.

7.4 LOGO

At the Self Help Group meetings later in 1988, when teachers were beginning to be more aware of the demands of the new coursework requirements, questions were asked about the sort of lower school assignment that could be called Practical Geometry. Many of the teachers encountered were familiar with the geometry associated with the syllabus content and examination questions but could not envisage the sort of activity which could form the basis of a piece of coursework. A colleague in the ATM suggested that introducing teachers to LOGO may be a way of showing how this could be achieved. LOGO is a computer language which, in its simplest form, is used to produce geometric drawings on a screen. The ATM regularly produces magazines and
articles on the use of LOGO in the classroom. With such a low membership of the ATM amongst Lincolnshire secondary teachers it would be a new topic to introduce to the county. When enquiries were made by the author at the Self Help Group meetings it transpired that there were no schools with LOGO facilities and teachers were interested in the provision of a one day seminar on the topic. Money was made available from the In-Service Training Budget to purchase 12 LOGO chips together with the manuals and associated software. All the county secondary schools were circularised inviting the head of department to apply for a place on the seminar for one member of the department who had to be familiar with the ideas of GCSE coursework and with the use of a BBC microcomputer. Applications were received from 36 schools and the 12 places were allocated by drawing names out of a hat. Each teacher was asked to attend with a BBC microcomputer and a small screwdriver as the chip was to be fitted to their own school machine and then retained at the end of the day. This was a great attraction as the school would be involved in no expense apart from any extra LOGO chips they wished to purchase. The services of the staff and the facilities at MEDU were organised and the author agreed to be the tutor. On arrival at MEDU each teacher was given their LOGO box and asked to follow the manual instructions to fit the chip in their BBC microcomputer. The MEDU team were on hand to
assist with any technical problems of which there were several. In the limited time available the intention was to introduce the teachers to the LOGO language in the morning session and in the afternoon give them an opportunity to discuss its use in coursework and try some examples. A list a basic LOGO commands in the form of notes and exercises related to specific pages in the manual were issued to the teachers. They then worked their way through this limited list, working in pairs, with assistance from the author when required. This took much longer than anticipated. The second half of the afternoon was devoted to discussion and some experimentation on ideas for coursework using LOGO as the starting point. The discussion was very useful to the author as all the teachers had participated in the lower school coursework trials and were familiar with other investigations and the techniques of assessment developed in the trials. The day was felt to have been a success by the teachers and the group requested a follow up day in spring 1989 to discuss LOGO and GCSE coursework.

Subsequently it was discovered that at least three of the teachers concerned were taking the BBC microcomputer home over August to improve their knowledge of LOGO. It was significant that, at the end of the day, several expressed the view that it would take a long time (which they implied they did not have) to become "...an expert like you". They
were very surprised to find that it had taken only about six hours of intensive work on the previous day to learn sufficient of the LOGO language to prepare for the course.
Chapter 8
Summary

Introduction
The inclusion of an obligatory coursework component in the assessment of the attainment of pupils at GCSE level in 1991 has been responsible for changes in the teaching and learning of mathematics. In 1987, 14.5% of the EMREB mode 1 CSE awards involved the assessment of an optional coursework component. The provisional entries through EMREB, in November 1987, for the 1988 GCSE showed a 15.3% entry for syllabus 1651 (with the optional coursework component). Allowing for the normal reduction in this figure when entries are confirmed, the EMREB Officer was of the opinion that the actual coursework entry for GCSE would be similar to the 1987 CSE entry. When the entries were confirmed in spring 1988 the figure had fallen from 15.3% to 9.1% for EMREB. This shows a marked move away from coursework assessment by centres registered with EMREB. The entry figures from the other constituent boards of MEG showed a similar pattern.

<table>
<thead>
<tr>
<th>Constituent Board</th>
<th>Provisional coursework entries</th>
<th>Confirmed coursework entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCLES</td>
<td>10.2%</td>
<td>7.8%</td>
</tr>
<tr>
<td>SUJB</td>
<td>17.4%</td>
<td>15.5%</td>
</tr>
<tr>
<td>O &amp; C</td>
<td>11.1%</td>
<td>6.0%</td>
</tr>
<tr>
<td>EMREB</td>
<td>15.3%</td>
<td>9.1%</td>
</tr>
<tr>
<td>WMEB</td>
<td>5.5%</td>
<td>3.9%</td>
</tr>
<tr>
<td>MEG total</td>
<td>10.3%</td>
<td>7.0%</td>
</tr>
</tbody>
</table>
In Lincolnshire the percentage of county pupils entered for coursework assessment at CSE has always been less than the overall EMREB figure. In 1987 5 schools used a coursework component for some of their CSE mode 1 candidates amounting to less than 5% of the county CSE mathematics entries. The number of county schools participating in the optional GCSE coursework assessment fell, from a provisional 6, to a confirmed 3 (vide 6.2.1). These schools used the coursework component for some of their GCSE candidates amounting to less than 2% of the county GCSE mathematics entries. The figures show a marked move away from coursework assessment with the change to GCSE in 1988. The figures also show the use of coursework in GCSE assessment in Lincolnshire is much less widespread than in the EMREB area as a whole.

From 1986 all schools had to begin preparations for 1991 when coursework is no longer an option at GCSE. Representatives of all the Lincolnshire secondary schools participated in the phased training programme for GCSE and 63 schools took some part in the Self Help Group work. This chapter is a summary of the changes in these schools observed and recorded by the author during the period 1986-88.

[The percentages above have been calculated using figures provided by EMREB and MEG.]

8.1 The Learning of Coursework Skills

Based on the above figures for GCSE entries in 1988 and on the comments made by teachers at the Phase 2, 3, 4A and 4B
training meetings (vide 2.4), it is evident there was little experience of, or enthusiasm for the introduction of, coursework to GCSE assessment in Lincolnshire. This view was confirmed many times in the Self Help Group meetings and at the school visits made by the author. Teachers emphasised their priorities were the acquisition of those facts and the practice of those techniques relevant to the content of the time-limited written examination papers. While there are no published figures for Lincolnshire, heads of department have stated at Local Subject Panel (mathematics, North Lincs & South Lincs) meetings that they enter from 80% to 90% of their fifth year for some external examination in mathematics each year. This is a little over the figure of 80% quoted at the time of the Cockcroft Report (para 442) in 1982. Because very few heads of mathematics departments in Lincolnshire enter all of their fifth year for an external examination this means that almost all pupils follow a mathematics course based on time-limited written examination papers.

This has influenced the style of teaching by the majority of Lincolnshire teachers with the exception of the staff at the Guild School (vide 5.6). In discussion at the Self Help Group meetings and observed by the author in visits to schools (vide Appendix 2) this can be described as some form of exposition by the teacher, pursued by some reference to texts and ending with answers on paper. Some
teachers have even adapted this technique to the coursework lesson (vide 5.3). This technique stresses the importance of answers being either right or wrong and that for most of the time there is only one route to the answer which can be considered suitable. It does not involve a pupil in:

i) identifying a problem,

ii) researching the facts and possibilities,

iii) making decisions about how to proceed (and in some cases whether to proceed),

iv) co-operative effort,

v) using equipment and materials not found in the examination room,

vi) discussion other than the usual question and answer dialogue with the teacher who is looking for the right answer to his/her question.

Yet all of these skills are the ingredients of real life mathematics, brought to the fore in the Cockcroft Report (paras 243 to 250) and included in the assessment objectives (3.16 and 3.17) for GCSE mathematics. The reason for these skills being included in the assessment objectives rather than in the aims of the GCSE course was given at the Lincoln Phase 2 training meeting as being "..if they are not assessed then mathematics teachers will not follow what is considered to be good practice." The title coursework was given to identify the activity by which pupils might acquire these skills and present evidence of their success. MEG was were careful to point out, initially through the Phase 2 trainer, that the common
form of CSE coursework, which usually consisted of classwork type exercises on topics supposedly not examined in the written papers, would not fit the requirements (vide 3.2 part ii). The skills themselves were never defined in any more detail than the statements in the assessment objectives 3.16 and 3.17 in the National Criteria. It was mentioned at some time at each of the Phased training meetings attended by the author that mathematics teachers have always felt capable of teaching to any examination by referring to the syllabus content, the number and duration of the examination papers and then the sample or past examination papers for the basis of their teaching strategy. They complained that they were being asked to manage and assess the acquisition of skills which were not clearly defined and of which the vast majority had no direct experience. A better understanding of these skills has emerged as a consensus over the past two years as teachers have had the opportunity to meet with others through local Self Help Groups and discuss the developments in their own school. Teachers have reported at these meetings that they have felt progressively more comfortable with coursework assignments and their assessment. The author has observed in the many samples of written work offered at the meetings a general improvement in the standard of presentation and argument shown by the pupils. Attempts to produce a objective list of individual
coursework skills at Self Help Group meetings have been inconclusive. As the trials of the lower school coursework developed the teachers involved became confident enough to express opinions on the nature of coursework skills. The author has compiled the comments and ideas associated with a definition of coursework skills and expressed by Lincolnshire teachers involved in the Lower School scheme of coursework into two lists. The first is associated with the activity - how the pupils actually proceed with an investigation; the second is concerned with the nature of the script - what teachers thought should be found in a "good" account of an investigation.

**Coursework Skills - List 1** (The Activity)

1. To understand a problem associated with an unfamiliar situation and discuss the problem with a third party.

2. For simple problems to recall and apply a simple procedure (the Investigation Algorithm vide Appendix 1) for solving the problem and to discuss the strategy with a third party.

3. For more complex problems to decide which of two or more methods is appropriate and to discuss the reasons for the choice.

4. To interpret the results obtained, forming some general conclusion based on the evidence and to demonstrate an application of that conclusion to a new but relevant situation.

It is an interesting feature of the development that some teachers have begun to, partly, assess their pupils' progress in coursework by considering their oral skills alongside their mathematical ability. Comments to this
effect began to appear at the Self Help Group meetings where several pieces of coursework had been trialled (South Lincoln, Gainsborough, Sleaford and Bourne). Similar comments were made to the author in school visits (vide Appendix 2 items 2, 10 and 11).

Coursework Skills - List 2  (The Script)

The script should contain :

1. A statement of the problem. In the early stages it is sufficient to copy the problem as presented. As the problems become more complex pupils are expected to use their own words and give more detail.

2. An explanation of the method being used. In the early stages this is found to be difficult for most pupils. [Very few scripts seen by the author from trials of the lower school scheme include this explanation.]

3. A record of all the information from the activity. This should be in the form of neatly labelled diagrams, tables of data and associated calculations. [This was one area where teachers reported noticeable improvements in their pupils' work.]

4. A conclusion. With the lower school scheme of work this will take the form of a rule in words and its application to a specific problem.

Evidence from the lower school coursework trials seen in the past two years leads the author to conclude that pupils do learn new skills as a consequence of coursework activity. The author has recognised this in pupils at YHS and other teachers have reported that they believe that their pupils have "...made a tremendous improvement over the past year.." to quote one head of department at the Local Subject Panel meeting (Lincolnshire North) in September 1988. These are skills not previously practised in
mathematics lessons in Lincolnshire. Only more time will tell if these can be extended into the descriptions offered in the MEG GCSE assessment criteria. Marion Bird [18] was quoted as encouragement by the SEC in their Guide for Teachers [19] in suggesting the effect that work of this kind would have on pupils. "Towards the end of the year, I felt that the confidence some of them were acquiring through making their own mathematical enquiries was starting to be reflected in their attitude towards awkward questions in textbooks. Rather than merely resorting to comments like 'I can't do it' or 'I don't understand this', some of the pupils were beginning to make far more of an effort towards sorting out difficulties by themselves." This has been confirmed in the observations made in the classroom by the author and in reports from the Self Help Group meetings.

8.2 Changes in Teaching Strategy
A strong point made by the SEC in their Guide to Teachers and repeated by the Phase 2 Trainer was that "The intention of assessed coursework is not that activities of the kind referred to in Assessment Objectives 3.16 and 3.17 should be hastily added to the curriculum as the examination approaches, but they should become a natural part of the mathematics curriculum at all ages." As the changes were so radical many teachers took advantage of the period of grace
until 1991 in order to develop along these lines. While it has been recorded that many heads of mathematics departments in Lincolnshire would prefer coursework to have been an option, having time to plan for 1991 was regarded as a refreshing change.

It cannot be said that the present situation in Lincolnshire schools has approached the ideal yet but substantial changes have been made in most schools to the introduction of coursework activities in the classroom. Every new piece of coursework is a challenge to the teacher and will require several trials in the classroom before it becomes a natural part of the mathematics curriculum. Nevertheless the author is aware of at least 50 of the 69 county secondary schools that now have a programme of coursework activities based on the Lower School scheme trialled through the Self Help Groups.

Some of those teachers involved in the trials who admitted to increased confidence are finding other ideas to try for inclusion in the scheme. Since September 1988 the author has received details of four further assignments which have been trialled by teachers for inclusion in their own lower school programme of coursework. Three of the assignments are suitable for assessment and will also be trialled at YHS at a later date. Eventually it is hoped that coursework will be included in the curriculum both as a means of assessing the pupils' attainment and as a vehicle for
teaching and learning the more traditional topics.

One of the main problems for teachers is whether a piece of coursework is appropriate to the selected class and it is only by trial that teachers discover what is appropriate and what is not. With experience teachers will be better able to judge the value of a particular assignment and its timing. Sometimes it will be obvious to an experienced teacher that the pupils do not have the necessary skills and knowledge to cope with the mathematics involved or whether the assignment could be the vehicle for their acquisition. One area which has not been developed within the scheme is the extension beyond the basic assignment. Teachers are still reluctant to allow the extra time to some pupils in order that they can extend the investigations and move into the "What-If" approach.

Experience with the more open-ended approach at YHS and Dragon High School (vide 5.8) suggests that given the opportunity pupils do become more adept at planning and making decisions.

In the matter of managing the activity in the classroom most teachers have had to adopt a different attitude to their traditional role. Previously they were regarded as the authority figure on matters of what is right or wrong, the provider of facts and techniques in preparation for examinations that they, the teachers, felt at home with. More material resources need to be available in the
classroom (vide 5.3). More thought needs to be given to the question of space and the arrangement of the room in order to provide the right conditions for coursework activity (5.5). In coursework the teachers were discouraged by the author from directing the pupils work and encouraged to adopt a more supportive role. Being in a new situation and not quite sure of the dividing line between what is acceptable intervention and direction created some insecurity amongst teachers. Being in a classroom where children were to be encouraged to talk and work together was a cause of anxiety as some teachers felt their control over the class weakening as the level of noise rose. Certainly on all the visits the author has made to schools over the past two years the recurring questions have been along the lines of "...what can I tell them?" "...how can I make sure they don’t copy?" "...what do I do if I see a pupil going wrong?"; previously very clear decisions for the teacher to make. The advice from the Chief Coursework Moderator has been to "... intervene in such a way that the pupil is enlightened through a guided discussion with the teacher". Furthermore any head of department who uses the Coursework Consultancy Service through EMREB is directly advised that while pupils are working in class it is expected that teachers will give them help in accordance with their normal practice. The different amount of help given to each pupil should be reflected by the mark for
Overall Design & Strategy. Through monitoring pupils' coursework in class teachers should be able to pick out any pupils' work that appears to have had a lot of help from other sources. The guidance for marking the Design & Strategy (vide 6.1.3) includes the comparisons:

Guidance for marking mark/4

- "strong personal contribution" 4/4
- "average help needed" 2/4
- "... even with considerable help" 0/4

One other cause for concern by the class teacher is the suitability of the assignment chosen for GCSE submissions (vide 3.2). In the early days of 1986-87 very few schools availed themselves of the Coursework Consultancy Service offered by the MEG and this was one possible reason for some coursework failing to meet the standards expected by the moderators. The number of entries for the MEG coursework option (syllabus 1651) is expected to rise from 9890 in 1988 (vide 8. Introduction) to over 140000 in 1991. It is in the teachers' interests to seek approval for the assignments to be submitted by their pupils and the according to EMRKB the number of referrals to them is rising rapidly from schools outside Lincolnshire. As most of the county schools have elected to wait until September 1989 (ready for GCSE assessment in 1991) they will then have the benefit of the experience of other schools in the EMRKB area. However, judging by the quality of some of the work seen from the first three years in Lincolnshire
schools, it is expected that the work eventually submitted for GCSE will be of a high standard. Lincolnshire teachers have made excellent progress in the matter of laying a good foundation for GCSE.

8.3 The Assessment of Coursework - Lower School

The first experience that most Lincolnshire teachers had of assessing coursework was at the Head of Department Conference in December 1986. It revealed a disturbingly wide variation in attitudes and standards amongst experienced teachers. This, coupled with a poor understanding of the assessment criteria for GCSE mathematics, provided a very poor base from which to start. The trials of the Lower School scheme of coursework have provided a framework for assessing simple assignments in a way that is easy to administer and is not too time consuming. The assessment of these investigations has identified issues that the teachers thought important in developing coursework. It is important to note that as the pupils become more proficient and the investigations become more complex the schemes of assessment (vide Appendix 1) consider the acquisition of more skills. Gradually the terminology of the individual assessment schemes moves towards that of GCSE and the structure becomes more general. Had there been more time available to the author then the last two assignments would have been assessed
using GCSE criteria as the last stage in the training process for teachers learning to assess coursework.

One point that has emerged in this research that was not planned. The assessment of Lower School coursework was originally intended to be purely a ranking device where pupils demonstrated their level of skill in the assignment. Very quickly the teachers involved in the trials began to use the marking scheme as a means of teaching the pupils what was expected of them and in highlighting the important aspects of the investigation. Teachers have reported that, where their pupils have been advised as to the detail of the mark scheme, the standard of the written account improved markedly (vide 4.2 and 4.6). This may have been an example of a self fulfilling prophecy but it had the effect of improving both the pupils' and the teachers' confidence in what they were trying to achieve. Many schools now issue the Mark Scheme along with the Briefing Sheet for the assignment (vide Appendix 1) in the belief that it helps in the acquisition of coursework skills.

8.4 The Assessment of Coursework - GCSE

There are two main questions to be considered. The first is whether Lincolnshire teachers are prepared for the task of assessing GCSE coursework. The second is whether the standard of coursework currently in progress is in line with the GCSE aims and objectives.
In 1987-88 there were only a few county teachers currently involved in GCSE assessments. At the agreement trial in January 1988 it was evident from both the wide variations seen in the analysis and from the interviews after the trial that there is no consensus. To some degree this reflects the lack of opportunities for intensive training on assessment and, in part, the "have-a-go" approach to the decision making of entry. The agreement trial should not have been their first experience of formal moderation. MEG do not employ new examiners for written papers without attaching them to experienced colleagues and giving them detailed instructions for the execution of their responsibilities. The principles of marking examination papers have been acquired by most teachers through information being shared on an informal basis since CSE began in 1965. This was evident at the Phase 4A meetings when a trial marking of 7 different answers to an examination paper question was conducted by the author. Without exception, all the representatives were able to understand and implement the marking scheme provided. This is not the case with coursework assessment as demonstrated by the teachers interviewed after the agreement trial (vide 6.7). To expect agreement between teachers from such a wide variety of experience, one of them a probationer, without proper preparation was expecting too much. The author concludes this is a weakness in the cascade model of
training and suggests how to overcome later in the conclusion to this chapter (vide 8.5). Only by ensuring that all classroom teachers of GCSE are trained in assessment and internal moderation will there be a more consistent standard in GCSE submissions. Funds are no longer available for this sort of continued training and coupled with the ban on moderators cooperating with their schools this means that things cannot get better in the short term.

The author concludes that for the schools observed in this study there was no coordinated planning for the entries to GCSE in 1988. Heads of Departments left it to individual teachers to decide whether to enter and what assignments to use (vide 6.7). It fragmented even further with decisions by some teachers not to enter the complete class for the coursework option. In general the whole department has not been involved in the new venture. Whether these departments will continue with this policy is not clear.

The suitability of the coursework being presented for moderation has been commented in the report on the 1988 MEG GCSE mathematics examinations by the Chief Coursework Moderator [20]. "..there is no substitute for experience of this type of work," referring to the teachers and their role as assessor. One criticism in the report was the degree of structure built into worksheets given to pupils, a relic of CSE coursework tasks, which means "...that the
candidate cannot break free of the structure and score well in the Design & Strategy section of the scheme. The report comments "...candidates generally scored, and performed, better from centres which detailed the original problem clearly but left plenty of scope for personal extension of the problem." Very few of the Higher level assignments contained mathematics which could be described as difficult e.g. the use of algebra beyond substitution, applications of trigonometry or graphical work. It must be said that some of the work from individual teachers was excellent with examples of mathematical modelling, statistical testing of hypotheses and records of highly organised investigations. The author concludes, from these comments and from the GCSE coursework he has seen, that most of the problems were associated with assignments which were unsuitable and which could have been avoided by using the Coursework Consultancy Service offered by MEG (vide 6.1.2). The magnitude of this problem will multiply to unmanageable proportions over the next two years if teachers are not informed early about the suitability of proposed assignments. In marking scripts teachers had found difficulty in balancing the interpretation of the criteria and the level of entry, leading to a general inflation of marks at the Higher level and an underestimation of marks at the Foundation level which were adjusted by the moderators. This particularly refers to the areas of Design
management and assessment of coursework assignments. There was no common approach and, in particular, all reported a failure to moderate coursework within their school (vide 6.7); a feature of the phase 4B training which had not been passed on.

