The mathematical association diploma in mathematical education as an instrument for in-service education for primary school teachers

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THE MATHEMATICAL ASSOCIATION DIPLOMA IN MATHEMATICAL EDUCATION AS AN INSTRUMENT FOR IN-SERVICE EDUCATION FOR PRIMARY SCHOOL TEACHERS

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Submitted for the degree of Master of Education
of the University of Durham

The research was conducted in the School of Education
and supervised by Mr. M. Cornelius

December 1986

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ABSTRACT

THE MATHEMATICAL ASSOCIATION DIPLOMA IN MATHEMATICAL EDUCATION AS AN INSTRUMENT FOR IN-SERVICE EDUCATION FOR PRIMARY SCHOOL TEACHERS

Author - Jean Melrose

The Mathematical Association Diploma in Mathematical Education is a qualification for teachers with at least two years' qualified teaching experience, with its emphasis on teaching children in the 5-13 age range. Its purpose is to equip suitable and interested teachers to make a strong personal contribution to the teaching of mathematics within their own schools; it is particuarly appropriate for those who hold, or hope to hold, positions of responsibility for mathematics in first or middle schools. Diploma courses first started in 1978 and by 1982 about 2000 teachers had enrolled for Diploma courses.

The research project 1980-82, based at Durham University, was funded by the Department of Education and Science to monitor the progress of the Diploma and to assess its effectiveness. Information was collected from students (a postal questionnaire was sent to 1003 students with a 74% response rate, visits were made both in 1981 and 1982 to the schools and Diploma centres of a stratified random sample of 41 students), tutors, moderators, Diploma Board members, mathematics advisers and records of the Mathematical Association.

In order that the course should be more effective, recommendations were made from the Research Project to the following groups of people:-

tutors,
moderators,
members of the Diploma Board,
other subject teaching organisations,
those responsible in LEAs for funding courses, and
those responsible in central government for funding courses

The Research Project provided the first substantial published British evaluation of in-service education for primary school teachers in mathematics and was characterised by the helpfulness and friendly co-operation of the various individuals and groups of people who gave evidence, advice or encouragement.

DECLARATION

No part of this thesis has been submitted for a degree in any university. The research design (Appendix 4) was prescribed by the D.E.S. research project but otherwise the research is original.

STATEMENT OF COPYRIGHT

THE MATHEMATICAL ASSOCIATION DIPLOMA RESEARCH PROJECT

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Mr. L. Webb	Principal, Teachers Branch, Department of Education and Science

FOREWORD TO THE DES REPORT

The Mathematical Association Diploma Research Project was initiated after discussion between the Department of Education and Science and the Mathematical Association. It was supported by a grant of £35,567 from the Department of Education and Science during the period September 1980 to August 1982.

The Mathematical Association Diploma is a relatively cheap and easy way in which to provide in-service activity. All in-service courses, in addition to giving assistance to teachers, will have their own particular strengths and weaknesses. The project has attempted to look at the model provided by this Diploma and to present evidence which may be helpful, not only to those already running or thinking of running diploma courses, but also to those who make decisions about the provision and organisation of in-service work in all subject areas.

This report has been written by the project's research fellow, Miss Jean Melrose, in consultation with the advisory steering committee.

M.L. Cornelius
Project Director

ACKNOWLEDGMENTS

The research project was financed by the Department of Education and Science.

The work of the project has been marked by the friendliness and helpfulness of everyone involved.

Members of the advisory steering committee met on five occasions and offered valuable comments on the conduct and reporting of the research.

Members of staff of Durham University, especially Professor G.R. Batho and Professor F.J. Coffield from the School of Education, Dr. A.H. Scheult of the Department of Mathematics, Dr. J. Hewison of the Department of Psychology and Mr. J.W. Steele of the Computer Unit, gave invaluable assistance.

Members of the Mathematical Association, Mr. D. Quadling and Mr. B.J.R. Dorrington, supplied details of the early development of the Diploma course and Mr. J. Gray, the Executive Secretary, dealt with many queries.