A large part of the work by the author over the past two years has been with teachers who have been prepared to stay on after school or drive to another school for meetings which lasted until 5.30 pm or 6.00 pm. It is not surprising that these Self Help Group meetings attracted only about 25% of the teachers of mathematics and were affected by other duties and responsibilities. It is very gratifying to know that the scheme did find its way into so many classrooms in spite of the problems faced by teachers.

There are reports of First Aid courses, Administration meetings and, lately, sessions on Local Management of Schools taking place on the Baker Days set aside for In-Service training in school. All of these have a place and a value but they do mean that departments are unable to continue the cascade for their own subject. Curriculum changes in the classroom are being inhibited by other considerations being given greater priority.

In the HM Inspectors report on the implementation of the cascade model of training it states "...the trainers could lead consortia sessions to familiarise teachers with the new initiative while the trained institutional managers
could take over the school based work which follows." It is not clear in the model proposed when and how this school based work takes place. The author concludes that the cascade model will only be totally effective with the addition of a phase 5. The phase 5 should be resourced in the same way as the first four phases. It should be delivered during one (or two) days of school closure by the representatives who attend phase 4. Phase 3 would still have a part to play in giving all teachers an overview and general appreciation of the initiative. Phase 5 would be the opportunity for all teachers to be trained in the detail of the initiative.
The Changing Face of Mathematics Education

"We trained hard, but it seemed that every time we were beginning to form up into teams, we would be reorganized. I was to learn later in life that we tend to meet any new situation by reorganizing: and a wonderful method it can be for creating the illusion of progress while producing confusion, inefficiency and demoralization."

Caius Petronius.

(AD 65 ?)
References


[14] Shell Centre for Mathematical Education, "In-Service Training Pack; Specimen Examination Questions," EMREB, Nottingham, 1986


Bibliography


The Introduction of Mathematics Coursework into Lincolnshire Secondary Schools

by


APPENDICES

Contents

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appendix 1 .. The Lower School Scheme of Coursework</td>
<td>1</td>
</tr>
<tr>
<td>Appendix 2 .. The Record of School/Classroom Visits</td>
<td>33</td>
</tr>
<tr>
<td>Appendix 3 .. A Record of the Interviews</td>
<td>98</td>
</tr>
</tbody>
</table>
APPENDIX 1

The Lower School Scheme of Coursework

Contents

<table>
<thead>
<tr>
<th>Introduction</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Perimeters</td>
<td>4</td>
</tr>
<tr>
<td>2. Matches</td>
<td>7</td>
</tr>
<tr>
<td>3. Squares</td>
<td>10</td>
</tr>
<tr>
<td>4. Triangles</td>
<td>14</td>
</tr>
<tr>
<td>5. Chessboard</td>
<td>17</td>
</tr>
<tr>
<td>6. Trees</td>
<td>20</td>
</tr>
<tr>
<td>7. Triplets</td>
<td>23</td>
</tr>
<tr>
<td>8. Lines</td>
<td>26</td>
</tr>
<tr>
<td>9. The Investigation Algorithm</td>
<td>32</td>
</tr>
</tbody>
</table>

page - 1
Introduction

The assignments described in the following pages are intended for use with the first two years of secondary school pupils. They are all investigations which have been produced from work done in Lincolnshire secondary schools during the period 1986-88. The early versions were tested, evaluated and revised during the trials and the final version prepared using the services of MKDU in Lincoln.

Each assignment is presented in three parts.

a) The Briefing Sheet which gives the framework for the investigation in a form which can be issued to the pupil in the form of a worksheet or used by the teacher as a basis for an oral presentation. Each Briefing Sheet is written in the same style and consists of description of the situation followed by the relationship to be investigated. The pupil is then asked to test the rule they have proposed before using it on a problem.

b) The Assessment Record Form which lists those parts of the script teachers thought should be described and gives a weighted mark to each section. Mark schemes are all out of 20 for consistency and no section carries more than 4 marks. The scheme is organised with the aim that most pupils will score more than 50%. The author suggests that the Assessment Record Form is photocopied and attached to the completed script as evidence of progressing through the scheme.
c) Notes for the teacher on a suggested breakdown of marks for each section and comments on the sorts of answers which might earn the full marks in each section. Also on this sheet are some brief notes on how the assignment may be extended by those pupils who could be extended by further investigation.

In addition there is a single sheet, called the Guidance Sheet which offers an algorithm for dealing with investigations in general. The author suggests that this is provided to all pupils when they have completed two or three of the assignments rather than at the start of the scheme.

The order of the assignments is the recommended order of presentation to the pupils as the skill level progresses.

Photocopying rights are granted for use in Lincolnshire secondary schools.
Mathematical Investigations

PERIMETERS

1. A shape is made by joining triangles together. All of the sides on all of the triangles have the same length - called 1 unit.

![Diagram of triangle shapes]

Problem:
Find a rule, expressed in words, that connects the perimeter of the shape and the number of triangles used.

Test your rule, by calculating and by drawing, on a shape with 12 triangles.

What would the perimeter of a shape with 99 triangles be?

2. A different shape is made by joining squares together. Each side is of length 1 unit.

![Diagram of square shapes]

Problem:
Find a rule, expressed in words, that connects the perimeter of the shape and the number of squares used.

Test your rule, by calculating and by drawing, on a shape with 12 squares.

What would the perimeter be for a shape with 99 squares?
Mathematical Investigations

PERIMETERS

Date ................ Name ......................

Group ........... Bonus grade ............

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drawings</strong></td>
<td>- presentation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>- minimum 5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td>- presentation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>- accuracy</td>
<td>2</td>
</tr>
<tr>
<td><strong>Rule</strong></td>
<td>- explanation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>- test i) calculation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>- ii) drawing</td>
<td>2</td>
</tr>
<tr>
<td><strong>Calculation using rule</strong></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>
Mathematical Investigations

PERIMETERS

**Drawings - presentation** (4)
- use of ruler 1
- look like equilateral triangles 1
- sequence continued properly 1
- shapes spaced out tidily 1
  (colouring not relevant)

**Results - presentation** (2)
- shapes labelled with number of triangles 1
- perimeter stated nearby 1
  (table of results an alternative)

**Rule - explanation** (4)
- "to find the perimeter" 1
- "add/plus two" 2
- "to the number of triangles" 1

**Rule - test** (2 + 2)
- show perimeter " = 12 + 2", " = 14" 1 + 1
- show drawing and state perimeter 1 + 1

**Calculation** (2)
- show working / explanation and answer 1 + 1

**Notes**

Suggest names for the polygon string.
Use grid sheets for the triangle and square drawings.
*Extension*: make other polygon strings. Draw the polygons using a home-made template.
MATCHES

1. A shape is made by arranging matches in a pattern of triangles laid side by side.

\[
\begin{array}{ccc}
1 & 1 & 1 \\
1 & 1 & 1 \\
1 & 1 & 1 \\
\end{array}
\]

Problem:
Find a rule, expressed in words, that connects the number of matches used with the number of triangles in the shape.

Test your rule, by calculating and by drawing, on a shape with 12 triangles.

How many matches would you need to make a shape with 99 triangles?

2. A different shape is made by arranging matches in a square pattern of squares.

\[
\begin{array}{ccc}
\square & \square & \square \\
\square & \square & \square \\
\square & \square & \square \\
\end{array}
\]

Problem:
Find a rule, expressed in words, that connects the number of matches used with the number of squares in the shape.

Test your rule, by calculating and by drawing, on a shape with 12 squares.

How many matches would you need to make a shape with 99 squares?
# Mathematical Investigations

**MATCHES**

Date ............... Name ....................... 

Group ............ Bonus grade  ................

<table>
<thead>
<tr>
<th>Drawings</th>
<th>- presentation</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- minimum 5</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results</th>
<th>- presentation</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- accuracy</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rule</th>
<th>- explanation</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>- test i) calculation</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ii) drawing</td>
<td>2</td>
</tr>
</tbody>
</table>

| Calculation using rule | 2 |

| Total                  | 20 |

---

Mark scheme GHN 1988

---

page - 8
MATHS

**Mathematical Investigations**

**Matches**

- **Drawing - presentation** (4)
  - use of ruler 1
  - look like equilateral triangles 1
  - sequence continued properly 1
  - shapes spaced out tidily 1
  (colouring not relevant)

- **Results - presentation** (2)
  - results with the labelled drawing 1
  - results in tabular form 1

- **Rule - explanation** (3)
  - "to find the number of matches" 1
  - "double/twice the number of triangles" 1
  - "add/plus one" 1

- **Rule - test** (3 + 2)
  - show number "$ = 2 \times 12 + 1", " = 25" 2 + 1
  - show drawing and state number 1 + 1

- **Calculation** (2)
  - show working/explanation and answer 1 + 1

**Notes**

Suggest names for the polygon strings.
Use grid sheets for the triangle and square drawings.

*Extension*: make other polygon strings.
Draw the polygons using a home-made template.
Squares

Part 1

A Square pattern is made by arranging matches as shown below.

Problem:

Find a rule, expressed in words, that connects the number of matches needed with the size of the square pattern.

Test your rule, by calculation and by drawing, on a 6 by 6 square pattern.

How many matches would be needed to make a 20 by 20 square pattern?
Squares Briefing Sheet - part 2

Mathematical Investigations

Part 2

Squares

Present your results in tabular form like this, going down as far as an "8 by 8".

<table>
<thead>
<tr>
<th>Size</th>
<th>Number of matches</th>
<th>First difference</th>
<th>Second difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 by 1</td>
<td>4</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2 by 2</td>
<td>12</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>3 by 3</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 by 4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This is called a 'difference table'

Complete the table using the information you have up to the "6 by 6".

Can you extend the table to the number of matches in

i) "7 by 7"

ii) "8 by 8"

without using your first rule?

Explain, in words, how you arrived at your answers.
### Mathematical Investigations

**SQUARES**

Date ...................  Name ................... 

Group ...................  Bonus ...................

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Drawings</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Results</strong></td>
<td></td>
</tr>
<tr>
<td>- presentation</td>
<td>2</td>
</tr>
<tr>
<td>- accuracy</td>
<td>2</td>
</tr>
<tr>
<td><strong>Rule</strong></td>
<td></td>
</tr>
<tr>
<td>- explanation</td>
<td>4</td>
</tr>
<tr>
<td>- test</td>
<td></td>
</tr>
<tr>
<td>i) calculation</td>
<td>1</td>
</tr>
<tr>
<td>ii) drawing</td>
<td>1</td>
</tr>
<tr>
<td><strong>Calculation using rule</strong></td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Difference table</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i) completed correctly</td>
<td>2</td>
</tr>
<tr>
<td>ii) answers to 7 and 8</td>
<td>2</td>
</tr>
<tr>
<td>iii) explanation</td>
<td>2</td>
</tr>
</tbody>
</table>

| **Total** | 20 |

Mark scheme

GHN 1988

* page - 12
Mathematical Investigations

Squares

Drawings
use of ruler and sequence 1+1

Results - presentation
results with the drawings and a table 1+1

Rule - explanation
"double/two times" 1
"size" of shape 1
"times/multiplied by" 1
"size plus one" 1

Rule - test
show number "= 2 x 6 x 7" 1
show drawing and state number 1

Calculation
show number "= 2 x 20 x 21", "= 840" 1+1

Difference table - explanation
"fill in more 4's" 1
"work back by adding" 1

Notes
Complete part 1 before considering part 2.

Extension: try either a triangular pattern of matches or a hexagonal honeycomb pattern using a triangular grid.
TRIANGLES

In this problem we only count triangles which point upwards in the drawing like the one shaded in the example.

1. Explain why there are more than three triangles in the size 2 triangular grid.

2. Problem:
   Find a rule, expressed in words, that explains how to calculate the number of triangles drawn on a particular sized grid.

   Test your rule, by calculating and by drawing, on a size 8 triangular grid.

   Draw up a table of results as far as the size 8 grid. Use the 'difference method' to extend the tables as far as a size 12 grid.

3. Ask your teacher for the formula that connects the number of triangles with the size N of the grid. Use the formula to check each of your totals in your table.
# Mathematical Investigations

## TRIANGLES

<table>
<thead>
<tr>
<th>Statement of problem</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Explanation</td>
<td>2</td>
</tr>
<tr>
<td>2. Strategy</td>
<td>4</td>
</tr>
<tr>
<td>Table of results</td>
<td>2</td>
</tr>
<tr>
<td>Rule</td>
<td>4</td>
</tr>
<tr>
<td>Test on size 8</td>
<td>2</td>
</tr>
<tr>
<td>Difference table</td>
<td>2</td>
</tr>
<tr>
<td>Use of formula</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

Mark scheme GHN 1988
Mathematical Investigations

TRIANGLES

Strategy (4)
"Increase grid size systematically" 2
"State size and count minor triangles" 2

Table of results (2)
Information and Accuracy
(Inf = headings in table showing grid size, minor and major totals)
1+1

Rule (4)
"To find the ..." 1
"Add up the triangle numbers" 1
Explanation of triangle numbers 2

Test (2)
Show "1 + 3 + 6 + .... + 36 = 120" 1
Drawing 1

Notes
If they find it difficult to count the minor triangles let them cut out templates of each size to slide across the grid.

The formula is \( N \cdot (N + 1) \cdot (N + 2) / 6 \)

Show them how it works with \( N = 1, 2, 3 \) and let them do the rest.

Extension: what happens to the totals if we include triangles which point down in each drawing?
Mathematical Investigations

CHESSBOARD

1. Explain, in words, why there are more than 64 squares drawn on a chessboard pattern (8 by 8 grid).

2. Problem:
   Find a rule, expressed in words, that explains how to calculate the number of squares drawn on a particular sized grid.

   Use your rule to calculate how many squares are drawn on a chessboard pattern.

   A new game is invented in which the board is a 12 by 12 grid. How many squares are drawn on the board?

   Draw up a table of results as far as the 8 by 8 grid. Use the 'difference' method to extend your table as far as a 12 by 12 grid to check your calculated answer.

3. Ask your teacher for the formula used to calculate directly the number of squares on an N by N grid. Use the formula to check each of your totals in the extended table.
# Mathematical Investigations

## CHESSBOARD

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Date ..........</td>
<td>Name ..........</td>
<td></td>
</tr>
<tr>
<td>Group ..........</td>
<td>Bonus ..........</td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong> Explanation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>2.</strong> Strategy</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Table of results</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) information</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>ii) accuracy</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Rule</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Calculation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) 8x8</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ii) 12x12</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Difference table</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) presentation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>ii) accuracy</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>3.</strong> Use of formula</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

Mark scheme  
GHN 1988  

---

page - 18
# CHESSBOARD

**Strategy**

1. Increase grid size systematically
2. State size and count minor squares

**Table of results**

- Headings 'grid size', 'total'
- Breakdown of each total

**Rule**

- "To find the ..."
- "Add up all the square numbers"

**Calculation**

- Show $1^2 + 2^2 + ... + 8^2 = 204$
- Show $1^2 + 2^2 + ... + 12^2 = 650$

**Notes**

If they find it difficult to count the minor squares, let them cut out templates of each size to slide across the grid.

The formula is $N \cdot (N + 1) \cdot (2N + 1) / 6$.

Show them how to use it with $N = 1, 2$ and $3$, and let them do the rest.

**Extension**: what happens if we add extra lines to the grid to give more squares?
TREES

These shapes are made by arranging matchsticks in a pattern. Each pattern is called a Tree and some examples are shown below.

There are no closed loops in a Tree so these patterns are not allowed.

This Tree has 7 loose ends (L) and 5 junctions (J).

Problem: Investigate the relationship between the number of loose ends, the number of junctions and the number of matches in a Tree.
# Mathematical Investigations

## TREES

Date .......... Name ..............

Group .......... Bonus ..............

<table>
<thead>
<tr>
<th>Category</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement of problem</td>
<td>2</td>
</tr>
<tr>
<td>Statement of strategy</td>
<td>4</td>
</tr>
<tr>
<td>Diagrams i) quality</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>ii) organisation</td>
<td></td>
</tr>
<tr>
<td>Results i) tabulation</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>ii) accuracy</td>
<td></td>
</tr>
<tr>
<td>Rule i) statement</td>
<td>3</td>
</tr>
<tr>
<td>ii) test</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>
Mathematical Investigations

TREES

Statement of strategy

"Increase number of matches by 1 each time"  2
"Find the number of different arrangements  2
for that number of matches."

Diagrams

(4)
Quality - clear drawings, well labelled  1 + 1
Organisation - M = 1, 2, 3 etc  2

Results

(4)
Tabulation - systematic with M, J, L headings  1 + 1
Accuracy - values, number of arrangements  1 + 1

Rule

(6)
Any clear statement equivalent to J + L - M = 1  3
A test on a new arrangement  3

Notes

Extension - is there any connection between the number of matches and the number of arrangements?
- what happens if closed loops are allowed?
Mathematical Investigations

TRIPLETS

Definitions

i) Three whole numbers in a particular order make up what is called a TRIPLET.
   eg (5, 7, 3) is a triplet.
   (3, 5, 7) is a different triplet.

ii) Zeros are not allowed
    eg (3, 0, 2) is not a triplet.

iii) Numbers may be repeated in a triplet.
    eg (2, 5, 2) is a triplet.

iv) The sum of a triplet is found by adding up the three numbers together.
    eg (3, 6, 2) has a sum of 11.

Problem:
How many different triplets are there with a sum of 20?
Do not attempt to list them all but justify your answer.
Mathematical Investigations

TRIPLETS

Date ................ Name ................

Group ................ Bonus ..............

<table>
<thead>
<tr>
<th>Explanation of problem</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategy</td>
<td>4</td>
</tr>
<tr>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>i) collection</td>
<td>4</td>
</tr>
<tr>
<td>ii) presentation</td>
<td>4</td>
</tr>
<tr>
<td>Rule</td>
<td>4</td>
</tr>
<tr>
<td>Answer to problem</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

Mark scheme GHN 1988 page 24
Mathematical Investigations

TRIPLETS

Strategy
Increase the sum in stages 1
Start with 3 because ..... 1
List all the triplets for each sum 1
Look for a rule that will help 1

Data
i) collection systematic listing 2
of sufficient triplets 2
ii) presentation tabulation S, N 2
accuracy 2

Rule
"They are all the triangle numbers" 1
"related to the sum less 2" 1
Test on the next sum 2

Answer to problem
Listing of the triangle numbers 1
Correct answer 1

Notes

For a bonus i) any correct algebraic expression for the number of triplets.
ii) any explanation of why the numbers are the triangle numbers.

For an extension why not try the same idea with Quadruplets?
LINES

A Magic Rose is generated by drawing lines from each of the points around a circle to every other point around the circle. Templates for 3, 4, 5, etc points around the circle are available.

example

A 5 pointed Magic Rose

Problem:

1. i) Find a rule, expressed in words, that connects the number of lines drawn on the Magic Rose with the number of points around the circle.

   ii) Use the drawings to explain why your rule works.

2. i) Use the rule to calculate how many lines there would be on a 12 pointed Magic Rose.

   ii) Check your answer in two ways and explain the methods you used.

3. Express your rule in algebraic form.
## Mathematical Investigations

### LINES

**Date** .............. **Name** .................

**Group** .............. **Bonus** .................

<table>
<thead>
<tr>
<th>Statement of problem</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement of strategy</td>
<td>2</td>
</tr>
<tr>
<td>Information</td>
<td></td>
</tr>
<tr>
<td>i) drawings</td>
<td>2</td>
</tr>
<tr>
<td>ii) tabulation</td>
<td>2</td>
</tr>
<tr>
<td>1. Rule</td>
<td></td>
</tr>
<tr>
<td>i) statement</td>
<td>3</td>
</tr>
<tr>
<td>ii) explanation</td>
<td>3</td>
</tr>
<tr>
<td>2. 12 pointed Rose</td>
<td></td>
</tr>
<tr>
<td>i) calculation</td>
<td>2</td>
</tr>
<tr>
<td>ii) two checks</td>
<td>2</td>
</tr>
<tr>
<td>3. Formula</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
</tr>
</tbody>
</table>

**Total Mark scheme**

GHN 1988 page - 27
Mathematical Investigations

8c. Lines

Notes for the teacher

LINES

Information (4)
Drawings .. accurate and labelled 1 + 1
Tabulation .. presentation and accuracy 1 + 1

Rule (6)
"To find the number of lines ..." 1
"no. points times no.points less one .." 1
"divide by two .." 1
"From each corner there is" 1
"one less line than the number of points" 1
"each line is drawn twice" 1

12 Pointed Rose (2+2)
Show" 12 x 11 / 2 " = 66 " 1 + 1
Method a) extend difference table. 1
b) drawing 1

Formula (2)
If n is the number of points .. 1
and L is the number of lines .... 1
then L = n.(n-1)/2 1

Notes

For an extension: ask for a definition of a Diagonal and a rule for the number of Diagonals on a Magic Rose. n.(n - 3)/2
Mathematical Investigations
Mathematical Investigations
9. The Investigation Algorithm

Mathematical Investigations

INVESTIGATIONS

1. Try some simple cases.

2. Be systematic.

3. Find a helpful representation (labelled drawings).

4. Make a table.

5. Spot patterns.

6. Find a rule.

7. Check your rule.
APPENDIX 2

Visits to Schools

Contents

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>34</td>
</tr>
<tr>
<td>2.</td>
<td>Meadow Lane School</td>
<td>35</td>
</tr>
<tr>
<td>3.</td>
<td>Fielding Grammar</td>
<td>39</td>
</tr>
<tr>
<td>4.</td>
<td>The Guild School</td>
<td>46</td>
</tr>
<tr>
<td>5.</td>
<td>Montford Girls School</td>
<td>51</td>
</tr>
<tr>
<td>6.</td>
<td>Dashwood Grammar School</td>
<td>58</td>
</tr>
<tr>
<td>7.</td>
<td>Westings County School</td>
<td>61</td>
</tr>
<tr>
<td>8.</td>
<td>Seatown Grammar School</td>
<td>64</td>
</tr>
<tr>
<td>9.</td>
<td>Greenway Grammar School</td>
<td>70</td>
</tr>
<tr>
<td>10.</td>
<td>Dragon High School</td>
<td>75</td>
</tr>
<tr>
<td>11.</td>
<td>Newton Hugh Comprehensive</td>
<td>81</td>
</tr>
<tr>
<td>12.</td>
<td>Lady Manners School for Girls</td>
<td>88</td>
</tr>
<tr>
<td>13.</td>
<td>Freshman High School</td>
<td>92</td>
</tr>
</tbody>
</table>
1. Introduction

What follows is a description of the visits to schools made during the year 1987/88. The visits are recorded in the form of personal encounters between the author and the pupils and teachers mostly in the classroom situation. The initiative for most of these visits was taken by a teacher at the school. The names of the teachers and the schools have been changed. The visits to eight of these schools is commented on in Chapter 5.
2. Meadow Lane School

Staff

Head of Dept  Mr Able  Cert Ed maths
Mrs Baker  (1 yr contract leaving August 1988)
Mr Callon (Acting Head)  Cert Ed Maths
Mrs Dingle  French Assistant!

Background

This is a small rural 2 form entry Secondary Modern School of about 275 pupils each receiving about 2 hours 20 mins of mathematics per week. The two teachers observed had previously tried some of the Lower school assignments through working with the local Self Help Group.

The Visits

The author had been invited along to watch a class undertake their third piece of coursework entitled Squares (the revised version). It was a class of second years about 22 in number in a designated mathematics room. The first twenty minutes were taken up with a thorough review of the two pieces of coursework attempted in the first year. The review covered both the problem set and the route to the rule required. Some pupils were new to the school and did not know what had happened so it was useful for them to hear the review. The pupils, although not having done any coursework since July, soon warmed to the task. They were free with their answers and obviously remembered a great deal. The use of prepared overhead projector transparencies was very effective and saved some time. Reference was made, several times, to a large notice over the blackboard labelled "Coursework Method" which was the investigation algorithm (Appendix 1.9) The new task was then introduced by issuing half the worksheet entitled Squares. The idea behind this was to avoid pupils having any ideas about the tabular presentation. The author subsequently rewrote the worksheet in two parts as a result of this successful idea. Mr Able discussed the opening in general terms and then left them to get on with it while we moved around the classroom talking to the pupils. A large number of the pupils started straight away on the 6 by 6 drawing without finding or recording the simple cases. After discussion with the author or the teacher these pupils decided to restart their investigation. A few pupils drew out a table first of all but had no data to put in. It seemed a common fault was a lack of understanding of the logical order in which to do things in spite of an apparent understanding of the "Coursework Method". They responded quickly to discussion on this point and
understood the reasons for the restart. They were also quite easy to talk to and, for middle band children, reasonably articulate. They found it quite easy to draw the grids with no errors in the progression or drawing. All had placed "results" near the drawing and all were using a table to record their results. One interesting heading for the table was to use

<table>
<thead>
<tr>
<th>number of squares</th>
<th>number of matches</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
</tr>
</tbody>
</table>

The only rule that can be derived from this tabulation is to include the drawing column on the left and came up with size + number of squares doubled. This is a very difficult association for pupils to make.

It was interesting to watch how they organised the counting of the lines. This was a check on their systematic approach to counting. Methods varied slightly but most seemed to count in a rotary sense; starting on the outside and going inwards in a circular motion ... most odd. With two groups the author counted the lines (out loud) and at the same time indicated the lines being counted. The object of this was to see if they noticed how much easier it was when the counting was systematic. The author did not directly describe the method of n by n+1 doubled. They had to make the association by observation. Both groups quickly realised that the answer could be found by multiplying. By the end of the lesson (1 hour) one group had arrived at the method of finding the answer but had not formalised the rule.

In discussion afterwards Mr Able thought that this was a big step for his pupils to move from a simple linear relationship to a product. The author took the view that part of the reason for undertaking a programme of graded coursework was to let the pupils experience different techniques and relationships. Part was also to give them practice in recording their activities even if they had to be led through this small piece of mathematics (provided they could understand it at the end). The author suggested allowing the pupils who had found a suitable rule explain it, and the counting, to the rest of the class. The experience was still relevant and valuable and could be used on different problems.

14th March 2.00 to 2.40 pm

This was a follow up to a previous visit but this time it was possible to watch two classes complete a assignment on Chessboard.

Mr Able; Year 2; 23 pupils

He started very quickly and made very little reference to
previous activities. They had done 4 pieces of assessed coursework before.

A chessboard was drawn (ready) on the blackboard and they were asked to say how many squares were shown on the drawing. Five thought there were 64 squares. Sally thought there were lots more "cos you can count that one there (and pointed out a 3 x 3) as one". A few guesses were allowed with answers ranging from 80 to 1000. One pupil was adamant there were only 64 squares and it took some time to find why he would not include the 2x2's in the squares to be counted. It was because the squares on a chessboard were coloured alternately and a set of 2 black & 2 white did not look like a single colour square!

15th March 10.45 to 11.20
The pupils were issued with the Briefing Sheet, lined paper and dotty paper with instructions to read the Briefing Sheet. The Coursework Method, still on the wall from previous occasions was referred to and the pupils asked for a routine. They had obviously remembered the tactics and several were confident in their explanations of start simple etc. This took about 10 minutes.

The tables were in a normal "formal" arrangement. (This was discussed at the end of the lesson with Mr Able who had not really thought about grouped arrangement.) It really is difficult to talk to anyone other than those sitting next to the aisles. The author also found (during the week) that there were four recorded occasions of pupils going wrong in pairs while their neighbouring pairs were correct; this would not have arisen if they had been working in groups of 4 or 6. After about 30 mins work most were at the stage of getting results for a 5 x 5 chessboard. Two groups were using an unusual approach to the drawing by building up one picture by adding two outside lines each time but both had wrong totals. The author suggested that they drew separate drawings for each size and this improved their accuracy. Two groups (of 2's) were counting their squares from each corner and then adding up the total but this did not give any clues as to how the total is related to the sum of the squares. The author discussed the more usual method of counting. This was adopted by the pupils.

16th March 11.20 to 11.55
Nobody was able to suggest a rule because they were all recording only the totals. Mr Able stopped the activity and started on the blackboard again and developed the art of recording all the information i.e. the number of 1x1's, 2x2's, etc and gave them the table structure to cope with this. After another 20 mins work no rule had emerged so he again addressed the table on the board. By careful questioning he obtained the idea that the next line in the sequence could be obtained using the previous line and
adding in the next square number without actually drawing the square pattern and counting.

17th March 10.30 to 11.05
The author moved into Mrs Baker's class of less able pupils who had reached the tabulation (the full version) and were beginning to develop a rule. Although less able they seemed to get the idea - in poor English - of the rule. The author and Mrs Baker were able to turn this into a reasonable form. They then got onto the difference table which all seemed to understand how to use and were able to get to the 12x12 answer. Several were keen to do things in a tidy fashion and wanted to redo any messy work. This they were allowed to do. They were working on pieces of paper from torn up exercise books which did not attach much importance to the script. The author suggested, very tactfully, the use of A4 file paper or a designated exercise book would be more suitable. The author had time to ask several of this class if they could demonstrate the calculation of the number in a 7x7 square which they did successfully. They did not know how to use their calculator memory efficiently.
Back into Mr Able who had rearranged his class in table groups and said that it seemed to work but was not able to say why he felt it was better.

Comment

For Secondary Modern pupils they performed very well. They demonstrated they had acquired the basic skills of investigation as listed in the "Coursework Method" poster. They were able to apply that list to the new investigation. They did have poor oral skills but they did demonstrate a good understanding of the mathematics. Any badly expressed rule or opinion does not take long for the teacher to improve with the pupil. One noticeable feature was that the pupils, almost without exception, were prepared to talk and try to explain their ideas. Any inhibition because there was a visitor was short-lived and they were more forthcoming as the week went on. At no stage did the author notice pupils being distracted even when they felt they were not being watched. This suggests a high degree of interest and concentration were present. They seemed quite fascinated by the number structures they found as they were "..Different to ordinary sums". Both teachers were pleased with the progress their pupils had made in conducting an investigation. They were also pleased with the favourable comparisons the author made between their pupils and others in terms of the oral skills. Mr Able commented that "..I am beginning to assess their ability by taking their conversational skills. Some of them explain better than they can do."
3. Fielding Grammar School

Staff

Head of Department  Mr Alder  All Graduate
Second in dept  Miss Browning  All Graduate Mathematicians
Mr Coles

Background

This is a well established Boys Grammar school of about 450 pupils including a flourishing Sixth form. The department had a good examination record. New pupils to the school are given a Mathematics, an English and a French test to assess their suitability for the school by Miss Browning who looks for a high standard of attainment or a good standard with evidence of tidy organised work. The school operates in a mixed ability system until the fourth year when they are setted to produce a fast stream and two other classes. The author had been invited into the school, by the head of department, to see how they did the coursework from the local Self Help Group meetings. Reports of these meetings show that the school regards coursework as something to be done in a hurry and then to get on with "...the real mathematics" aimed at the examination papers. Initially all the staff felt that coursework was not for them or their pupils as "...it got in the way of the examinations, particularly GCE O level". The school had entered its normal 5th year for the Joint GCE/CSE examinations in 1986 and 1987. They felt the examination papers and standard was easier than GCE O level. They also had no failures and the grade distribution moved significantly towards grade A. They equated this with a fall in the standard of the external examination and was not welcomed. They admitted they had taught in exactly the same way and to the same syllabus (Cambridge C) as GCE and just entered their pupils for the Joint GCE/CSE instead of O level.

Previous meetings with the staff had highlighted the lack of time that the school gave their pupils to do an investigation. This showed up in the scripts offered at the Self Help Group meeting. The assignments were written on two sides of A4 paper with little comment or evidence of writing to an audience. The scripts were a factual record of results with a rule and never any extensions for the faster/brighter pupils as they only allowed one lesson and a homework for completion.

The Visits

20th January 1988

The first visit was with Mr Coles who had a second year class of about 23 pupils and was taking on the
investigation Squares. He issued the class with the Briefing Sheet, gave them time to read it through and then asked if they all understood it. There was some limited dialogue in the form of questions and one/two word answers for about five minutes when he asked if they had any ideas on how to tackle the investigation. Very few pupils seemed to have any idea of general strategy. Eventually they decided to start with a 1x1 and progress from there. One feature of this class was that they were encouraged to do their drawings and working in rough first. When they had written it up in rough it was then to be transferred to the "best book". This seems to avoid any record of blind alleys and decisions for a particular tactic and the record is of one single successful route to an answer. Again the pupils and the school seems to have the idea of a right and a wrong method/answer as opposed to developing learning and investigative strategies. The pupils spoken to were prepared to explain what they were doing but were not comfortable with the author’s presence and wanted to give "right" answers - mainly single words rather than an explanation. One pupil was watched in detail. He immediately drew the first three drawings very well, counted the matches and wrote them down alongside each drawing. He then did the same for the 4x4 and 5x5. He then transferred his results to a fresh sheet, not in a formal table but in two rows before writing in a factor of 4 in each total. This left a sequence of numbers he recognised but could not name. The author intervened to tell the pupil that these numbers were called triangle numbers. The author discovered later that the pupil experimented with the drawing of the triangle number sequence to see if he could arrive at a formula/rule without success. It was interesting to find (later) that no record of this appeared in his script. The ESG Advisory teacher present on this occasion as an observer also reported that they all counted the matches in a spiral pattern rather than the systematic method that generates the rule. Another pupil was able to say that the numbers went up by 8, 12, 16 etc "...four more each time" so he had some idea of differences even though he did not know the table method for differences.

21st January
This was a different class of pupils being taught by Miss Browning. There were 19 first year pupils in the room, all sitting at individual desks (4ft x 2ft). There was a front row of four who were the less able pupils (teacher’s description). Miss Browning stated that this is how the pupils preferred to work and it was evident the teacher approved. "...I don’t like any noise in my classroom." The author was further assured at the end of the lesson that her pupils would normally be a little bit more active but the presence of a visitor had quietened them! This was to
be the first investigation for this class. At the teacher’s instruction text books had to be placed at the front of each pupil’s desk with their exercise book on top. The pupils were then issued with a sheet of graph paper and a sheet of writing paper "...not to be touched yet". Not a word was spoken by any of the pupils while all this was going on. Miss Browning then went to the front of the room and explained that they were going to do an investigation which they had not done before and that she was going to explain exactly how it was to be done. "...Copy this into your exercise book" was followed by Miss Browning writing on the blackboard the exact wording of the Briefing Sheet. The pupils duly copied all this down; some faster than others. They were allowed ten minutes to finish the writing, whereupon they had to sit with the pen on the table, quietly waiting for others to finish. Still no words were spoken by any pupil. There was only one surreptitious glance by one pupil to see if the boy behind had finished. Miss Browning then took the pupils through the investigation instructions and asked three directed questions about
i) the meaning of the word perimeter,
ii) the number of triangles in the next two drawings.
She also explained the triangles were strung out in a straight line thus avoiding one of the problems. The author felt that this would have been better left for the pupils to discover that the rule does not work if one polygon touches more than two others. Miss Browning then wrote out on an adjacent board a further and detailed list of instructions for doing the investigation.
1. Use the graph paper for the drawings do 10 of them.
2. Use the writing paper for the table of results and the rule.
3. Then test your rule on a 12 triangle string (no need to draw). The author felt that this defeats the object of the test.
4. Then answer the question (on 99 triangles).
5. Then turn the sheets over and do it again for the squares.
Through all this exposition by the teacher there was no dialogue. The pupils’ attention was totally on the teacher. The pupils were a little slow to start. After about one minute Miss Browning sat down at the desk at the front and started to do some marking/paperwork and had nothing to do with the pupils for 12 minutes. After two or three minutes to let them start drawing before the author went round to ask them questions. The children seemed very nervous of being asked questions as though they were under an inspection or on test and if they did not give the right answer they felt they were at fault. After about ten minutes several pupils had got the 10 drawings complete but had not written anything down by way of results or
information. The drawings were tidy and reasonably presented but had no space for information. One pupil had got the perimeters written down in columns without headings and was about to start writing his rule. When asked for his rule it was necessary for the author, by discussion, to help him improve his English. His rule was brief because he thought it had to be rather than because he was inarticulate. A similar conversation was held with two other pupils who responded quickly and also arrived at a suitably worded version. Two pupils were discovered, by Miss Browning, to have done something different and were promptly given another sheet of paper to start the investigation again - the right way. One boy had not drawn the triangle in a straight string and from the look on his face he seemed to feel he was the fool. He did not enjoy the attention of the class being focussed on him by the teacher. He was shown a graph sheet from another pupil as an example of what to do. It would have better to have discussed the effect of his drawing on any results. One boy had drawn his triangles exactly 2cm sides and measured the perimeters as 6cm 8cm 10cm etc. Miss Browning had asked them to draw their triangles to fill a 20mm grid. In discussion with him the author referred to the blackboard notes and he then understood. He crossed out his cm answers instead of putting unit versions alongside. This was another example of the right/wrong approach. At the end of the lesson they were told very carefully how to complete the work for homework using the reverse of each sheet of paper. The four sides were to be the end product of the investigation - their first. It struck the author as being a very regimented way of teaching but it must be emphasised that it works for Miss Browning (and the other teachers in the school) who judge their performance on their examination results. An area of further concern for GCSE would be the lack of dialogue/conversation between pupil/pupil/teacher and the atmosphere of a test situation. Miss Browning is a very thorough teacher and a firm classroom manager.

29th March am 11.00 am to 12.00 am

This was a follow up to the first investigation on Perimeters with the same class and Miss Browning. In the class there were 23 pupils normally but with 4 away on this occasion. The classroom was arranged as before with pupils at single 4x2 tables apart from the front row of "...slower ones". The pupils were issued with graph paper and lined paper and told "...put your text books away and place the two sheets at the front of your table to the left and your class book in front of you to write on and then look this way". The pupils remained silent as before. "...Copy this out in your class book" Miss Browning then went through the Briefing Sheet, writing it on the blackboard and saying it
as she wrote, as on the previous occasion. The author noticed the teacher insisted on completing ten drawings (which seemed to have not been favoured by other teachers). When asked about this she gave the same reasons the author had used for the early trials at YHS - that the pupils need the practice in drawing neat diagrams. The pupils duly copied out the instructions from the board. It is worth commenting that these pupils will not have the experience of working from a typed worksheet. (Will it matter?) They were then all stopped and the instructions were gone through by the teacher. There was no dialogue except the question. "How many matches in this drawing?" pointing to four different shapes for four pupils to answer. There was no mention of tabulating the results (which they did reasonably well). Miss Browning then explained how they were to use the two sheets of paper issued to them. The writing paper was for copying down the question and the results on side (a) with the corresponding drawings on side (a) of the graph paper. They were then to turn over and use the other side (b) of the writing paper for the squares with the corresponding side (b) of graph paper. (What do they do if they go over one side of paper? It implied they have to make it fit one side only). Not a sound from anybody. They were told to draw their shapes a particular size on the graph paper.

Miss B. then sat down for 14 mins while the pupils got on with the work. The author began to circulate after 8 minutes when the pupils had begun to get some drawings and results. They were very reluctant to talk although they understood the mathematics. It was as if their knowledge should not be articulated. It took a great deal of persuasion and leading before they would hold a limited discussion. All were totally engrossed in the work and there were no conversations between pupils. After a while Miss Browning asked who had drawn the 10 shapes and went to look at their drawings. There were about five pupils the author spoke to who got to a rule. Most rules were expressed badly and needed to be turned into good English. The exception was one boy who had written the rule almost word perfect (overheard?). Three were able to write the rule in algebraic form and use it. The lesson ended with instructions from Miss Browning on completing the script for homework using only the two sheets issued.

29th March 1988

Mr Coles had begun to show an interest in the possibilities of introducing coursework into his teaching programme and had approached his head of department with a view to the author demonstrating a lesson in practical mathematics. One reason for his request was so that he could get an idea of what to say and how much to lead/direct the pupils. In view of their ability and their age we decided to try the
investigation in Mathematics from 5 to 16. This concerned
the volume of an open box made from a piece of squared
paper. The pupils had not tried any of the Lower school
assignments and had no experience of investigations. The
department had no scissors or 1cm square paper. The author
obtained the equipment from another source and arrived at
the school with time to cut the paper into 16cm squares;
one per pupil. The class consisted of 19 pupils sat at
single pre-war box-lid desks. They were quickly organised
into five groups of four before the lesson started. Mr
Coles joined in with one group. This grouping of pupils and
furniture was discussed with Mr Coles at the end of the
lesson and he was pleased. Apparently he could now quote
the author as a justification for improving the furniture!
He also agreed that the group worked better than his first
year seen previously at single tables.
The introduction was fairly standard with a lot of dialogue
and good responses. These pupils were much more relaxed
than the first years seen earlier in the year. They were
shown a 16cm square of paper and asked how it could make an
open box. The replies indicated a good understanding of
three dimensional geometry but not of nets. After showing
the pupils two nets made previously they were issued with
scissors and paper and asked them to make their own net and
box. They were then asked what information they could give
about one of the boxes. It was a little while before they
suggested surface area and volume. From their nets a
starter table of results showing volume and cut-out size
was drawn up on the board. They were then asked for the
dimensions of the box with the maximum volume possible. The
author had to show that it was easier calculate the answer
rather than cut & measure each time. Most went to a fuller
table of results but not in order and not starting with the
most simple cut-out size. By talking to each of the groups
in turn all ended up going for an organised systematic
table of results and deciding the answer lay around 3 cm
cut-out. Two groups decided to use their calculator at
2.5cm before deciding upon a plan. Eventually all groups
were guided towards the graph method of finding the first
approximation. The graphs were well drawn. Many thought the
graph peaked at 3 and drew a lopsided parabola to make it
fit so it was a good discussion point on graph drawing
which they took on board well. Two groups decided to
calculate to an increasing number of s.f.'s but were not
sure how to isolate the peak value. Two other groups
plotted again at a much finer scale to zoom in on the peak.
The class teacher had become quite closely involved with
his group. Apparently they developed along the same lines
on their own.
They were left them with a problem based on the same idea
to last for two homeworks. "...A piece of paper 20 x 16 cm
is cut into a cuboid (open) - what is the cut out for
maximum volume?" Seeing some of the completed scripts at a later date showed the pupils had coped with the mathematics but the quality of description/explanation could be improved. The author and the class teacher were convinced that the presentation and content of the scripts would improve with practice and guidance. Mr Coles felt that, while it was not his style of teaching he had seen enough to realise that a more conversational style was necessary.
4. The Guild School

Staff

Head of Department: Mrs Pringle B.Sc.(Maths) MA
Second: Mr Quorn Maths
Mrs Restle Maths
Mrs Staines Maths
Mr Tammer (Science teacher)
Mr Unwin Maths (probationer)

Apart from the head of department all were Cert.Ed. qualified.