Teachers, college tutors, moderators, LEA advisers and Diploma Board members gave up much time to provide information and comments by completing questionnaires.

Headteachers and teachers went out of their way to make the visits to schools valuable and informative. College tutors were similarly helpful in making visits to Diploma courses worthwhile.

Mrs. K. Meacham not only typed the DES Report but also ensured the smooth and efficient organisation of the project.

In particular, Mr. M.L. Cornelius who was the Project Director and Mrs. S. Hickson who typed the final manuscript with great speed, patience and precision, deserve special thanks.

A debt of gratitude is owed to all these people.

CHAPTER 1

A REVIEW OF THE DEVLOPMENT OF MATHEMATICAL IN-SERVICE EDUCATION FOR PRIMARY SCHOOL TEACHERS AND A DISCUSSION OF CURRENT NEEDS

Towards a definition

1.1 The word 'in-service' has only been used in relatively recent times. In 1928 in America the report of the Committee for Education mentioned 'preservice and inservice training of teachers for rural schools'. The first noted use in this country was in 1960 when the Guardian contained comment on the 'Development of in-service training.... for staff nurses.' In 1963 F.F. Laidler in the Glossary of Home Economics Education defined in-service training as 'the continuing education and training given to a person after he/she has begun to work in a particular occupation.'

By contrast, the phrase 'refresher course' was used slightly earlier. In 1907 the Interim Report of the War Office Committee mentioned officers having 'short periods of recall to the colours for 'refresher' training' and in 1930 the Times Educational Supplement used the phrase 'refresher courses for leaders'. This points to one of the considerations for those providing, taking part in or evaluating in-service education i.e. where on the spectrum of the front line/a quieter place on the field of battle/regimental headquarters does the in-service education take place.

1.2 Plato (approx. 387BC) in the Meno gives an account of the dialogue between Socrates and the slave boy concerning the doubling of the area of a square. This is an early written account of mathematics teaching and learning. A sequence of guided questions

Ed. R.W. Burchfield (1976) Supplement to the Oxford English Dictionary, Vol.2 p. 268 and Vol.3 p.1154

awakens and draws out some of the unconscious knowledge associated with $\sqrt{2}$. The account informs us simultaneously of a mathematical problem, a strategy for learning and teaching and an indication of the underpinning philosophy. The questions What? and How? (presumably When? is a subset of How?) are seen to be curiously interwoven and it is possible to infer some of the answers to Why?

In its written form it has the potential to influence for good the content, method and process and underlying philosophy of mathematics teaching of its readers. It goes beyond the Elements of Euclid, which can probably be most easily considered as mathematics, it is writing on mathematical education albeit embedded as an illustration of part of Platonic philosophy.

1.3 The D.E.S. in 1970 used a definition of in-service training as:

> 'Any activity which a teacher undertakes, after he has begun to teach, which is concerned with his professional work.'

Such a broad, inclusive definition contrasts with accounts which consider in-service training largely in the context of provided courses.

Suggested models of professional development

1.4 In order to survey such a vast and diverse area it is helpful to adopt a model of professional development. Pinner and Shuard (1985) suggest a four stage model 'not because they are discrete phases, but because the characteristics listed for each stage tend to show themselves as a teacher becomes more experienced and skilled in a particular situation or type of work; these stages

Plato 'Meno' translated by W.K.C. Guthrie (1956) - Penguin Harmondsworth.

Sr. M.T. Pinner, H.B. Shuard 'In Service Education in Primary Mathematics' Open University Press, Milton Keynes 1985 p.12

seem to recur as the teacher moves on to new roles! The suggested stages are:-

1. Initiation
2. Consolidation
3. Integration
4. Reflection

They suggest that initiation is the gaining of experience of what to teach and how to teach it, consolidation is mainly concerned with organisational teaching skills and a growing awareness of pupils' needs, integration is a growing awareness of the decision making element of teaching and reflection is 'the development of a personal educational philosophy which enables a teacher both to express beliefs in action in the classroom and to provide principled and well-founded leadership to colleagues.'

Presumably the detailed longitudinal work necessary to trace the professional development of a sufficient sample of teachers is still to be tackled. Until then, it is difficult to be specific about the appropriateness of the model.

1.5 Beeby has inferred a four stage model of the evolution of an educational system for a developing country by considering the history of elementary schools in England. Griffiths & Howson (1974) quote below the summary of the model:-

> "Stage I. The 'Dame School' stage: at which the teachers are neither educated nor trained.
>
> Stage II. The stage of formalism: at which the teachers are trained but poorly educated. This stage is characterised by the highly organised state of the classroom, the rigid syllabus, the fixed textbook and the emphasis placed on inspection. It is the stage found in England around 1900.

Sr. M.T. Pinner, H.B. Shuard 'In Service Education in Primary Mathematics' Open University Press, Milton Keynes 1985 p.152-163

H.B. Griffiths & A.G. Howson 'Mathematics: Society & Curricula' Cambridge University Press, Cambridge 1974 p.63

Stage III. The stage of transition: at which the teachers are trained and better educated but still lack full professional competence. The aims are little different from those of Stage II but the syllabus and the textbooks are less restrictive. Teaching is still 'formal' and 'there is little in the classroom to cater for the emotional and creative life of the child.'

Stage IV. The stage of meaning: at which the teachers are well trained and well-educated. Meaning and understanding are now stressed, individual differences are catered for and the teacher is involved in the assessment of his pupils. He may now be so confident as to reject any curriculum but his own."

1.6 Howson comments '.... one could claim that all the schools in England had reached Stage III and some had reached Stage IV. Upgrading is, however, a long and continuing process.' Perhaps some caution is needed when applying this comment to primary schools where a class teacher is often responsible for teaching all or the majority of the curriculum to his or her class. (DES (1978). The survey of primary education in England undertaken by H.M. Inspectors found that 5% of 7 year old classes, 10% of 9 year old classes and 10% of 11 year old classes (the percentages were rounded to the nearest 5%) were taught by a teacher other than their own class teacher for mathematics.)

1.7 It is possible that a teacher or a group of teachers in a school may appear to be at different stages of development, as defined by the model, according to the curriculum area considered. It is necessary, insofar as mathematics in the primary school can be thought as a distinct strand of the curriculum, to attempt to apply the model to teacher development in mathematical education for primary school pupils.

DES (1978) 'Primary Education in England - a Survey by H.M. Inspectors of Schools' H.M.S.O. p.34, Table 20.

All teachers are trained so Stage I is probably excluded. Stage II is characterised by teaching which is constrained by external pressures or by lack of confidence, knowledge or insight to deviate from narrowly prescribed content and organisation for mathematics. A contentious suggestion would be that teaching which consisted solely in children working individually, with minimal discussion with the teacher or their friends, 'at their own pace' through a series of workcards or textbooks, forms a highly organised, rigid, fixed system which makes few demands on the teacher in a comparable way to the teaching characterised at Stage II by Beeby.

At Stage III there would be genuine discussion, more flexible organisation, a variety of materials and starting points, some understanding of children's mathematical development and a sufficiently good knowledge of mathematics to enable appropriate use to be made of books and materials and to ensure that the children had a sound, varied and interesting experience of mathematics.

Stage IV may be summarised by referring to a set of aims for mathematics teaching and learning such as those contained in DES (1979) 'Mathematics 5-11'. Alongside mathematical skills, knowledge and communication, the concern is to develop confidence, independence, an appreciation of pattern and structure, an awareness of some of the applications of mathematics and 'an appreciation of the creative aspects of the subject and an awareness of its aesthetic appeal.' Such a list has radical implications that the organisation of and provision for mathematics should be sufficiently imaginative and versatile so as not to unnecessarily impede the children's learning.