Background

The department has a policy of proceeding through the curriculum through the medium of coursework. There is no text book used (except as occasional resource) and the normal expression of a curriculum in terms of content (as per List 1 and 2 of the Cockroft Report) is replaced by themes such as patterns, games, movements. All of these are on worksheets prepared by the member of the mathematics department and are very impressive. They have their own resource area with photocopier, colour printer, punch and binder for making booklets and a lot of equipment.

The Visits

Thursday 19th Nov 1987
A class of 22 first years taught by Mr Tammer. It was getting near Christmas and there was also a Parents/Open Evening that week. Folders and exercise books were given out and the pupils were instructed to tidy them up ready for parents to see at the Open Evening. There was little formal mathematics in the folders; just some very rough scribbled sheets on one piece of work. To the author the exercise books used by the pupils contained what appeared to be a lot of rough working. There seemed to be no "mathematics" that one would expect of a first year pupil.

The piece of coursework was called twiglets. The investigation consisted of discovering all the patterns you could make with twigs joined together at right angles. The only written work on this was a collection of drawings. The four pupils the author talked to about this seemed not to have any idea about order, symmetry or being systematic. Several patterns were identical. They had not noticed this and had proceeded in a random fashion (no attempt at a systematic approach). For the major part of the lesson the pupils were making a Christmas card from the parts of a cut square as defined by Mr Tammer. The teacher drew a square on the board and showed where to draw the lines to divide the square into triangles, squares, parallelograms ready
for cutting and sticking. The three pupils observed were not able to follow the instructions and needed help with positioning the lines.

Friday 20th November
Mr Pringle
A practical session with a class of third years doing a lesson on capacity. This was a good lesson. Nothing was written into notebooks nor was there any follow up but it was a good participative lesson for the pupils. There was a bowl of water and several containers such as spoons, egg-cups, butter dishes, cups etc. The class was organised into tables of three/four pupils and called 1/2/3 etc. A list was kept of the guess at the capacity of each container and points were awarded for the closest and extra points for being within the prescribed limits. Capacity was measured by using a measuring cylinder from the science department. A similar lesson was held with a group of lower ability fourth years later in the day with similar results.

Thursday 11/2/88 7.30 pm to 9.30 pm
The department had organised a mathematics evening for the parents of first year pupils.
There were four rooms in operation.
1. Mrs Pringle was doing calculator games with Mrs Staines assisting. The author did not get time to go into this room.
2. Mrs Restle had organised investigations for the parents similar to the first year assignments - Hanoi Towers, Hand shaking, Frogs and Worms.
3. Mr Quorn was conducting a lesson on algebra with the parent audience as pupils.
4. Mr Tammer was supervising an activity session on Worms. The BBC micro was on automatic producing patterns every 10 seconds in a sequence of colours which looked impressive.

About thirty parents were in attendance together with the Head and Deputy and the Mathematics Inspector. All were given refreshments before being divided up into groups to go round three of the rooms in a circus. All parents experienced three of the four activities at about 20 minutes per session. It was an excellent idea to involve parents in the changing ideas operating in the school. In two of the three rooms visited by the author parents were saying that it was not like this in their day. Several "confessed" to having helped their child with his/her projects and several said they were not able to help at all. No one spoken to by the author had any idea why this sort of work had been introduced except that it "...had to do with the new exam." The author spent most of the evening watching parents getting to grips with investigations. All the parents seemed to be enjoying the new approach and most
were successful with their task; sometimes with a little
guidance. One parent encountered trying the investigation
Worms said "...What's this got to do with maths? Do they
ever do any what I call proper maths?" It was doubtful
whether the author was able to convince him of the benefits
partly because he did not understand the mathematics. "...I
was never any good at it when I was at school but then all
we seemed to do was percentages and fractions and sums like
that." The public image of mathematics is still, and will
be for a long time, that of lots of numerical manipulations
with some hard algebra for the clever ones "...Solving
equations and all that."

Thursday 5th May 1988 2.15 pm to 3.00pm
This was with a group of 19 4th year pupils arranged in
groups of 3/4 and taught by Mrs Staines. Of those present
15 were being entered for the 1652 syllabus in 1989 and 4
were preparing for syllabus 1651. This immediately presents
a problem of teaching a "split" class. Apparently the
pupils were all asked whether they wanted to do coursework.
It broke down into those who were "...prepared to work"
(1652) and those who were "not prepared to work" (1651).
These were the teachers descriptions. The 1651 pupils were
given a book of questions/puzzles on mathematics to
complete whenever the rest were doing coursework. When in
conversation with these pupils they were not enthusiastic
about working on the book and there was no set order to
work through it "...we just do what we like, its just games
and puzzles; not like exam work". The rest were working on
a piece of coursework involving perimeters and areas of
shapes. An area of (say) 36 sq.cm was arranged into
different shapes and the perimeter was noted. The different
factor combinations were noted i.e. 36x1, 18x2, 12x3, 9x4,
6x6. The different rectangles were described as long/short
and fat/thin but none of the six spoken to had thought
about minimum perimeter or tabulating all the options from
36x1 through to 1x36. None realised there were other
non-factor versions such as 10x3.6. One pair of girls
working on their own had a much better script than others
and has realised that 72x0.5 was possible. They were able
explain how to get the 0.5 by drawing intersecting
diagonals on a 1cm square at each end. Most scripts would
not, in the author's view, offer much evidence at
Foundation level under the criteria Mathematical Content or
Clarity of Argument. The style of writing was distinctly
"chatty". There was little which could be assessed under
Mathematical Content. Phrases like "...Miss suggested I try
.... but I will leave it till later..." " I will colour in
the short fat ones red and the ...." were common.

Thursday 5th May 3.00 to 3.45
This was a better set of fourth year pupils taught by Mrs
Pringle and aiming at Intermediate level GCSE syllabus 1652. There were 15 pupils with four out and about in town (without a teacher) doing a survey. Mrs Pringle is always out on a Thursday so there is a regular supply teacher. On these occasions the pupils get on with their coursework. These were working with a much better attitude than the other class. One boy was looking at tesselations and had come up with some good drawings. When questioned he had no idea that there was an organised way of obtaining tesselating tiles by drawing a frame and adding/deleting matching extras. He was able to extend his tiles as a result of the discussion. He was then able to add the frame to the tiles he had already drawn. Another was looking at symmetry from the view of different grids. The grids were drawn from sets of lines which were curved, met at a point to give a sort of perspective. He was able to explain how he had drawn his grids but this was not in his script. The author explained that this was what the examiner was looking for. The other boys were listening and the point was made to them all that they had made mathematical decisions and not recorded them. They had another think about their scripts. The third boy in the group was looking at the number of intersections when two triangles overlap, when three triangles overlap and then two squares, three squares overlap. His drawings were excellent and were systematic. It was not, at first, apparent from his script or drawings that he was using a template. There was no mention of how the template was made. He produced a good pentagon template for the next stage of intersecting pentagons. It took a lot of questioning to find that he did not consider the fact that he had made his own template to be of mathematical significance. He had made the template by drawing a large, accurate pentagon using a protractor. He drew in the diagonals which left a smaller accurate pentagon in the centre. This he cut out to use as a template. He suggested to him that this was important and should be used in his script. This pupil was more articulate than the others who found it difficult to discuss their work clearly.

One girl was devising a questionnaire to research the hypothesis that "...people with large gardens had large pets". This was an interesting approach to the use of statistics and was later commented upon by the Chief Coursework Moderator. There is obviously a lot of work to do here as she was thinking about stopping people to ask about 50 questions and most of her questions needed some clarification. She had not thought about the implications of her questions. What is a "large" garden? What is a "large" dog? etc. Another girl was working on the intersecting shapes problem and was struggling to get 7 points when two squares crossed. Because she had not been systematic and gone through 1, 2, 3, 4, 5 etc she had no idea
of how they should be arranged to get the 7. These pupils had not trialled any of the Lower school assignments and were not familiar with the ideas expressed in the algorithm.
5. Montford Girls School

Staff

Mr Manders  Head of Department (appt May 86)
Mr Norman   2 i/c (doing Open University BA)
Mrs Patten  (12 periods/week maths)
Mrs Oster   full time
All are Cert Ed trained teachers.

Background

This is a Girls Secondary Modern school with a student population of around 450 in 1987-88. The intake for this year is 70 split into a three form entry. There is a corresponding Montford Boys School. The school made its first entries to the Joint GCE/CSE examination in 1985 and is working to the MEG mathematics syllabus 1851 at present. The department is considering the SMP 11-16 Green Series as a possibility for the future. When the pupils first enter the school they are in three mixed ability tutor groups and are taught mathematics in those groups for about 6 weeks before being setted for mathematics. The test used is the Linkmaths test on Place Value. The current arrangement for 1987-88 is 26+27+17, with the 17 being a low ability group with a better teaching ratio. Mr Manders has the top set of 26, Mr Norman the second set of 27 while the bottom set is taught by Mrs Oster. The text in use at present is the STP series with some copies of the Progress in Maths for the bottom set. During last year and in response to the letter about Phase 4B they did try out Perimeters and Trees with the first year but Mr Manders was unable to recall much detail or comment about either.

The Visits

December 12th
Mr Manders had been sent a copy of the revised Perimeters some time ago so he had had time to read and think about the exercise. We talked through the exercise and discussed what could be achieved in a 35 minute lesson. It seemed reasonable that, with the pupils he had described, it would be possible to get some of them to identify the rule and discuss it with a teacher. The author arranged to sit at the back of the class during the briefing and be introduced as "Mr Nelson, a teacher from another school". It was also arranged for the author to circulate and talk to the pupils as they were working. The classroom was a traditional square about 35 sq.m. with second world war box-lid desks arranged in rows of 2-4-2. In the middle of the room, access to the pupils in the middle of any row was impossible. Mr Manders put out the Briefing Sheet.
(photocopied) and a half sheet of triangular dotty paper on each desk before the pupils arrived. As the pupils came in they picked up the sheet and were reading through it before the lesson commenced. When they had all arrived the lesson began by Mr Manders saying that they must have gathered that they were going to do something different today. The introduction was very brief (lasting less than two minutes). Mr Manders checked that they knew what perimeter meant and drew out a simple triangle string on the board. He said that "...the snake has to be in a line and not bent back on itself". This prevented the pupils finding this out for themselves. They were told they were looking for "...a rule in words that connected the perimeter with the number of triangles". Working in pairs was allowed if they wished and the dotty paper was there to help with drawing. Predictably hardly anyone started to get on with the drawing. It did not take long to discover they did not know how to use the dotty paper to draw strings of triangles. In fact most of the were very confused about what to do. The author and Mr Manders talked to small groups of pupils to find what the problems were. Some pupils were waiting for their turn while this went on. It would have been better to stop the class and start again.

The following are conversations with individual pupils. It was necessary for the author (GHN) to explain what they were expected to do and why:

GHN Have you started?
pupil No.
GHN Why not?
pupil I don't know what I've got to draw
GHN Well let's look at the worksheet...

[The author then went through the worksheet word by word and got the pupil say what the perimeter was for each of the shapes drawn there.]

GHN So you are looking to find the perimeter of shapes with a different number of triangles in.
pupil What is the spotty paper for?
GHN So you can draw out different shapes easier than if it were plain paper. If you draw out the first three shapes that are on the worksheet you can write the perimeter alongside; can you?
pupil Yes
GHN And then you can carry on and draw out the next three or four shapes in the sequence?
pupil And do I have to write the perimeter out as well?
GHN Well you are going to need the results to answer the problem so what do you think?
pupil All right then. Then what do I do?
GHN When you have the drawings done let me have a look and we'll talk about it.

This conversation was repeated to three or four groups of
about four pupils and the teacher was presumably doing the same. Several pupils found it difficult to draw triangle strings on the dotty paper and had to be shown. Two girls said they found it easier to draw on the lined paper. Several of the drawn triangle strings were cramped and badly drawn/presented. No room was left for adding the information about number of triangles and perimeter. It was suggested they might like to turn over and start again which they were happy to do. Eventually, after about 25 minutes, they began to show a completed set of drawings and results. They were then asked if they could explain how to work out the perimeter of the next shape in the sequence.

GBN

pupil Well that's 3, that's 4, that 5, that 6, that 7, that 8 so that must be 9.

GBN Why?

pupil Cos it goes up 1 each time.

GBN So you are saying there is a sequence of numbers and you are giving me the next number in the sequence. If I say for 1 triangle the perimeter is 3, for 2 triangles the perimeter is 4, can you carry on in the same way?

pupil .....pupil does so ... that's always 2 more than that.

GBN What is always 2 more than what?

pupil It's always 2 more than the triangles.

[The next part is the classic route to a rule]

GBN Well if that is your rule write it down and then show me.

GBN What does the next bit of your worksheet ask you to do?

pupil .....reads...

It's 14

GBN How did you get 14?

pupil Added 2 to 12

GBN So that is the calculation part which you need to write down first and then you have to draw it out to see if it is actually 14. Come and tell me if it is.

[Later]

GBN What does the last part of the worksheet ask you to do?

pupil .....reads...

It's 101

GBN Well done. Why?

The end of lesson bell went.

pupil Mr Manders. Can we do some more of these next time?

Two impressions were very strong after these exchanges. The first was that pupils of this ability level need a thorough briefing when they do an investigation for the first time. It might have been better if this had been done on the
blackboard as a class exercise to start things off. The second was the reluctance of pupils to say more than a few words at a time. This has to change over the lower school as they are now to be assessed on their oral skills at GCSE so conversation about mathematics should be encouraged. After the lesson the author discussed the session with Mr Manders. He said they were obviously not aware of what they had to do and if the author not been there he would probably have stopped them and talked a bit more. More than half the class had arrived at the rule and could use it. There had not really been a lot of time for them to write much down so the script was very thin. The drawings were of poor quality due to them not having had any experience of drawing shapes using dotty paper. They would be allowed to have another three lessons to complete the work. It was felt they had enjoyed themselves.

On returning to the staff room the other members of the department were looking over some more scripts. They were discussing the mark scheme which was being applied to one script. They had all given the same exercise to their classes at the same time Mr Manders. They did not know it was meant to be one week of lessons and were worrying about the poor marks being gained. Some of the work showed the pupils had had considerable difficulty in getting the drawings together. They had not had the advantage of dotty paper which only the head of department used. From a teaching point of view the lessons could have been more profitable if it had been arranged for the whole department to be briefed together. They agreed that it was important to spend a longer time explaining the work to the pupils at the beginning of the lesson and perhaps doing the first few examples on the board. From the pupils' point of view it seemed to have been an enjoyable lesson and in the little time available many seemed to have got the rule sorted out. The general cooperation between pupils and the "jungle telegraph" had failed in one case where a girl had decided she had got the rule and promptly went and sat on her own at the back of the room so nobody else could find copy from her!

14th December
This was with a class of first years (set 2/3) taught by Mr Norman. There was no opportunity to discuss the session beforehand with the teacher. The class were going to try Matches as a continuation of Perimeters. He described his first attempt at investigation with Perimeters and it seemed as though he was unsure of how much help to give them. After some discussion as to the nature of the class and their general ability it was agreed that he would tackle Matches in stages, letting the class do a little of the work at a time and being collected together for a discussion on how to proceed. Mr Norman issued dotty paper
and the worksheet to the class. It was unfortunate that after discussing with the author the advantage of dialogue with the pupils that he then proceeded to introduce the assignment by monologue with occasional questions. He did not wait for an answer to many of these questions before proceeding. The introduction took some 10 minutes. He reminded them about Perimeters and broke the new assignment down into three simple stages by reference to the worksheet. One pupil immediately said she knew the rule but she was not allowed to give her version to the rest. He showed them how to start by drawing the first two drawings for them on the board but did not label each drawing with information. The pupils did the same and this detracted from their recording in that the table of results did not refer to the drawings. He also put the table up on the board for them and with a little contribution got the headings for the table from the pupils. The pupils then got on with the exercise on their own.

[first pupil]
GHN What are you doing?
A I've got to do these drawings.
GHN Well you have done 2, what do they tell you?
A They are triangles.

[It was apparent the pupil had little idea of what to do so the author went through the idea with her again. On returning later she had 5 drawings set out and labelled and was doing the table of results.]

[second pupil]
GHN You have a table of results that goes up to 7 but you have only got 2 drawings can you explain what you have done.
B Well it goes up in two's donnit
GHN What you are saying is you think it goes up in twos. What happens if you draw out the next three drawings and they go up 2,3,4 etc...
B But it doesn't (patience Graham)
GHN Well we are trying to teach you good practice and while it does go up in two's this time it might not always be the case so it is a good idea to actually get 5 or 6 definite and correct drawings done before you make decisions. Can you do that for me and let me know if you are still right?

[third pupil]
GHN I see you are putting down your rule as a calculation. Can you explain it to me please.
C (patronisingly !) you twice it and add one.
GHN Show me with say 3 triangles.
C 2 threes is 6 and 1 makes 7
GHN What would Mr Norman say about "you twice it"
C You multiply
GHN Or?
C Double
So you are saying you double it and add 1
Yes
And what would he say about "it"
The triangles.
Do you mean the number of triangles?
Yes
So you double the number of triangles and add one
and what does that give you?
Mr Norman broke into the lesson and spoke about the use of
the words "it" and "times" and also spoke about the table
of results. Just before the end of the lesson the third
pupil had written a rule which was acceptable and had
calculated the 12 triangles and had the answer to the
problem of 99 triangles.
Mrs Oster had taken the same investigation with her bottom
set. It was disappointing to find the pupils had been
working on scrap pieces of paper but they may rewrite what
they have done. In a two minute conversation with Mrs Oster
before the lesson the author suggested that the assignment
could be broken into 2 parts. It was also suggested that
for the first few investigations the teacher led the
discussion until the pupils were confident enough to carry
on themselves. She felt the lesson had been much more
successful and several pupils had got to a rule. One girl,
in particular, had stated that to find the number of
matches you had to add the triangles on to one more. What
she meant was $M = (N) + (N+1)$ which is algebraically the
same as $2N + 1$ and was the first time anyone had suggested
this form of the rule.

The author was asked to go in again to see the next
investigation under way. In discussing the assignment with
the teacher it was agreed that the author would take the
class and he would observe. The investigation was to be
Squares.

19th January 1988

One 35 minute lesson with a class of 24 first year girls on
their third investigation. About 20 minutes were spent
introducing the work to them. On reflection this was too
long and too detailed a discussion on the strategy of
investigations. The word strategy was not used.
The list

simple
systematic
drawings
table

was left on the blackboard when they started (as a
reminder). They got started very well but had produced very
little by the time they had to pack up for the end of the
lesson. A 35 minute lesson is too short a time for
involvement. They had reached the stage of drawing the 3x3
square and their work was better organised than the last two. There had been some improvement since the last investigation. Most had results written alongside their drawings and all had something to show for the lesson.

21st January
Their work from the previous lesson was issued and they got on with the work immediately. The lesson was more successful as there was no time wasted. The main problem encountered was that some got confused with the counting and some got lost with their random method. Most pupils crossed out the sides they had counted with a mark and then they could not check as the marks got in the way. They were shown how to count in a systematic way. Several had seen a rule and were struggling to put it into formal wording. A group of three girls achieved this before the end of the lesson and were really pleased with themselves. One change was very noticeable on this occasion. A number of the pupils had a good idea how to put their work down on paper. They had been issued with A4 7mm squared paper to see if this improved the presentation. It did. The pupils were also more prepared to discuss what they were doing, perhaps because they were more used to the presence of a visitor. They were also amused that Mr Norman had elected to sit at the back and write up his own account and work out his own rule before going to help them.