The coming together of the mathematical knowledge and skills with the confidence and independence may enable a teacher to play a significant part in the development of mathematics throughout the schoool, if he or she is encouraged to do so by the headteacher and other teachers.

DES (1979) 'Mathematics 5-11' p.5

A model for the development of education has been taken and applied to the teaching and learning of mathematics in primary schools. A relevant question would inquire as to the more (or even most) appropriate forms of in-service education for teachers (or schools) at the various stages.

The scope of in-service education

1.8 It is important not to limit any definition of in-service education to that provided for the teacher in the way of courses. The potential influences on the mathematics teaching of a primary school teacher are numerous and some of these may be:

(i) the children with their interests, their original and often surprising insights, their difficulties which require special action by the teacher

(ii) other teachers in the school with their differing aptitudes and experiences (especially important may be the headteacher or the mathematics co-ordinator)

(iii) personal friends who are also teachers

(iv) published material and other resources that are available in the school (The adoption of an expensive series of textbooks/workcards may sometimes be a contributory factor to a lack of subsequent continuing curriculum development in mathematics in a school)

(v) the curriculum of feeder schools and that of schools to which pupils proceed

(iv) the mathematics adviser, advisory teachers and all the other support provided by the LEA including short in-service courses

(vii) the facilities that initial training institutions and centres for mathematical education provide; the library, long and short in-service courses, and the formal and informal contacts between teachers and lecturers

(viii) Open University courses including those from the Associate Student Programme.

(ix) professional subject organisations such as the Association of Teachers of Mathematics and the Mathematical Association; their publications, meetings, conferences and the in-service courses which they validate.

(x) H.M. Inspectorate through their publications and reports, the advice given on visits to institutions, and the DES courses which they organise

(xi) mathematical material contained within general educational publications e.g. Times Education Supplement, Child Education

(xii) schools' television programmes

(xiii) microtechnology such as microcomputers and calculators.

The list does not claim to be exhaustive and the order of the list has no special significance. It is interesting to imagine which of these influences are likely to bear on teachers who may feel different amounts of enthusiasm and confidence for teaching mathematics. If we refer to the adaptation of Beeby's model (see 1.7) we may suggest that a teacher at Stage III may find it difficult to accept anything that implies a sudden move away from the security of the rigid structure for teaching mathematics, whereas a teacher at Stage IV is likely to be properly critical of new developments and to show independence in the mode of their incorporation into his or her classroom or school.

The development of in-service education

1.9 The beginnings of organised in-service education for teachers of mathematics to primary school children is obscure. Howson (1982) comments that to his knowledge his is 'the first book to be published which attempts to tell the story of mathematics

A.G. Howson 'A History of Mathematics Education in England' Cambridge University Press, Cambridge 1982

education in England. That this is so is rather surprising, for one can turn to histories of the teaching of science and to a history of mathematics teaching in Scotland.'

1.10 Elementary education was slow to develop and was provided in a variety of forms. The National Society was founded in 1811, the British and Foreign School Society in 1814 (Parliament voted £20,000 in 1833 to further their work) and the London Infant School Society in 1824. H.M. Inspectorate was established in the 1840s. Before 1840 there were isolated attempts at teacher training (notably by Joseph Lancaster to train teachers for his school at Borough Road) but between 1840 and 1860 there was a significant expansion and by 1860, 34 training colleges had been opened.

1.11 Howson (1982) describes the life and work of an exceptional teacher and teacher trainer, Thomas Tate, whose work and writings spanned mathematics and mathematical education. His influence was described by Archbishop F. Temple.

> "Both as an author and as a teacher he must be considered to stand quite at the head of his profession. Most of his books are either in universal use, or are only displaced by others which owe their existence to imitations of his method.... It would be difficult to find any man who in proportion to his opportunities has done so much for education in this country."