22nd January
Unfortunately bad weather conditions prevented the author observing the last session. Mr Norman later reported that the pupils finished the exercise with some greater degree of understanding than they had shown before and that the scripts were a "...definite improvement". "...They talked more as well."
6. Dashwood Grammar School

Staff

Head of Dept  Mr Christian
Mr Dainty
Mrs Ellman
Mrs Feather
Mrs Graham
Mr Hacker

All the teachers are graduate mathematicians

Background

The school is the amalgam of a boys Grammar school and a girls Grammar school originally on adjacent sites. The two staffs were combined in 1984 under the leadership of the Headmaster from the boys school. The school draws from a wide area following selection by the 11+ examination and has an intake of about 25% of the secondary population. There are three secondary modern schools serving the same area. One of these three is to be closed and the other two merged in September 1988. The grammar school has always enjoyed a good reputation as an academic centre and has always tried to maintain that tradition. In the past the school has had six sets in upper school mathematics. One set has always done the GCE O level in the fourth year and then proceeded to take the additional mathematics or statistics in the fifth year before going on to the Sixth form. In recent years one set "...at the bottom" has taken Mode 1 CSE with EMREB. The school hopes to continue to enter the top set for GCSE in the fourth year but is unsure at this time what to do with them in the fifth year. The head of department is not impressed with the extension papers proposed by the MEG. The Home Board for this school is the UCLES as with most of the other grammar schools (from the GCE links).

The school decided to enter for the GCSE coursework option in 1988 because
1) They had to do coursework eventually anyway.
2) They had some pupils currently on the Intermediate level which they thought suitable to practice on.
3) For these pupils (the staff thought) coursework was a fruitful use of their time.
4) Some of the staff had experience of submitting coursework for Computer Studies and for Statistics.

The current arrangements for the fifth year are:
set 1 - already taken O level in 1987, taking Stats 1988
set 2, 3, 4 - taking Higher level GCSE in 1988
set 5, 6 - taking Intermediate level GCSE 1988 with C/work

None of the staff had any experience of coursework in mathematics before September 1987 and, apart from a minor
trial in the third year, neither had the pupils. The staff seemed to be quite interested in the idea of coursework but were also quite self contained in that they did not see a need for sharing ideas with other centres and were working in isolation. The current second year had had an investigation as part of their end-of-first-year examination which counted for 20% of the marks. The assignment was to design a paper aeroplane and test its flying potential; to modify the design and test, by statistical method, to see whether there had been a change in performance. For the GCSE coursework entry they had sent off their ideas for coursework to the Coursework Consultant. They had received approval for the proposed schemes and were happy to get on with it. The author had the opportunity to talk to the two staff currently engaged with the classes doing GCSE coursework.

Mrs Ellman - a probationary teacher in her first year having taken over from a previous teacher. Fortunately while on her PGCE course she had been introduced to coursework in a thorough way and was not intimidated by the MEG scheme of assessment. The class had already done three pieces of work which she discussed in some detail.

Mrs Graham - an experienced teacher who has a first year class for the first time this year. From the limited trial in the third year there were some definite opinions expressed about coursework and gender; "...Girls are better than boys because they were more careful, neat and show more pride in the presentation of their work." "...The better boys are not suited to coursework as they tended to be too sloppy in terms of presentation and approach to the technique." "...Boys also tend to bite off more than they can chew when planning their strategy." "...The less able boys in a Grammar school are happy to do repeated examples of the same problem ie BP rather than find a variety of ways of arranging finance (see holiday project)."

The pupils from the two classes had covered three topics from:

- Practical Geometry - an investigation of nets. This was given to the pupils in the form of a highly structured worksheet which set the problem for the pupil.
- Practical Geometry - Japanese water bomb. A structured worksheet gave the pupils details of how to make a cube by paper folding. There was little opportunity to develop any mathematics as defined in the MEG mark scheme.
- Statistics - data collection and comparison. Much less structured for the pupils but it was an exercise in the collection of data in two situations (word length in a page of script or traffic flow at two times of the day).
- Investigation - primes. A study of prime numbers and the generation of primes.
- Probability - roll a penny. An analysis of the fair ground game of rolling a penny onto a squared grid.
The size of the grid is varied and they have to estimate the probability of winning if the coin has not to cross a gridline. Some practical work was involved but the work was again presented in a structured worksheet.

Probability - random numbers. An analysis of what is a random number and how it is generated.

Everyday Applications - planning a holiday. This had the usual ingredients but had the added extra in that pupils were expected to compare the different ways of financing the holiday as well as costing the trip itself.

The coursework had all been marked by the class teacher but there had been no attempt to moderate the marks internally other than by a "...A quick look through" by the head of department. The work had been assessed using Control Elements by interview (on cassette tape) and by test. One statistics test was impressive in that it assumed that the pupils had done the statistical theory in their coursework (and some classwork). They were expected to be able to interpret data presented to them in diagrammatic form.

The coursework only involved the fourth and fifth year on an organised basis and no work (apart from the exam) was set up for the first three years. The school did not participate in the Self Help Group scheme.
7. Westings County School

Staff

Head of Department  Mr Major Cert.Ed.
                  Mr Nolan (not a mathematician)
                  Mr Oliver (not a mathematician)

Background

Number in Yr 1  46  2 groups  taught in mixed ability
Number in Yr 2  60  3 groups  taught in mixed ability
Number in Yr 3  65  3 groups  taught in sets
       set 1  I  22  SMP 11-16
       set 2  F  21  Green
       set 3  R  20  Series

This is a very small rural secondary modern school of about 300 pupils. The school used the EMREB CSE mode 1 and some pupils took the limited grade scheme.

The Visit

The author had been invited in to watch a group of first years attempt coursework for the first time. They were to have tried Perimeters. For some reason connected with the absence of another mathematics teacher the assignment turned out to be Matches. There were 16 pupils in the classroom which was arranged normally with 6 sets of single desks in groups of 4. There was plenty of space in the room with such a small number in the set. The teacher issued triangular dotty paper and the Briefing Sheet (revised version) without explanation. He then told the pupils they were to work in the back of their exercise books where homework normally goes and to start on a new page.

Introduction by the teacher:
“Every now and then I shall be telling you to stop your normal work and do what we call an investigation. You normally learn from a text book. Some thing you have to find out for yourselves. What is it all about?” (he reads the problem from Matches Briefing Sheet) and asks for answers to the pictures for 1, 2 and 3 triangle strings he has drawn on the board.

The pupils are unsure what is happening but count up correctly. They appear from the expression on their faces to be somewhat confused. “What is the rule?" The class is even more confused. The teacher then turns to the b/board where he has prepared a list of suggestions/tactics for the pupil to follow.

1) experiment on a few easy cases.
2) tabulate the results.
3) look for a relationship (rule).
4) test the rule to see if it works.
5) use the rule.
6) explain why the rule works.
The teacher then works through these suggestions with the class. Each suggestion is directly related to the investigation in such a way as to direct the pupil. The responses of the pupils led to the author asking several questions.
1) Have they used dotty paper before? (answer later = no)
2) Have they any notion of organisation or being systematic? (from their work answer no)
3) Do they know how to tabulate? (answer later = no)
4) Have they done Perimeters? (answer = no)
5) Will they set out their work out tidily (from the work answer = no)

[The following is an exchange between the teacher (PM) and the class.]

PM How do we start?
A 99x3
PM Then what do you know it is right?
A Divide it back
PM How do you know it is right?
A Do it on a calculator (the answer to everything)
PM Obviously saying 3 matches per triangle is not correct since it is not a chain of separate triangles.

[This idea was discussed for quite a while before PM realised it was not working and changed tack.]
PM You are looking for an answer out of the blue without doing any trials. (Refers to b/b).
He then led on to the idea of easy cases but not stressing the approach of 1, 2, 3, 4 etc. The pupils then got on with it on their own with a break in the middle for 10 minutes.
The author took the opportunity to talk to several individual pupils in the groups.
A Had drawn 12 triangles and got the answer 14. Was thinking about drawing the 99! After a discussion he started to look at 1, 2, 3 etc. (systematic).
B Had drawn 3, 7, 12 but were untidily arranged and freehand. By discussion led her to 1, 2, 3 etc.
C Had drawn 1, 2, 3, 4 up to 11 but there were no results written alongside each drawing. Pupil seemed happy to keep on going. The author helped her count the matches in a few cases and got her to put her results in a table. The table had the column headings exchanged as had several others.
D Had drawn and labelled up to 5 but had produced a table up to 16 by extrapolation. "...I just added on 2 each time." It was explained that results are really what had been seen to be true not things we hoped would be true. He redrew his table in two parts showing results from the
drawings and extension of this information by calculation. E Had 6 sets of drawings nicely labelled and a table of results. We discussed what was next. The impression was that the pupils were relying their recollection of what the teacher had said and not using the worksheet at all. Again the phrase "...You add two" appeared and had to be turned into good English.

At the end of the double lesson a few pupils had got the idea and were well on their way to writing a rule with help. Many of the tables of results were the wrong way round - number of matches first and the number of triangles second. Much of the work was badly laid out through inexperience rather than being weak. Two or three pupils had decided that they needed $2 \times 99 + 1$. A major problem for the pupils was their idea of what should be written down in the account. It was apparent that they only considered the drawings (because the teacher said they had to be there), the table of results and a numerical answer (because a question was asked) as important.

After the lesson the teacher expressed concern about the amount of help it was necessary to give to the pupils when undertaking coursework. He considered the amount of help given by the author as excessive and was worried about the future progress of his pupils. He was reassured when the author explained that this amount of guidance had been found necessary for the first investigation in other schools. It was also difficult for the pupils because they started with a more difficult assignment than usual. It was also pointed out that the amount of assistance would decrease as the pupils became more proficient.
8. Seatown Grammar School

Staff

Head of Department  Mr Samson
Second in Dept  Mr Tinker
  Mrs Unwin
  Mrs Vernon

All teachers are graduate mathematicians.

Background

The involvement with this school started in early December 1987 when the author received a phone call from the head of department. He expressed reservations and anxiety about the introduction of coursework into school and wanted advice and guidance on site. He asked if the author would come into school and do a demonstration lesson which could be observed by his staff. It suggested that if there was so much anxiety about the new work it would be better if there was a general discussion with the staff first to explain the strategies and classroom techniques beforehand. The demonstration would then have more meaning. He agreed and a meeting was arranged with the staff on Monday 14th December in the afternoon. The demonstration lessons were arranged for the day after. The reason given for the date chosen was because "...It is the end of term and the concerts were on so it will not affect anything." The author was to discover later that this approach had been initiated by the Head, Mr Walton, who had heard of the work of the Self Help Groups and other school visits and had suggested Mr Samson make contact. Later it was also discovered that the Head had rearranged the timetables of staff and pupils on the two days to facilitate both activities.

The Visits

Monday 14th December

During the discussion with the staff, which went on for 2 hours, it became clear that they really were unsure of how to select, administer, support and assess GCSE coursework. They accepted the premise that it was better to wait until 1991 before taking on the coursework assessment and that the best way to proceed was to start with the lower school and develop with the pupils. They had received the preliminary notes for the Phase 4B training which suggested they try an assignment. They had tried Perimeters (old version) but with what they regarded as little success. This was found to be due to the fact they had not given any guidance in the classroom as they felt it was "...cheating". One of the teachers (Mrs Vernon) had tried a different
assignment as she felt Perimeters was too easy for "...grammar school" children. She had picked Regions which asked for a relationship between the number of intersections and the number of regions in an asymmetrical Magic Rose. When the children were not able to find anything significant in their results she looked for the rule herself. Finding that she could not see a relationship she decided it could not be done and abandoned the attempt. A classic case of failing to try something yourself before expecting the pupils to do it. They were all of the opinion that the exercises in the Lower school scheme were too easy and would be finished in a very short time and "...what do we do with the rest of the class?" The author discussed Perimeters at length showing how it could be extended by the fast or clever pupil into generalised algebra. This impressed the teachers as it "...belongs in our world." Some time was spent discussing the amount of help the teacher may give to any pupil in the classroom. They took a lot of persuading that it was reasonable, and expected in the early days, to give whatever help the pupil needed to progress and gain confidence. The teachers then asked why the pupils should write an account when they were "...just getting a formula". The author then referred to the criteria for marking scripts as the only evidence of the activity. In pointing out that it was necessary for the pupils to learn how to present their evidence in an assessable format for GCSE it was seen to be necessary for the staff to learn how to assess that evidence according to specific positive criteria. Again the old argument came in. "...If we help pupil A and she produces work of the same standard as pupil B then should they get the same mark ? " The answer was, that at lower school level, "...yes, because this is how we teach anyway - by example and assistance." At GCSE it has to be taken into account in the marking scheme and teachers have to move slowly towards such a strategy in stages. The author then went through the mark scheme for Perimeters so that they would be able to use it to mark the scripts their pupils would produce.

The next day had been organised so that the author was in front of a first year class who would attempt Perimeters followed by a second year class who would attempt Squares. It was necessary to point out that this would be a class the author did not know and that teachers always get a better reaction with their own classes. It was also necessary to point out that, within certain limits of principle, each teacher must find his/her own method of presentation which may be different to the one they would see.

15th December 1987
This was a first year class with Mr. Samson, Mr. Barry and Mrs. Unwin observing. The assignment Perimeters was
introduced to the class with some general discussion about strategy (start simple, be systematic etc.). The pupils were also advised in general terms about what was expected by way of an account. The pupils were quick to offer responses to questions asked in the introduction and did not seem inhibited by the presence of a visitor. Although they were being guided very carefully they understood the purpose of the investigation. The introduction took about 15 minutes. During the lesson the author took each of the observing teachers round in turn to let them listen to the sort of conversation held with the pupils. This had been stressed as important to them in the previous meeting. From later remarks it was obvious they thought that the pupil was being "...instructed". In fact the pupil was being "guided" and the discussion was more important than the end statement.

The pupils themselves were very capable and seemed to get into the idea fairly quickly. All were able to come up with a rule of sorts by the end of the lesson. The main problem was their feeling that there was a right and a wrong way of doing things rather than discovering better ways. This was reinforced in one instance where Mr. Samson had told a pupil his idea was "...wrong" rather than "...is there a better way?" The word wrong implies failure whereas "...can you improve it?" or "...explain it to me another way" does not destroy confidence and encourages more ideas.

15th December

This was a second year class with Mr. Barry, Mrs. Unwin and Mrs. Vernon observing. These pupils had done Perimeters last year so it was possible to refer to their previous experience but they had remembered very little except it was about snakes (it was the old version). The same sort of introduction as with the previous class took place. The class got on with the investigation in much the same way as the first year class. The author noted here that, as on other occasions, the first investigation produced similar responses regardless of the fact that these pupils were a year older. The pupils had arrived at a sort of rule by the end of the one hour lesson. While they were articulate in conversation the pupils did not have the skill at phrasing their mathematical knowledge in terms suitable for a layman to follow. What was very revealing was the way in which they counted the lines in a very unsystematic spiral fashion which did not guide them towards a rule. Several rules emerged and yet again a new version appeared that had not been seen before. This rule was based on whether it was an odd sized square or an even size. The rule worked and could therefore be accepted even though the teachers were not happy about it. "...It's not very logical is it?" In a discussion with the staff at the end of the day, they said they felt they had more of an idea and
would be happy to give it a try themselves. They did not seem to be totally convinced that coursework was for the clever pupil but they realised it was a necessity. They would try these investigations with the rest of the first and second year groups and see what happened. It was stressed that it would be a good idea to let the investigation to run its full course and take about a week of lessons. The Headmaster asked for a word with the author and explained how the visit had been initiated. He saw one problem as that of a head of department who is approaching retirement and who had been doing a particular examination job very well for a long time. The new GCSE regulations were against the grain. The same was almost true of the second in department who had been at the School for over 20 years. The author had met similar problems at the phased training meetings when teachers approaching retirement were obviously going to ignore, as far as possible, the imminent changes to the curriculum.

January 25th 1988
The author followed up the visits by telephoning to ask what had happened and what were the plans for the future. It was noticed that they were not participating in the Self Help Group scheme and were on their own. Apparently the total coursework attitude and experience of the local secondary modern school staff had been intimidating to the two teachers who had been to an early meeting. They had not been since. "...We were made to feel inadequate." The author was invited to visit again on the 18th March. This date was chosen "...Because we have not had time to mark the first investigation yet as there were so many things to do." This was interpreted as the investigations not having any importance and it would wait until they had some spare time. The 18th March was mentioned as "...Being near end of term when things have slackened off."

18th March 1988
10.30 am 2nd year Mr Tinker
Chessboard
The head of department wanted his staff to take the investigation which seemed to be the best solution. He said that Mr Tinker was quite nervous at having a visitor despite the fact he had been teaching longer than the author. According to the head of department Mr Tinker saw the visit as "an inspection" whereas the reverse was true. The author was there to watch the pupils and listen to the pupils’s responses to a second investigation. The head of department paid the compliment of saying "...I know you are’nt an Inspector; because ‘you are one of us’" (praise indeed !) The teacher was nervous and hesitant. (The reason was not known at the time) but settled down after he had had a joke with his class of 26. The pupils were seated at
tables for two and were left in the normal arrangement i.e. all facing the front. Although it was a new, purpose built block there was not a lot of space around the room to walk around. Again it is very difficult to talk to the pupils except near the aisles. The lesson went very well with a novel idea of referring to the 1x1’s as Baby squares, the 2x2’s as Mummy squares and the 3x3’s as the Daddy squares (The panto was in town). The tabulation of the minor squares was given to the class. It would have been interesting to see whether they would have developed this on their own. As a consequence the rule was soon discovered and was given in a reasonably articulate form. The only omission was in not stating the purpose of the rule. The pupils were quite adept at using the calculator memory to calculate high value totals. In the one hour available most were demonstrating they understood the rule and its application. The pupils had not met the difference table technique before this was seen by the pupils as new and interesting mathematics. The pupils were articulate and keen to talk and explain their understanding of the problem. They did need some help in phrasing their rule in good English.

18th March 1988
2.30 pm 1st year Mr Samson
26 pupils. They were to try Matches, their second investigation; they had done Perimeters with the author last term. At the author’s suggestion the tables were rearranged for groups of 4. The pupils seemed to enjoy moving around and picking the four people who were to work as a group. The teacher started by referring to the previous investigation and the strategy used. He then introduced Matches using an overhead projector with real matches on the screen. These showed up very well. He set up a 1x1 and a 2x2 and asked a pupil to come and make a 3x3. Then he asked about the number of matches before posing the problem of the rule. The pupils were then given a copy of the Briefing Sheet and squared paper. This came from the author as the school only had graph and lined paper. For this investigation the author has found that 7mm squared paper makes the drawings and tabulation easier. The pupils set to with a will and enthusiasm almost as though it was a competition to find “the answer” first. In spite of that they all started with a simple case and progressed very quickly to finding the basic rule. During the one hour lesson all the pupils were engrossed in the activity. They seemed to regard coursework as “...great, better than doing algebra.” “...A nice change.” One pupil did indicate that he knew that Mr Samson was not keen on this sort of activity. It transpired that apart from completing the account for homework, no further time was devoted to this investigation. This was a pity as these pupils had the
ability to take on the extensions and benefit from the need to make their own decisions and be experience something a little more demanding.
9. Greenway Grammar School

Staff

Head of Department  Mrs R Williams (Grad. maths)
                    (Headmaster - not maths)
                    (Deputy Head - Chemist)

Background

This is a selective school with about 250 pupils on roll. During the year 1987-88 it was being considered for closure and the numbers on roll were being allowed to fall in anticipation of the closure. The school and the community were opposing the closure and were eventually successful. The head of department telephoned and asked if the author could go into school and demonstrate this "...coursework thing as I don't know what to do." The last week of term was suggested as "...it is the last week of term and nothing much happens so I can arrange the class to fit in with you". In view of the falling roll situation leaving very low numbers in the lower school Mrs Williams arranged to put the first and second year pupils together for a whole afternoon. One of the ESG advisory teachers also attended the session. It was interesting to discover that the ESG teacher had no previous experience of teaching or working with pupils from the top end of the ability range.

The Visits

Tuesday 15th December 1987

A copy of Perimeters was sent to the head of department before the visit in order that she might be prepared. Before the lesson the author was able to brief the teacher on what should happen and the approach to the investigation. It was evident that this teacher had never experienced this sort of classroom activity before and was more accustomed to the formal more expository approach to teaching. The author was introduced as "...Mr Nelson who has come to show you how to do assessments for GCSE." There was a total of 25 pupils from the first and second year in a small room at the top of an old building. Individual desks, which were put together to make tables for four pupils, were crowded into the room. The children arrived in "civvies" as there was some party on that night after school. The investigation Perimeters was used for this class and the introduction was as described elsewhere in this Appendix. The children were very bright and willing and talkative with both the visitors to the class. The teacher took very little part in any conversations with the pupils. The pupils also argued with each other about whether their version or ideas were sensible. The lesson
lasted for almost two hours with a short break in the middle (many pupils came back early to get on with the work). At the end most of the pupils had got to the rule stage for triangles and squares and some were into pentagons and hexagons. The level of sustained concentration was impressive for such young children. This was shown by the fact that the author did not hear any conversations about any other topic than the investigation. When the EGG teacher was asked about this she agreed and was somewhat surprised. The pupils were also competitive in groups in so far as they would work as one group but refuse help to another group "...can't you get it, its easy. We're on to the next one".

At the end of the lesson the scripts were collected in and reviewed with the class teacher. There were a number of scripts which showed the pupils had understood the mathematics and had devised some rule. This was shown in the calculations rather than in the formal expression of words. Some time was spent discussing the need for a script in terms of the GCSE scheme of assessment. The phased training programme had not made much impression at this school. The teacher expressed some surprise that the scripts would have to be marked seemingly thinking that to experience the activity was a sufficient break from the norm. The mark scheme and the Assessment Record Form were explained in detail and the teacher agreed to give the pupils a little more time before marking the scripts. A later telephone conversation revealed that the teacher had marked the scripts. She commented that in view of the fact that they had received so much help she had expected them all to get the top mark. In fact the marks were spread from 60% to 90%. The spread was in agreement with other trials and was quite informative. The rank order of marks was in agreement with the teacher's perception of the class. It also fitted with her perception of the careful and thorough pupil getting better marks than the quick and clever who rushed it and gave very little evidence.

6th March 1988

The author received another invitation to the school to watch a combined first and second year in action on an assignment. By agreement with Mrs Williams the assignment would be Squares. It would have been preferable for them to try Matches as a follow up to gain confidence. Mrs Williams thought the two assignments were too similar "...for my pupils". When her attention was drawn to the differences it was evident that she had not read beyond the first two lines. Mrs Williams referred to the work as Assessments which was an unusual description. In discussion beforehand we talked about the marking of the scripts. She thought it would be a good idea to mention the marks they had got for the last assignment and explain why they were
awarded and then outline the main points of the scheme for the new assignment. It turned out to be a very vague review, possibly because she was not familiar with the marking scheme and had not seen the sort of script that can be produced by pupils of this ability with practice. The pupils were told they would be marked on:

- drawings
- rule
- calculation
  (tabulation was mentioned later)

The Briefing Sheet was split in two parts so the pupils would not have sight of the difference table format. Previous experience and comments from the Self Help Groups suggested that this interfered with the derivation of the rule. It became apparent that the teacher was not familiar with this assignment. Part one was issued along with squared paper, rulers and a few pencils. There was no discussion on strategy or presentation or tabulation. Mrs Williams was concerned about time and was hoping the pupils would complete the whole assignment (including the account) in the one hour available. She realised towards the end, when only one group had got close to a rule, how little time there had been. Another session will be set aside for the completion of the assignment and the account but this will not be enough for any extension to stretch the more able grammar school pupil. The author went round the groups discussing with the pupils what they had achieved and what they were going to do next.

Group one 3 girls first year
They immediately started writing the answers to the first three drawings on their paper. The author sat with them and discussed how they might attempt the assignment in a systematic way. This was a group the author had talked to on the previous visit. One pupil was, in fact, new to the school and had done no coursework before but fitted in quite well. "Why do we have to write this essay?" was explained in terms of the need for an account of their activities. The analogy with a detective investigating a crime was one these pupils were happy to accept and use. They came up with the idea of describing the situation, stating the problem and then collecting the evidence. They then got on with those stages while the author talked to another group. On returning they had done the drawings and almost finished a table of results. We discussed their results but they could not see a rule. The author then asked them how they counted their matches and, sure enough, they counted around an inward spiral and one of them actually lost track of where she was. This gave an opportunity to demonstrate a systematic method of counting related to the rule without being too directed. They were asked to watch the author count (the systematic way) and one girl at the half-way stage said "...and another 20". The
others understood and were able to see that to count in rows and double would save time. They then arrived at the idea of 3x4, 4x5 etc and they then gave the instructions for calculating a 10 by 10 and a 33 by 33. This meant they knew how to calculate; the difficulty was then how to say the rule in general terms. It was not long before decided it was "...the size times one more". They were left to finish off Part 1 by testing the rule and then calculating the 20 by 20. This they did well. One problem occurred later when they asked "...what do we do because Mrs Williams told us we had to add the sizes not times them" and "...was that right cos we had to times it?"

Group two two boys second year
One boy seemed to think it was too easy to start with. He had drawn four messy squares using pencil. After a discussion he started again still working in pencil! Neither boy thought it was necessary to explain, in the account, what it was all about. Both took some persuading that it was in their interest to draw tidily, and in sequence, the required shapes. Both thought that they could "...suss it out in three." Here was one instance when the author found it very difficult not to direct because these two boys were very independent and did not accept the arguments for writing a comprehensive account. At the end of the afternoon, however, both scripts were very good. The discussions, apart from that issue were very much similar to group one although they did not get as far in the time available.

Group three three girls second year
These girls had remembered a great deal from the first assignment they did on Perimeters. They had already written out the explanation and the problem and got all the drawings done perfectly together with a table of results when I arrived at their table. They were much more organised and had a strategy in mind that they were following. They had tried a couple of ideas for a rule but knew they did not work. The author went through the "...how did you count the matches?" routine and they very quickly got the rule and were able to use it. Articulation of ideas and description from two of the girls was excellent. They were then given Part 2. They were asked to draw up the table and fill in with the information they knew was correct (rather than calculate more values) which they did. On returning they had already decided that the last column had to be all fours and it took very little for them to work back through the difference table. Nor did they have any problem explaining how they did this in their account. As they had completed the basic assignment an extension was proposed which they took on with enthusiasm. They chose the pentagon grid. These girls could have achieved a very creditable mark for their work without the author's intervention and this was the result of good retention from
previous experience. This was more evidence that the coursework skills could be learned. Exactly what the skills are is another matter.

After the lesson the author reviewed the lesson with the teacher. Like many others she was concerned not to spend too much time on this work as "I will never get the exam work done." Pupils were asked as they left the room if they had enjoyed themselves. All apparently had except for one boy who thought "It were a bit boring doing them drawings." It was suggested to Mrs Williams that next time she might like to consider discussing strategy with the class in general terms before they start. We spent some time discussing the investigation algorithm and its implications for the writing of scripts. It was decided to issue a copy of the guidance sheet to the pupils before they started the next assignment. Mrs Williams thought it would be a good idea to prepare a script writers advice sheet as well.
10. Dragon High School

Staff

Head of Dept | Mr Collins | BSc PGCE | Maths
Mrs Dufton | B.Ed | Maths (prob.)
Mrs Edmundson | Cert Ed | Maths
Mr Fairley | B.Sc | mostly computing
Mr Grange | ex RAF 8yrs
Mrs Holmes | Hist + remedial
Mr Inch | absent on other business
Mr Josephs | 2 afts / week
Mrs Kent | 1 aft / week science

Background

This is a comprehensive school of about 800 pupils in a modern building and next door to a competing Grammar school. This school had a good local reputation and a number of its pupils went on to a joint Sixth Form unit in the town. Two of the department, the head of department and a probationer teacher, were regular attenders at the Self Help Group meetings and keenly interested in the development of lower school coursework. The head of department had trialled several of the assignments in his school with the support of the probationer. The probationer had done some work during her PGCE year at University which had been of tremendous help. Two other probationers, encountered by the author at other schools, had never seen any coursework in their training. The head of department had intimated that he was having problems convincing some of his more conservative and traditional teachers that the coursework activity had advantages that could benefit the school and the pupils.

The Visits

The head of department asked the author to attend a departmental meeting as an observer. The purpose of the meeting was to discuss the success/failure of an investigation on sorting that some groups had trialled (not from the Lower school scheme). Scripts were available for perusal but there was not much examination of this work.

1. It was felt that the trouble some pupils had gone to in the presentation of the work (inside a stiff card folder with emphasis on colour and tidyness) was the result of work the pupils had done in the Junior school rather than prompting from the classroom teacher. One group had been promised 10 housepoints for the best script.
2. The time available varied between the classes ranging from one double period plus a homework to three
doubles and a homework. There was no policy on the assessment; two groups being marked out of 10 and two on a scale of A to E and +/- . No criteria had actually been specified but the staff seemed to have some idea of what they regarded as important. Two scripts were checked with Mrs Dufton. One was untidy but had all the relevant information and comment and the other very pretty and with similar content. Both got the same grade A–.

3. It was noticed that the majority of scripts were in fact no more than two sides of ordinary exercise paper. In many cases there was no explanation just a table of results and an answer for the 50 red + 50 blue. All the answers were correct so the pupils had acquired the manipulative skill, observed the relationship and were able to implement the rule. The rule was well stated in many cases and badly in others.

4. The amount of help given to the pupils varied with no clear policy. One teacher said that he told them "...exactly what to do and the order in which it should be done." Another said "...I just told them to get on with it."

5. Very few pupils had attempted the suggested extension to the investigation where the pattern of counters was changed. One teacher was concerned at the "...amount of time we give up for this sort of activity." The author is convinced the teacher would have preferred the word waste.

6. When the head of department asked if it had been a worthwhile exercise all agreed it had. The next item to be discussed was the mathematics examinations to be held in school next term. The head of department had decided he wanted to include a coursework assignment as an item to be tested. "%...If we feel it is important and it will appear in the GCSE then we should give them the experience at the earliest opportunity." The pattern of assessment was decided as follows:

   Years one and two
   Top sets 3 x 1 hour written papers plus Investigation
             3 x 100 marks 50 marks
   Other sets 2 x 1 hour written papers plus Investigation
             2 x 100 marks 50 marks
   The same investigation for all with the time allowances of
   Top groups : one double period + homework
   Middle groups : two double periods + homework
   Bottom groups : three double periods + homework
   Mixed ability groups : two double periods + homework
   The suggested coursework marking scheme caused some controversy.
   25 marks general care, presentation, enthusiasm and interest
   5 marks for a clearly stated aim
   5 marks for a clearly stated method

page - 76
5 marks for a correctly done table
5 marks for spotting of patterns from the table
5 marks generalization, conclusion from the table

The discussion was centred on the 25 for "...effort they put into it" and "...the time they are prepared to spend at home" (head of department). The head of department clearly felt that it was right to reward effort and enthusiasm at this stage and let the content begin to take priority as the pupils move up to the 4th/5th year. He remembered from his own school experience that "...whenever a History or Geography project had to be done it was always those who spent hours at home and handed in 10 pages who got the top marks".

The important point is that the school is actually taking on board the concept of coursework and its place in the system of assessment. The head of department said "...We are entering a whole new area and we are going to have to experiment". Staff were asked to think about the scheme. The head of department said he would consider changing the scheme if there was a strong case made out for doing so. Apart from the probationer teacher there seemed little enthusiasm for coursework as a vehicle for learning skills. When the Cockcroft Report was mentioned its importance was not appreciated. It must be remembered that here is a staff of 9 teachers all doing a small bit of mathematics teaching and in most cases not their speciality subject. this does not help the cause of innovation and progress when retraining is a greater issue.

8/3/88
Mrs Dufton
This was a second year top set who had done
Handshakes ( no script )
Sorting ( script )
Flower power"
Squares"
Matches"

Each of the assignments had been marked on a subjective basis of A to E with a +/- added to indicate effort. They were to attempt a new piece of coursework on packaging. There were 34 pupils in the class and the room was crowded. Tables were arranged so pupils were sat in groups of threes at tables. They had been warned that a visitor would be present but the author was not introduced to the class. Discipline was excellent and the class were easily called to order when needed by Mrs Dufton. Obviously a good relationship between the teacher and the pupils. Each group was given eight sticks of six multilink cubes and the worksheet which was taken from the distance learning package produced by MEG. They were instructed to separate the sticks into 48 cubes. Next they were asked to make up a cuboid using all the cubes. A sheet of rough
paper and a sheet of triangular spotty paper were issued to each person.

The sizes of cuboid they made were

- 8 x 2 x 3
- 4 x 4 x 3
- 6 x 4 x 2

They were then called to order and Mrs Dufton went through the worksheet which was very specific. They were then asked to get on with it and we went round the groups. All groups were quite prepared to discuss what they had been doing and offer reasons for ideas etc. This stemmed from their previous experiences at coursework type activities. They were certainly more confident and articulate than pupils seen at other schools with less experience and possibly brighter children. They were also very cheerful and liked Mrs Dufton. When referring to length, width and height they were quite happy to say that height was "the distance measured up from the table". The interchangeability of length and width was strange. Most said length was the distance measured "away from you" and width "is across". Most agreed that if a cuboid was turned on its other face it was a different cuboid (when it is still the same). This suggests that when they document their shapes they will record an 8x3x2 as different to a 3x2x8 but they all knew it would have the same area and volume. One pupil said that to say (on a base of 8x3) the length was 3 "seems wrong" and then decided that she called length the "longest of the sides". A few thought to start with that they would get the same volume and area for all the different shapes "cos we're all using the same number of cubes". All were tabulating their results, some with more skill than others on rough paper - this is Mrs Dufton's policy. The perspective drawings were good and dimensioned in accordance with their models. One boy was concerned about the definitions offered in the worksheet. The way he was holding his model he said the front and back were the same as the two ends and he was missing out the two sides. He even offered an explanation of his use of the words by referring to the view of a cat and it was a sound argument. However he agreed it was not was Mrs Dufton would be expecting so he had better conform!

At the end Mrs Dufton called the class to attention and discussed the numbers they were playing with i.e. as factors of 48. She also tried to establish some system to the results by asking them how to proceed in an organised way through the set of factors.

End of first session (1 hour 10 minutes)

Second Session

Mrs Dufton collated the information the pupils had gathered on the blackboard and discussed the organisation of the data into some order. Nine different sets of factors were...
found. They noticed the surface areas were different and the 4x4x3 had the least area. They were asked to chose one of their cuboids from their drawings and make a net on 1 cm squared paper, cut it out and make up into a model. It was interesting to watch them make out the arrangement of faces for the net. Some were confused until the author suggested they actually look at their drawing of the box in perspective and then they found it easier. All made symmetric nets apart from one boy who "...is always awkward" (peer description). His was the only net of an extreme shape (12x2x2).

They were then called together for a discussion on cereal boxes. The discussion had a deal of reality to it in that they were considering cereal boxes which were arranged on a shelf in different orientations. The problem of stability was identified.

"...What happens if we make a large surface the top?"
"...You'll pour 'em all over the table miss."
"...What happens if we stack them to fit exactly under a shelf?"
"...They'll fall over or you'll not get 'em out miss."

The pupils had a good sense of real problems. In discussion on the most stable box with one group they were able to understand the conflicting demands of
1. stability
2. need to pour from the box
3. minimum material in making the box

They stated the most stable would have the bottom surface the largest area and also realised that the pouring area had to be the smallest area.

By reference to the homework table of size/area one boy in particular was able to say that the least area was nearest to a cube so we were looking for a box with the volume of (32x22x7) 4928 ccm whose sides were similar in length. By reference to the expansion of 48 into 3 factors they were able to split one factor up:

\[
i \quad e \quad 1 \quad 48 \quad 1 \\
2 \quad 24 \quad 1 \\
3 \quad 4 \quad 4 \\
\]

and were then able to split the 32 x 22 x 7

\[
i \quad e \quad 32 \quad 22 \quad 7 \\
16 \quad 22 \quad 14 \\
\]

to get three sides near the same and were going to look for a better set of factors. They also looked at the length of the sides if the box was a cube. At their suggestion we tried 15 x 15 x 15 and worked to 17.02 x 17.02 x 17.02. This had a lot of possibilities for discussion but the bell went.

When some of the scripts were seen later they had a quality that would have scored well at GCSE Intermediate level. These were third year pupils who had had a good
introduction to coursework activity and were making the most of their previous experiences in dealing with new assignment. The standard of linguistic ability of these pupils was commented upon by the author. These pupils are able to discuss their knowledge and ideas with fluency and confidence. Mrs Dufton said "...There are a number of those pupils who achieve more in the coursework than they can ever do in an examination paper. They have learned how to use their mathematics in the last year and I am sure they are enjoying it more. I can find out more about their ability by talking to them than I could in a written test."

The teacher later took the sample box of ATM tiles to try the assignment seen on the training video made at LUT. She later recorded that the assignment had been a success but there was no time to find out the exact nature of the success.
11. Newton Hugh Comprehensive

Staff

Head of Department  
Mr Walden  Graduate maths  
Mr Markham  Graduate maths  
Mrs Packham  Cert.Ed. maths  
Mr Prince  ?  
Mr Quorn  ?

Background

This is a comprehensive school of about 500 pupils with a Sixth form and suffering badly from falling roles. Part way through the year the LEA announced it was proposing to close the school. One of the Self Help Groups was based at this school and the members of the department were regular attenders. The department trialled most of the assignments in the Lower school scheme.

The Visits

Monday 22/2/88
Mr Walden  35 minute lesson  
First year class  22 pupils  top set  
Room  arranged in formal setting - tables for two all facing the front.

Coursework

Matches

The class had done Perimeters before and were reminded of this. There was some discussion as to what had happened and how it had been tackled but there was not much recall from last term. Mr Walden handed out copies of the briefing sheet and gave them a few minutes to read through. He pointed out that while it looked the same as Perimeters it was in fact different. He asked how it should be done and got a reasonable response. A few pupils understood that they had to do some drawings and make a table of the results. He gave out the mark scheme and said that this is what they would be marked on. The pupils then got on with the task.

The following is a record of the discussion with one boy (X) and one girl (Y) in the class as they worked through the assignment.

GHN  "Can you tell me what this is about?"
X  "You've got to find how many matches there are."
GHN  "In what?"
X  "In these drawings"
GHN  "And then what?"
X  "Find a rule"
GHN  "What are you going to write down first?"
X  "I'm going to draw the shapes"
GHN  "Then what"

page - 81
"Work out the rule"

[He obviously had some hazy idea of what was expected but not a clear understanding of a method. This boy was seen in the next lesson and his work was disorganised. More later.]

"Can you tell me what you are doing?"

This girl had started on the drawings and done about 4 unlabelled sketches on file-paper.

"You've got to find how many matches there are in 99 triangles"

"Explain what you have done so far"

"Well we have to do all these drawings and then find a rule"

"How many drawings are you going to do?"

"Twelve"

"Can you tell me why you need twelve?"

"Cos it asks you about twelve here"

The bell went.

Wednesday 24/2/88
Mr Walden 65 minute lesson
First year class 22 pupils top set
Room as before
Coursework Matches continued
Coursework folders were given out and pupils got on with the assignment.

Pupil A had no written introduction just 6 unlabelled drawings on her paper and was starting on a table of results.

"Can you explain this table to me?"

"Its just how many matches there are"

"You have written here that with 4 triangles there are 9 matches"

"That's that" (pointing at the drawing)

"If anyone else saw this would they know?"

"Spose not"

"If you do work in Geography and History do you label the drawings?"

"Yes"

"What could you label these with then?"

"Number of matches"

".. and ..?"

"How many sides"

Not many pupils had labelled their drawings to start with and this conversation was held with four of the six pupils the author spoke to. None of those seen had written an introduction or an explanation of the problem. The author has found this to be quite common. With three of the groups the idea of a writing a detective story, where the writer sets the scene (describes the shapes) asks who dunnit (find a rule) explains the evidence (drawings and results) before deciding who diddit (the rule), was explained. They seemed quite happy with this and one of them started again on
fresh paper.
Pupil B had done the labelled drawings and drawn a table of results and was about to draw the twelve triangles.

GHN  "Have you got a rule?"
B    "Yes"
GHN  "What is it?"
B    "It goes up in two's"

[What the pupil was describing was, in fact, a pattern and while this was useful and good it would not help him solve difficult problems. The only way to say how many matches there are in say 200 triangles would be to extend the table and work out all the answers. "...A rule gets the answer in one" was the explanation offered to the pupil.]

GHN  "Forget these numbers for a minute."
B    "How can you get from 5 to 15?"
GHN  "Add 10"
B    "Yes, and what is another way?"
GHN  "Three it"
B    "Great. Well done. Now get from 5 to 16"
GHN  "Three it and add 1" (after some thought)
B    "Now back to your table, can you get from 4 to 9?"
GHN  "Double and add 1" (after some thought and pencil waving)
B    "Does that work on all the numbers?"
GHN  "Yes I think so" (after some thought)
B    "So you now have a rule"

This was then discussed with the pupil to arrive at a more precise wording of the rule. This conversation was held with two others in a similar vein.

A variation on the rule was proposed by one boy: "...There are three sides in a triangle so you multiply by three but they all share one side so you have to take off one for every triangle except the end one which is on its own." This is equivalent to $3n - (n-1)$ and the girl could use it on any sized shape.

The class were given a homework in which to finish the assignment.

Wednesday 24/2/88
Mrs Packham  65 minute lesson
Second year class 22 pupils  top set
Room  tables arranged in doubles with three or four pupils to a group.
Coursework  Chessboard

The original Briefing Sheet had been rewritten by Mr Walden as the department felt it needed some guidance on method. This contradicted a comment he made in a Self Help Group meeting when he said that the Briefing Sheets should be brief.

The school version was very full:
Explain in words why there are more than 64 squares on a chessboard.
How many different sizes of squares can you see?
How many squares of each size can you see?
How many squares can you see?
You should not have started with a 3 by 3 square. Start again with the simplest diagram possible and work up from it.
Construct a table and use it by continuing the pattern to find the number of squares on a chessboard.
Describe the pattern you have found in words..
A new game is invented using a 12 by 12 chessboard.
Find the formula connecting the size of the chessboard and the number of squares.
It is good that they have gone to the trouble of thinking out their own approach. The idea of asking them about a 3 by 3 and 4 by 4 and then saying they should have started with a different size could be confusing to some pupils. It certainly does not encourage the use of the algorithm.
The pupils had already had one 35 minute lesson and were into the work during this lesson. Most had actually counted the right number of squares on each of the drawings up to 6 by 6 and seemed to be struggling to find a rule. The problem was they had not recorded (as the new worksheet suggested) the numbers of each sub-squares in each grid.

GHN "How did you get this 30?"
C then proceeded to show GHN and explain "There are 16 little ones, 9 of the 3 by 3's, 4 of the 2 by 2's and the big one."

"And where does this 55 come from?"
C "There are..." (explains correctly)
"Oh I see" (takes the paper from GHN)

On returning to this pupil and his group later they had a perfect table of results showing the addition of the square numbers.

GHN "Have you found a rule then?"
C "Yes, you add up all the numbers times themselves."

GHN "So what would be the answer for the chessboard?"
C Did an addition of 64, 49, 36, 25, 16, 9, 4, 1 to get 204.

Some time was spent discussing whether they understood the term square numbers - they did. They then tried to write down a rule.

C "Well you have to add up all the square numbers to the size of the square"

GHN "Fine, you have a rule"
C "Yes but how do we write it down?"

[This is obvious confusion between the spoken and the written word which the author has encountered elsewhere.]

GHN "Why not write down exactly what you just said to me?"
Will that be it then?"
"Write it down and then read it through"
Similar conversations were held with two other groups.
"We've got a rule Mister"
"Explain it to me then"
"Well you do these take aways and it goes up in square numbers"
They had written down the answers to the grids 2 to 6 and placed the first differences underneath.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>14</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>

"That's interesting, can you work out the answer to the chessboard problem using this?"
"and his two friends did just that by writing in the 49 and 64
They then write in the next two rows of differences to show that the third difference was 2.
The author then had the standard discussion on the difference between spotting a pattern/sequence and devising a rule which enables the calculation direct from the size. The same discussion was held with the group containing the girl C above.
There was one interesting problem posed by Mrs. Packham early in the lesson. One boy had, after a few minutes rough drawing, decided he knew how to calculate the answer to the chessboard. He had written nothing more than a few rough figures (square numbers added together).
"So you know how to do it then?"
"Yes. You add up the square numbers"
[He proceeded to do just that to get 204.]
The problem is what to do with a pupil who is mathematically perceptive and numerically competent and yet has poor English skills. He was quite articulate in his conversation but apparently cannot translate this understanding into a written script. Nor does he feel it is that important. "...If I can get the answer." Although Mrs Packham had previously explained why it was important that he was able to present a written account with certain guidelines he still did not appreciate the need. The author was not able to convince this pupil about the need for an account either. Mrs Packham said that this pupil was "...on a high." because he likes this sort of challenge and because "...there was someone else in the room." Perhaps the only way to show such a pupil is to actually let him write his own version and then let him see another, better, script. Then to place both scripts before an independent party for comment? Mrs Packham commented "...I can appreciate that that boy has ability in mathematics only because of his ability to explain himself. If I rely on his written work he scores very badly."
When the lesson was over it was break-time and the opportunity to talk to three of the staff about the coursework. It was interesting to note that they were "...Pleased that someone else has seen what we do because we would welcome some comment." This is more evidence that everyone works in their own little box and does not feel confident that what they are doing is right. One other point of discussion was the arrangement of the furniture in the classroom. Mrs Packham thought that she got more work and interest with groups. Mr Walden had tried grouping the tables and had reverted to the more formal setting as he felt he got better work that way.

When the assignment Chessboard is finished a different mark scheme will be applied to fit in with the changes to the Briefing Sheet.

Statement of problem 2
Answers to Q's (3x3 and 4x4) 2
Neat diagrams (up to 5) 2
Table (neat) 2
Accuracy of table 3
Number of square on Chessboard 2
Description of pattern 3
Prediction made (12x12) 2
Prediction tested 2

While this scheme satisfies the department's idea of achieving reliability it will take a long time to implement. It would certainly not be met with approval by the teachers from the Grammar schools with whom the time taken to mark a set of coursework scripts must be a minimum.

29th April 1988
2nd year set 3/4 24 pupils
Mr Walden Triangles
This is an ordinary classroom with tables all facing forwards - no groups as Mr Walden does not like it, he thinks it leads to distractions so the pupils work in pairs. The class had already spent 2 hours on Triangles and this was to be the wind-up session.

The first five minutes were spent in general confusion while some pupils gossiped and some got their folders out. Eventually all sat down with Mr Walden calling for attention. He referred to the previous session when some had had problems actually counting the number of triangles in each shape. He showed them with a roughly torn paper triangle on the drawings (all ready) on the blackboard. By sliding the cut-out along it is easier to count and the pupils were then given rough paper. Scissors were available. In fact most of the drawings were small and on lined paper and not regular so many found it not such an easy experience. In showing them how to count he also showed that it was better to tabulate the number of minor
triangles (as with chessboard) but the results were shown on the board in columns with no framing or labelling/headings. He then asked, after obtaining results up to four triangles, if anyone could provide him with the numbers for the next line. Some of the class caught on to the idea that each row consisted of the previous row with another number added in. In later discussion none of the pupils knew the term triangle numbers so where this was explained when appropriate. There was one physically handicapped girl. Her ancilliary teacher had no idea of the work at all and did not seem interested in the investigation. The tabulation in general was poor but this was a low set and the results were nearly all correct. They found it difficult working on lined paper. This was born out watching two of the pupils try to draw triangle patterns which the teacher then had to redraw for them. Those who had templates seemed to have progressed faster than the others.

Three pupils knew how to get the next number in the sequence and two of them had used the difference table and got to the 12 shape answer. The teacher had given three pupils the formula to look at but had not explained it to the two that the author encountered. They seemed disheartened. One said "...is this for us or the other groups?" After it had been explained what the formula could do using $n = 1$, 2 and 3 both pupils were able to calculate with $n = 4$. They were left to try 5 and 6. One came back as the lesson ended very pleased with herself because she had got the answer for $n = 6$ which agreed with her drawing.

More could have been achieved with these less able pupils if there had been more direction and control of the group progress. Certainly this group have produced better work on previous occasions. During the previous week the school had been advised by the LEA that it was earmarked for closure in September 1989 so, understandably, attention was elsewhere.
12. Lady Manners School for Girls

Staff

Head of Department  Mrs D Prince  graduate (maths)
               Mrs Leonard  Cert. Ed.

Background

This is a private school for girls in the centre of town. There are many county comprehensives nearby. The head of department had shown a keen interest in coursework during the phased training programme. Classes were small in number and the department achieved good results at GCE. There is a private school for boys (Blackwell) nearby and the two departments have cooperated before on mathematics work. They decided on a joint approach by combining the two year groups for the visits by the author. The staff at both schools were not confident in what they had done as part of the local Self Help Group. They asked if the author would go in and "...do a sample lesson" for them. The assignment Matches was agreed for the second years and "...something harder for the third years" - Triangles. The staff were to be in attendance to hear and see how someone else takes a coursework session and in particular to listen to the sort of conversations the author held with the pupils.

The Visits

2/3/88 9.30 am to 10.30 am
Second years – a mixed group of 29 comprising two classes from Lady Manners and one small class from Blackwell’s. The author was told (proudly) that "...We have been allowed to use the Hall." The hall had been arranged, by the mathematics teachers, using new examination desks in formation around the hall. One pupil was seated at each desk. The author was horrified and asked (tactfully) if they could be moved around. The pupils enjoyed arranging the desks in groups so there were 6 or 7 per table. One of the mathematics teachers in the hall was not pleased by this and said "...They will all be talking to each other." However the moves broke the ice and enabled some of the boys to sit with the girls. The classes were obviously used to a very formal type of lesson and it was a struggle to get them to respond. Whether it was because the author was unknown or because all the teachers were in attendance or because they were in the hall, and a different school for the boys, they took some warming up. In the end the "holiday camp host" approach seemed to work. At the end of the lesson the pupils were treating the author as a regular member of staff. As the pupils were so small the
The author was obliged to get down on one knee to talk to the pupils at the tables. Basically they had no idea of how to cope with an investigation.

The first ten minutes were spent revising the two investigations they had done before and talking about Squares and its strategy before letting them get on with the new assignment. As the author circulated, one of the four teachers was always present to listen to the conversations. One was frankly sceptical of the assistance they got and did not appreciate that it was a dialogue rather than a set of instructions (which was "cheating" in her view. Two of them became more attuned to the attitude to adopt and went away to conduct similar conversations with other groups. The author listened to these conversations and found the teachers concerned were adopting a more open ended approach than previously admitted.

The pupils were quite amused by the plethora of staff. "Why are they all here, don't they know what to do?" The pupils were, in fact, little different to most others experienced this year and the session went according to plan. Most got to the tabulation stage showing size, the minor square totals and the grand total.

9/3/88 9.30 to 10.30
On the second session with the second years the group was fewer in number through being hit by an epidemic of flu and the Blackwell class being at the theatre. The class got to the difference table and some pupils completed that with the clever use of colour. The figures obtained from the drawing exercise were written in blue. The figures calculated by difference methods were written in red. The author has tried this approach with other groups and it does help the pupils to explain, in writing, how difference tables are completed. The teachers had not come across difference tables before and it was necessary to give them a lesson in the design and use of differences. The method of deriving a relationship from a difference table was also shown. The class needed a further session so they all finished the basic investigation. Some had the chance to do an extension as practice for both teachers and the pupils. This extra time was unusual.

9/3/88 10.50 to 11.50 am
Third years girls only
This group undertook the Triangles investigation and had not done Squares so there was going to be a problem over the introduction of difference tables. The session went reasonably well even if the assignment was out of place. Again the class were slow to warm up but a little more responsive than last time. The formality of the school was evident when, at the start of the session, the Head four
teachers and the author entered the Hall to be greeted by all the girls standing up and chanting "Good morning Mrs Turpin, good morning Mrs Prince, good morning Sir." They even managed to agree on the hierarchy and put the author last. The class of 29 had little idea on presentation and what was expected in the script. By then the teachers had more idea of the approach and methodology so the lesson was successful. One group of four pupils was very adept and sensible and finished the whole assignment in the two hours of lessons. Some of the time was spent just with the pupils and some of the time was spent listening to the explanations and discussions by the teachers. This was because they really were not sure how to cope with the discussion; they were more used to the direct approach. On occasions there was a look that said "What do I say now?" or "...Was that the correct thing to say?"
The author was at pains to point out that this was only one way and it was up to the teachers to develop their own style with their own classes but that there were some common approaches to be considered. The staff considered the author had a "...very easy approach with the girls" who they thought had soon lost their apprehension. One teacher will certainly find it difficult to be less formal and engage in the sort of dialogue that is essential.

14th March 1988
Blackwell School
Headmaster (maths teacher) 14 pupils
This was a continuation of the lesson 9/3/88 they were not able to complete by attending Lady M's for the last session and the teacher was keen to see it through "...with you at the helm". The class was arranged in groups of four by turning the old fashioned desks around.
It went much the same as with the Lady Manners class with one exception. There was one pupil who had tremendous problems writing down the rule. He was able to calculate the number of squares in any grid and was able to use his calculator memory correctly. It took quite a long conversation to bring him round to stating a rule that was appropriate. He was made to repeat it a couple of times before leaving him to write it down. About ten minutes later had written something totally different to the agreed wording. After a second discussion and practice at saying the rule he wrote down a different version yet again. He did not understand that all he had to do was copy down the agreed wording for it to make sense. He was convinced there was one version was for "saying" and he had to find another version for "writing". It would not have been too bad but the word versions worked and the written version did not. In the end the correct rule was dictated word by word. He was not convinced that what he had done was right. This was a boy who was clever and numerate but poor at
English comprehension. It is one area that most teachers have difficulty with when confronted by a pupil with this sort of articulation problem. The mathematics teacher commented at a later date that he had tried a couple more assignments with his classes. He was pleasantly surprised at the noticeable improvement in both the standard of the scripts and the ease with which the boys set about a new investigation.
13. Freshman High School

Staff

Head of Department Mr G.H. Nelson on secondment
Acting Head of Dept. Mrs Bowmann Cert Ed Maths
Mr Morgan B.Ed. Maths
Mr Bucken Ph.D. (Phys) PGCE
Mr Greene Maths Dip.
Mr Sturman Cert Ed (Geog ?)
Mr Helpman B.Sc. Maths

Background

This is the school from which the author was on secondment during 1978/88. A one year appointment was offered to a temporary teacher who has since been given a permanent post.

The school is a comprehensive, purpose built in 1971 for 11-18 yr olds with a current number on roll of around 1000. There is a sixth form of about 100 including a one year CPVE course. The first year intake is timetabled in two equal parts. Each part of approximately 90 pupils is setted into A, B or C after a 3 week induction course. There is a common scheme of work for all sets and there is opportunity for mobility between sets which is well used together with a termly review of the setting. During 1986-87 the author's first year set trialled pieces of coursework before they were attempted by the rest of the first year group. Other year group classes also tried some of the assignments. The author's first year group had done 7 assignments in their original form and now known as the investigations:

- Perimeters
- Matches
- Squares
- Chessboard
- Triangles
- Lines

By the time of the secondment it was felt that the pupils in this set in particular had the skill to apply a positive strategy to a new piece of work. These pupils had also been included in the video recording of several coursework investigations used for INSET with the department as a whole (vide 7.1.1). The 31 pupils were enthusiastic, bright and very willing. They had also experimented with different classroom arrangements to see if this could encourage more involvement amongst the more passive members of the class. The evidence from these different arrangements suggested that there was more activity, interest and involvement when they worked in groups of four or five which maintained friendship groups. This was tried in other schools during 1987-88 with success dependent upon the flexibility of the
teacher in charge.

The Visits

Mr Buckan had found an investigation in Mathematics in School (Sept 1983) and had organised a meeting of the maths staff to explain how it was to be attempted. The author was invited in to watch a second year set attempt the investigation with Mr Helpman. This was to be the first investigation (or any other coursework) since the start of the secondment. Unfortunately on the morning of the first visit Mr Helpman was absent. The author was asked to take the class at short notice. It was the same pupils who had trialled much of the first year assignments in 1986. The ESG Advisory teacher arranged to observe Mrs Bowman’s class with the same investigation.

25th January 1988

This was a class of 31 second year pupils who knew the author and his style of teaching. On entry to the classroom the author was greeted with smiles and "..Are you coming back?", "..Are we doing an investigation?"

The lesson plan had been prepared by Mr Buckan. A worksheet "Kingdoms" (prepared using a word processor) was issued to the pupils and we read through the first part together. The author had not been party to the departmental discussion so it was an unfamiliar investigation. Then one or two pupils were asked to explain to the rest of the class what the investigation was about. This was intended to gauge their understanding of the worksheet introduction. While most were keen to repeat the words on the worksheet one pupil eventually gave an explanation of the situation. He and two others were asked to explain their understanding of the situation with the aid of drawings they made on the board. This they did satisfactorily. The class was then asked how to set about solving this problem. Most of the class put their hands up. It was obvious from the replies that they all knew to start with something simple i.e. 1 city. They did not consider the fact that with one city there were no roads; they were following a plan which would take them through 2, 3, 4, etc. They were able to quote from the substance of the investigation algorithm they had used several times last year on strategy.

- start simple
- be systematic
- drawings
- table
- pattern
- rule
- test

This list was left on the board for their reference. They then got on with the work on rough paper.
Observations
1. Only two pairs did not start with 1 city.
2. Half the class arranged their cities in a straight line as the worksheet indicated, the rest arranged them in a circular pattern. When asked about this during the lesson they decided it would not make any difference as "...You have to get from one place to another and the roads did not have to be straight anyway."
3. Only four pairs, all boys, laid out their drawings in a random fashion on the rough paper.
4. All were careful to label each drawing with number of cities number of roads number of tollgates
5. There was some confusion as to whether one road could merge with another. The class decided to define a tollgate as the place where drivers can drive straight across at a crossing of two roads. The pupils were identifying problems and defining the parameters of the investigation without external guidance.
6. One pupil very quickly came up with the observation that he could fix as many tollgates as he liked and was that right? He then demonstrated this on a drawing. The worksheet gave no indication that the tollgates were to be kept at a minimum and this had deliberately not been mentioned by the author. This led to a discussion with the pupil about the fact that he was doing a mathematical exercise. He then decided that it had to be the least number of tollgates "... otherwise I’lI not get a rule!" This was an astute decision.
7. Similar conversation to this were held in other parts of the room until the class was called together to discuss this. They all then proceeded on the basis that they were looking for a rule connecting the number of cities and the fewest number of tollgates needed.
8. Several pupils had noticed the pattern of the number of roads but had formed no conclusion about the number of tollgates.
About ten minutes before the end of the lesson they were asked to stop drawing on the rough paper and to start writing the script. As a reminder the author went through what should be contained in each account.
i) An explanation of the situation in their own words. The worksheet was collected in to prevent them copying the words given there.
ii) A statement of any problems or decisions they had made such as the definition of a tollgate, the fact that they were looking for the minimum number of tollgates and how they drew in the roads.
iii) An explanation of the strategy.
iv) An organised set of tidy labelled drawings.
v) A table of results.
End of lesson.
Mr Belpman will take them for the next lesson. The author will attend for the third session.

Comment on the assignment.

a) It is far too complicated to give to a whole ability band. This class was a top set and even they found it difficult at the beginning. The discovery of a routine for drawing all the roads requires a very capable mind. Even when the pattern is shown to a less able pupil he/she will not be able to execute it beyond a few simple drawings. This will lead to failure and lack of motivation. There is also the complication of being able to decide whether to reroute a road to reduce the number of crossings requires a good spatial awareness. This assignment would have been better as an extension to the standard investigation on lines joining points.

b) The author believes it is bad practice to let them draw on rough paper first. The better pupils should be able to directly record the effect of changing the arrangement of the cities in their drawings. If drawings are on rough paper these things are forgotten. Good practice should be followed at all times.

The ESG teacher reported how impressed she was with one boy in Mrs Bowen’s class. He had started with one city and was able to tell her that he was going to work two, three, four cities etc and then present a table of results. The ESG teacher, in a note of surprise, said "...This boy actually had some idea of strategy and was going to use it!" When she asked the boy why he was doing it that way he said "...Because I did some of these with Mr Nelson last year and I remembered." It was in fact a boy who had been demoted for poor standards and attitude the previous year. This is another instance of a pupil remembering and implementing a strategy. Here was reinforcement of the author’s belief that investigative skills can be learned.

Wednesday 27th January
This is based on information from Mr Belpman who took this lesson.

Mr Belpman had noticed they had very little order to their drawings and had shown them how to approach the drawings from a systematic point of view. Only three of the children spoken to about the method had any idea that they had been given a system which would, by its method, create as few tollgates as were needed. All understood how to implement the method but some still got confused

a) with the actual drawings and got more overlaps than needed.

b) with the counting of the intersections.

It was becoming clear to Mr Belpman that the investigation was too complex for even for these bright second year pupils. Most were able to get up to 8 and 9 towns and
record their results in a table collated from their drawings. Their technique for proceeding with the investigation was excellent but they did not have the experience or ability to cope with such a complex relationship. None could see any way of expressing the totals as a rule. Mr Helpman halted the class and demonstrated how each total was made up from a set of sequences and they grasped the idea of the sets of sequences. None would have been able to devise that representation for themselves. They could then calculate a total by applying a method to the problem and writing down the sequences and adding each sequence.

Thursday 28th January
The pupils got on with the assignment very quickly. They were beginning to realise there was no direct or obvious rule. This was beginning to disturb and frustrate them. One of the more able said "...Can this be done because we should have got an answer (rule) by now should'nt we?"
The author took a set of results from one boy Marcus, who was known to be accurate, and asked him to set up a difference table which he did for 5, 6, 7, and 8 cities. Difference tables were something this class had come across in earlier investigations and something they were adept at tabulating. The first and second differences were not constant so there was no rule as yet. He was asked to draw the tollgates for 9 cities and he came up with 45 which produced a constant third difference. "...So there must be a rule then." was Marcus' response. An intelligent deduction. Marcus and two of his friends watched while the data was matched to a cubic by the author. They then used their calculators (memory) in evaluating the cubic to test it on 4, 5, 6, 7, 8 and 9 cities with total success. They felt they were involved in some really complicated analysis - which they were, and it excited them. Other groups were still struggling with the drawings for 7 and 8 cities and the table of results.
The whole class was then called together by the teacher and told what had been happening. This was that some data which, when set out as a difference table, came up with a constant column which indicated that there was a rule that could be stated. They had seen difference tables used in earlier investigations and realised that a constant column meant there was a rule. They had not gone as far as the third difference before. "...There is a gap in your knowledge at this stage which means in your account you explain that a constant difference means a rule exists and Mr Nelson provided that rule. You must then be able to test that rule." They were then taken through the test with the rule on 6 cities and showed them how to write it down. It was hoped that this would appear in their scripts. In fact several wrote it up as though the discovery was theirs.
CALAMITY then struck when it was discovered that the 45 tollgates were in fact 46. This meant the difference table was wrong and the relationship was not a cubic. It was necessary to call the class together again and explain what had happened. Their reaction was interesting in that they were not critical of the rule but of the original wrong figure of 45. They accepted quite calmly that it was more difficult than first thought and another rule had to be found. It was lucky in that they did not think the argument was faulty.

This is an unsuitable assignment for this year group in that

i) it was designed for the top ability only,
ii) it was too difficult for all the pupils,
iii) the teachers did not have a solution,
iv) the less able were defeated very quickly,
v) it was more suited to Higher level GCSE pupils.

The mark scheme was not available. This was in line with some previous trials of coursework when the scheme of assessment was devised after the trial. It is excellent that the department is prepared to try something and will profit from the experience but must be more realistic about what pupils can achieve.

On March 30th a mark scheme was devised by Mr Buckan which consisted of

- Defining the problem: 5
- Order of Cities: 5
- Diagrams: 10
- Ordering Crossroads: 10
- Tabling results: 5
- Predictions: 10
- Checking predictions: 5

The total of 50 suggests a degree of refinement which can not exist. There was no breakdown of what is expected from the pupils in each section i.e. what gets 10 for ordering the crossroads etc? At the time the mark scheme had not been given to the rest of the department nor had it been tried on any scripts. In fact the marking seemed to go by default. It was accepted that it was too difficult for the year group and would be better forgotten as far as they were concerned.
APPENDIX 3

A Record of the Interviews

Contents

1. Introduction 99
2. The Structure of the Interview 101
3. Mr Andrews 103
4. Mrs Bailey 106
5. Mrs Challon 109
6. Mrs Dalton 112
7. Mrs Evans 115

page - 98
1. Introduction

The agreement trial was organised with some difficulty in finding enough teachers with coursework entries in 1988 to make the exercise meaningful (vide 6.2.1). Five of the people who took part were known to the author from previous meetings in Lincolnshire. Two were teachers from out of the county and had not met the author before. One was a researcher with the Shell Centre at Nottingham University working on coursework material for MEG. The author had no detailed knowledge of the background qualifications or experience of the people taking part in the trial. This information was necessary in compiling the comments on the marking standards (vide 6.5). In evaluating the trial procedures it was necessary to interview the participants individually to gather opinion. To this end the author arranged to see five of the eight participants at their own school three weeks after the trial took place. It was not possible to interview the three participants from out of the county.

When contacted, through the respective head of department, all agreed to the interview and set aside about 40 minutes to answer questions on their experience of GCSE coursework, its administration in their school and the agreement trial. All the interviews were conducted in an informal manner, in a quiet area. The author attended with a typed list of questions with spaces for the author to add the
interviewee's responses. The interviewees were all advised that the questions were common to all five interviews and that their responses would be recorded and written up fully later.

The questions were asked in the order presented in section 2 of this appendix. The questions shown do not reflect the exact words used with the interviewee in all cases. With some questions the author rephrased the question to allow for the informality of the interview and the sensitivities of one or two of the interviewees. In a few cases the interviewee, in responding to one question, provided information which was appropriate (and ascribed) to a different question. Only those responses relevant to the content of the questionnaire have been included in the record. The author wrote down, using a form of shorthand, the responses of each interviewee. The interview was written up the same day while the responses were still fresh in the author's mind.

The records which follow are, therefore, a detailed summary of each interview. They are not verbatim accounts. The interview focussed on

a) the teaching experience of the interviewee,
b) the background to GCSE in the department,
c) the teaching arrangements for GCSE coursework,
d) opinion as to the structure and conduct of the agreement trial.

The names of people and schools have been changed.
2. The Structure of the Interview

Questions for the interview following the Agreement Trial held at Horncastle on 4th Feb 1988

1. How long have you been teaching?
2. What are your qualifications?
3. Previous experience?
4. What examination courses have you taught in the past?
   GCE
   CSE
   Joint 16+
5. What are your reasons for adopting the coursework option in 1988?
6. Was it an executive/democratic decision?
7. Was it discussed at a departmental meeting?
8. What part did the GCE training meetings play in your decision?
9. How were the topics for the coursework chosen?
10. Did the Coursework Consultant advise you?
11. Did all the pupils in your class do the same assignment for each category?
12. What is the class size?
13. How long was allowed for each assignment?
14. How many assignments have the pupils completed to date?
15. What are the levels of entry for the class?
16. Has there been any moderation within your school?
17. What form will/did the moderation take?
18. Comment on the agreement trial as a whole?
19. Comment on the format of the day?
20. Did you consider the samples of work offered for your inspection a fair representation for each level?

21. Did you consider there was a sufficient variety of titles within each category?

22. Did you notice any difference between your school's work and that of others?

23. Do you consider the use of detailed worksheets to be within the spirit of GCSE coursework?

24. Comment on the wide range of marks awarded by the group on some scripts?

25. Do you think the GCSE Board (or LEA) should provide more INSET for schools?

26. Would you welcome another meeting with other schools?

27. What would you see as a valuable exercise at another meeting?
1. How long have you been teaching?
   Since about 1968

2. What are your qualifications?
   Cert.Ed.

3. Previous experience?
   I used to work in a drawing office and then left to go to Bishop Grosseteste College of Education on a two year course.

4. What examination courses have you taught in the past?
   AEB for GCE classes (top set)
   EMREB mode 1 Syllabus 1 (set 2)
   EMREB for CSE using our own mode 3 which was
   2 exam papers - 60%
   coursework - 40% (set 3)
   In 1987 we used the Joint GCE/CSE 16+ with satisfactory results for all the sets.

5. What are your reasons for adopting the coursework option in 1988?
   With our past history of coursework we thought we could handle it well.

6. Was it an executive/democratic decision?
   I decided that each teacher could decide for themselves whether they wanted to try the coursework option. Staff could try it for half a term and then decide whether to change their mind.

7. Was it discussed at a departmental meeting?
   Yes. In fact it turned out to be:
   set 1 exam
   set 2 coursework
   set 3 coursework
   set 4 exam

8. What part did the GCSE training meetings play in your decision?
   Not much. I found them of mixed value.
   phase 2 could not attend
   phase 3 not much use
   phase 4A very helpful
   phase 4B really good

9. How were the topics for the coursework chosen?
   It varied with the class I taught.
Geometry: I chose the topic - tessellation
Everyday: Pupils chose 1 from 6 possibles
Stats/Pr: I chose the fitness test (SCAT)
Investn : I chose the Magic Rose
School : I chose a Shell Centre one.

10. Did the Coursework Consultant advise you?
No. Do you think I should have asked?

11. Did all the pupils in your class do the same
assignment for each category?
[See answer to Q.9]

12. What is the class size?
We have an agreement with the Head that we
only have twenties in maths fourth and
fifth year.

13. How long was allowed for each assignment?
About two to three weeks of work with as
much homework as they wanted to do.

14. How many assignments have the pupils completed to
date?
All have done four, some five.

15. What are the levels of entry for the class?
set 2 are all Intermediate
set 3 some Intermediate, some Foundation

16. Has there been any moderation within your school?
Not yet except that Jane and I attended an
ATM day in Nottingham when we marked
scripts and we were very close so I am
satisfied there will be agreement.

17. What form will the moderation take?
We will exchange scripts and spend some
time assimilating and then mark a selection
of each others scripts.

18. Comment on the agreement trial as a whole?
I thought it went very well apart from the
two people who were very severe and I
gather they did not have to enter any kids
this year. During the day I thought there
was a measure of agreement until you
produced those statistics and that worried
me.

19. Comment on the format of the day?
It was alright. It got a bit rushed
towards the end and we could have done with
a bit more time. I would have liked to have
looked in detail at more scripts to work
out why there was such a diversity of
marks.

20. Did you consider the samples of work offered for
your inspection a fair representation for each
level?
Oh yes.

21. Did you consider there was a sufficient variety of
titles within each category?

If you put the two sets together yes.

22. Did you notice any difference between your school’s work and that of others?

No. I thought they were very similar.

23. Do you consider the use of detailed worksheets to be within the spirit of GCSE coursework?

Well we went to an ATM meeting run by a woman from the Board. These SCAT sheets were used and seemed to be approved of. We like them and think that the pupils get a lot out of them. Apparently some people thought they were too detailed but I still think they are O.K.

24. Comment on the wide range of marks awarded by the group on some scripts?

To be expected because nobody really knew what they were doing with this mark scheme of the Board.

25. Do you think the GCSE Board (or LEA) provided the right amount of INSET for Schools?

No. I think we need a lot more specific advice and guidance from the Board on standards. I have decided to opt out of coursework until 1991 from next year.

26. Would you welcome another meeting with other schools?

Yes definitely.

27. What would you see as a valuable exercise at another meeting?

The same sort of thing but with more time to talk about individual scripts.
1. How long have you been teaching?
   15 years.

2. What are your qualifications?
   B.Sc.Hons (Maths)

3. Previous experience?
   All in grammar schools except for two years in a comprehensive.

4. What examination courses have you taught in the past?
   GCE: Yes - all Grammar schools.
   CSE: some ( in the comp )
   Joint 16+: none

5. What are your reasons for adopting the coursework option in 1988?
   I did not want to put off the evil day.
   I had never done coursework before. The one worry was that we did not have enough information.
   It was the blind leading the blind. MEG did not give advice on the length or depth of the assignments. The instructions in the syllabus were not full enough.

6. Was it an executive/democratic decision?
   I was given the choice whether I wanted to or not.

7. Was it discussed at a departmental meeting?
   Not really.

8. What part did the GCSE training meetings play in your decision?
   Well I ran the phase 3 at Deaconfield. You remember. I went to Horncastle with you for that meeting with the Coordinator when we were left with a "I don't know - do it yourself job". I got no help from the coordinator at all, did you? There was no material help. I led discussions on dummy projects with some samples to mark like a mini project on X-word grids. It was very much home made and structured.

9. How were the topics for the coursework chosen?
   They were chosen by me for my class. The assignments were own ideas. The kids don't have any. The statistics was well done they
were given two sets of data to compare.

10. Did the Coursework Consultant advise you?
    We got comments on the Control Element which I built into the project. This was acceptable as long as it was under the controlled conditions.

11. Did all the pupils in your class do the same assignment for each category?
    Yes except for the Everyday Arithmetic.

12. What is the class size?
    28 with 22 doing coursework.

13. How long was allowed for each assignment?
    Between 5 and 11 lessons in school. I removed parental help/involvement by not letting their written work out of school although they could do the research at home. I shan't be as worried about that in future. You can tell when parents have helped.

14. How many assignments have the pupils completed to date?
    5 with 4 of them marked.

15. What are the levels of entry for the class?
    All at Intermediate level.

16. Has there been any moderation within your school?
    We have looked at assignments but no formal marking like the agreement trial.

17. What form did the moderation take?
    A subjective discussion.

18. Comment on the agreement trial as a whole?
    Fine.

19. Comment on the format of the day?
    Fine.

20. Did you consider the samples of work offered for your inspection a fair representation for each level?
    Yes.

21. Did you consider there was a sufficient variety of titles within each category?
    Yes.

22. Did you notice any difference between your school's work and that of others?
    Only in level.

23. Do you consider the use of detailed worksheets to be within the spirit of GCSE coursework?
    Not if they are as detailed as some we saw. The work must be more open ended.

24. Comment on the wide range of marks awarded by the group on some scripts?
    Henry and I both marked the Foundation level scripts generously.

25. Do you think the GCSE Board (or LEA) should provide
more INSET for schools?

Should HAVE. It is now too late.

26. Would you welcome another meeting with other schools?

   Yes, in the early evening.

27. What would you see as a valuable exercise at another meeting?

   I could not improve on that format.
   The day was not a lot of use to me. Meeting other schools was useful.
Mrs Challon
Secondary Modern
11-16 (Mixed)

1. How long have you been teaching?
   19 years

2. What are your qualifications?
   B.Sc.(Maths) & BA (Philosophy of Maths)

3. Previous experience?
   7 years teaching at a Public School and head of mathematics at two comprehensives before coming here.

4. What examination courses have you taught in the past?
   GCE yes
   GSE yes
   Joint 16+ yes

5. What are your reasons for adopting the coursework option in 1988?
   Janette was already doing it when I arrived and I was glad about that. I dont like the HEG scheme and am going to change to the ATM scheme of continuous assessment when it is approved.

6. Was it an executive/democratic decision?
   Very democratic with the mathematics team being actively encouraged.

7. Was it discussed at a departmental meeting?
   Yes.

8. What part did the GCSE training meetings play in your decision?
   None, the decision was already made while I was working with the SUJ. I had been teaching via coursework for 15 years so it had little effect.

9. How were the topics for this years coursework chosen?
   By the kids.

10. Did the Coursework Consultant advise you?
    No, I know her and she got a lot of her ideas from me anyway.

11. Did all the pupils in your class do the same assignment for each category?
    [N/A.]

12. What is the class size?
    [N/A.]

13. How long was allowed for each assignment?
All the work is by assignment and they pick the bits they like best over a 3 to 5 week period.

14. How many assignments have the pupils completed to date?
   [N/A.]

15. What are the levels of entry for the class?
   [N/A.]

16. Has there been any moderation within your school?
   Yes.

17. What form did the moderation take?
   I looked at the scripts.

18. Comment on the agreement trial as a whole?
   It was a good day. Useful. I did not feel that many of the others had the same criteria for marking as me. The exception was ...(M7). I felt like a cry in the wilderness.

19. Comment on the format of the day?
   A good way of arranging it I thought.

20. Did you consider the samples of work offered for your inspection a fair representation for each level?
   No. It was poor. There was not enough evidence of Personal Contribution. There was not enough in-depth mathematics; no trigonometry, no gradients and equations. There was a lot of gimmicky things dreamed up for coursework.
   There needs to be a lot more moderation for the teacher to get to grips with the idea of coursework.

21. Did you consider there was a sufficient variety of titles within each category?
   No, the choice was very narrow.

22. Did you notice any difference between your school's work and that of others?
   Ours was slightly more investigative.

23. Do you consider the use of detailed worksheets to be within the spirit of GCSE coursework?
   Definitely no.

24. Comment on the wide range of marks awarded by the group on some scripts?
   People were giving marks for things being done and not for their worth.

25. Do you think the GCSE Board (or LEA) has provided the right amount of INSET for schools?
   No. There should be more meetings where teachers can do and experience mathematics. Agreement trials have their place but they are not enough on their own.

26. Would you welcome another meeting with other
schools?
Yes, anything – more meetings, more cooperation would get things moving.

27. What would you see as a valuable exercise at another meeting?
Going in and out of each other's schools would improve understanding and cooperation between teachers.
6. Mrs Dalton  
Secondary Modern  
11-16 (Mixed)  

1. How long have you been teaching?  
12 years  
2. What are your qualifications?  
Cert.Ed. (Maths)  
3. Previous experience?  
A lot with coursework on the CSE Arithmetic  
One year at Drings Grammar School.  
4. What examination courses have you taught in the past?  
GCE some  
CSE a lot  
Joint 16+ yes 2 years  
5. What are your reasons for adopting the coursework option in 1988?  
I like coursework and wanted to do it so I grabbed the opportunity because at the time I was acting head of department.  
6. Was it an executive/democratic decision?  
It was my decision two years ago.  
7. Was it discussed at a departmental meeting?  
No, but I talked to another colleague who was interested.  
8. What part did the GCSE training meetings play in your decision?  
None, the decision was already made.  
9. How were the topics for this years coursework chosen?  
By me except for the Everyday Applications which the pupils chose and I approved.  
10. Did the Coursework Consultant advise you?  
Well I sent off the details of the work I wanted to do to the Consultant but I never received a reply. By then we had a new head of department who said "Oh don't worry" so I left it.  
11. Did all the pupils in your class do the same assignment for each category?  
Except for the Everyday Applications.  
12. What is the class size?  
There is a class of 35 of whom 21 are entered for the coursework option. There are 20 for the Intermediate and 1 for Foundation.
13. How long was allowed for each assignment?
   Between two and three weeks in class with the associated homeworls but they have about four or five weeks before I say it must now be handed in.

14. How many assignments have the pupils completed to date?
   On the date of the trial all had completed five and all scripts had been marked.

15. What are the levels of entry for the class?
   20 at Intermediate and 1 at Foundation level.

16. Has there been any moderation within your school?
   None whatsoever with this group. They are the first and only group this year.

17. What form will the moderation take?
   I don't know what will happen in the future. That is up to the new head of department.

18. Comment on the agreement trial as a whole?
   I enjoyed it. I was pleased with what we are doing. I gained confidence from seeing how some of the others did it. I felt I had marked right and that my pupils content and presentation was better than most of the others. Alice (the head of department) agreed with me.

19. Comment on the format of the day?
   It was rushed. We had to mark scripts and we had to have the results to examine for comparison and we had to discuss. It would have been better if there had been two days and the second for a more detailed discussion.

20. Did you consider the samples of work offered for your inspection a fair representation for each level?
   Yes.

21. Did you consider there was a sufficient variety of titles within each category?
   As there were only 12 scripts in each set arranged as 3, 3, 2, 2, 2 (vide 6.2.2) so only saw the best three of each title.

22. Did you notice any difference between your school's work and that of others?
   Ours was better.

23. Do you consider the use of detailed worksheets to be within the spirit of GCSE coursework?
   It depends how they are worded. With Foundation they have to "lead" the pupils somehow so for the less able the work has to be structured. I think you can use such...
a worksheet and then make allowance in the marking.

24. Comment on the wide range of marks awarded by the group on some scripts?
   I expected it, it was the first of its kind. It was also necessary. Nobody had any experience of marking this GCSE material and there was no more help from the Board so we were all without experience. We had more agreement after the event.

25. Do you think the GCSE Board (or LEA) has provided the right amount of INSET for schools?
   No. More training and advice is bound to produce better results.

26. Would you welcome another meeting with other schools?
   Yes.

27. What would you see as a valuable exercise at another meeting?
   A repeat of this one but over two days. The first day could concentrate on a smaller number of scripts and the second could be a detailed examination of those scripts.
Mrs Evans  
Grammar School  
11-18 (Mixed)

1. How long have you been teaching?  
   I am in my probationary year at present.

2. What are your qualifications?  
   B.Sc. (Stats) with PGCE.

3. Previous experience?  
   My previous job was as a statistician. This is my first teaching post.

4. What examination courses have you taught in the past?  
   GCE [N/A]  
   CSE [N/A]  
   Joint 16+ [N/A]

5. What are your reasons for adopting the coursework option in 1988?  
   I took over two classes from a previous teacher who left. I had done some coursework and investigations in my PGCE so I did not mind carrying on the work of the previous teacher.

6. Was it an executive/democratic decision?  
   [N/A]

7. Was it discussed at a departmental meeting?  
   [N/A]

8. What part did the GCSE training meetings play in your decision?  
   [N/A]

9. How were the topics for this years coursework chosen?  
   I only had 11 pupils in this class taking coursework and I used some work I had done my PGCE course. This had been very useful to me.

10. Did the Coursework Consultant advise you?  
    No. Did not know about the possibility of outside help. That would have been helpful. Who is he?

11. Did all the pupils in your class do the same assignment for each category?  
    When I took over the class they had done a mixture and I had to try to bring them together. In future they will all do the same one at the same time. I find it very difficult when they have done different
12. What is the class size?
   Eleven at Intermediate. We don't have any Foundation level pupils.

13. How long was allowed for each assignment?
   Two weeks in class with one homework for writing up.

14. How many assignments have the pupils completed to date?
   Four.

15. What are the levels of entry for the class?
   All are entered at Intermediate level.

16. Has there been any moderation within your school?
   Only by an informal look through to see what marks I had given. The previous marks were just accepted as they were.

17. What form will it take in the future?
   I cannot see it being anything formal like we did that day.

18. Comment on the agreement trial as a whole?
   Really useful. Mainly because I could see what everyone else was doing. It was not dissimilar to what we are doing now. Everyone seemed very positive. Mr Smith seemed to know what he was doing and gave me some confidence as well as ideas for other assignments.

19. Comment on the format of the day?
   Well you did Foundation in the morning and I did not know anything about that and found it difficult. The afternoon session on Intermediate was fine.

20. Did you consider the samples of work offered for your inspection a fair representation for each level?
   Intermediate - yes.

21. Did you consider there was a sufficient variety of titles within each category?
   There was not much overlap which was helpful in one way. Two similar ones would have been a help.

22. Did you notice any difference between your school's work and that of others?
   A lot of schools seem to have spent a long time on the work - larger projects, more pages, more depth. I wondered what sort of time they had spent on the work.

23. Do you consider the use of detailed worksheets to be within the spirit of GCSE coursework?
   A list of questions is too much guidance. No. The work must be left more open for the pupils.
24. Comment on the wide range of marks awarded by the group on some scripts?
   I need more experience in marking. I did not have any trouble with the ones which got 17 to 20 marks.

25. Do you think the GCSE Board (or LEA) should provide more INSET for schools?
    More days like the agreement trial; yes.

26. Would you welcome another meeting with other schools?
    Yes.

27. What would you see as a valuable exercise at another meeting?
    More of the same with a bit more time to spend on one level.
    I am glad I did coursework this year. The only worry is that the kids are at risk.