1.12 The 1870 Education Act resulted in school boards being set up in areas which were short of schools with the power to use public money to provide sufficient schools. In introducing the Bill into

A.G. Howson 'A History of Mathematics Education in England' Cambridge University Press, Cambridge 1982 p.119

the Commons, W.E. Forster stated that approximately two fifths of the 6-10 year olds in the country were on the registers of (which did not necessarily imply that they attended regularly) the schools which were helped and about one million children who were not. He stated the priority "the first problem is this; 'How can we cover the country with good schools'?" School boards were authorised (required after the 1880 Act) to set up by-laws that made the elementary school education compulsory (but not necessarily free) for all children.

1.13 In 1871 the Association for the Improvement of Geometrical Teaching was formed but its aims were largely with the reform of the teaching of Euclidean geometry in secondary schools. A widening of its interests to include the primary school mathematics curriculum occurred much later. A rival organistion, the Association of Teachers of Mathematics for the South Eastern part of England, was founded in 1911 'to facilitate interchange of experience and opinions, and promote common action, among teachers of mathematics, including arithmetic, in schools of every type.' Its journal contained articles mainly of relevance to secondary school mathematics but there was material concerned with teaching mathematics to younger pupils. It ceased to function at the outbreak of World War One. Howson (1982) comments 'the need which it had attempted to meet, was to remain.' The importance of the professional mathematical associations in providing a forum for the exchange of views and helping to prevent the isolation of

J.Stuart Maclure 'Educational Documents. England and Wales. 1816 to the present day.' Methuen, London 1985. p.99

A.G. Howson 'A History of Mathematics Education in England' Cambridge University Press, Cambridge 1982. pp. 153, 156

enthusiastic and committed teachers is difficult to overstate. They provide a teacher who is developing the confidence and independence characteristic of Stage IV in Beeby's model with the support and stimulation of like-minded colleagues. Such a group can by their joint or representative action excercise a significant influence on the development of mathematical education. The membership of the AIGT grew from about 230 in 1900 to 750 in 1914. In 1897 the organisation had been renamed the Mathematical Association.

1.14 Mary Boole wrote at the turn of the century about the teaching and learning of mathematics. Her writings had some impact on the more progressive schools in the first decade of the century. She shows examples of how to encourage children to take some of the initiative to wonder why.

Advice such as 'And then, if you can, have the tact and the wisdom to be silent and let him think. Say no more of geometry that day' after posing a problem (in this case to find other right angled triangles with integral sides by counting square tablets) will lead to a style of teaching vastly different from the rote learning that was prevalent at that time. This is another example of an exceptional person having some potential influence of the current practice of serving teachers by means of her writings.

1.15 A.W. Siddons, in his presidential address to the Mathematical Association in 1936 reviewed 'the general progress that has been made in mathematical teaching' and 'the extent to which this Association is responsible for that progress.' He was the senior mathematics master at Harrow and the co-author with Charles Godfrey of a geometry text that remained in print until 1973 and sold over a million copies. It was the first time that the Mathematical

D.G. Tahta 'A Boolean Anthology - Selected Writings of Mary Boole' Association of Teachers of Mathematics, Derby 1972 p.31

Association had 'elected a mere assistant master to the chair.' The A.I.G.T. had only one schoolmaster president; he was an F.R.S. and examined in the Mathematical Tripos at Cambridge.

Siddons' address shows the association largely concerned with the teaching of mathematics to boys at public and grammar schools. There is little or no mention of mathematics (or arithmetic) for the under 13 year olds or for those in elementary schools. Yet from within this framework he wishes to increase the membership of the Association and to encourage the teachers to contribute to the work of the organisation and to write articles for the Mathematical Gazette.

> "One more appeal, and that is to the 'highbrows' - do be kind to the writers of articles on elementary work. I am sure that the fear of highbrows' criticism has, in the past, prevented some excellent teachers from giving to their fellow teachers ideas that would be valuable in the ordinary classroom."

Remarkably, in 1934, the Mathematical Gazette contained an article by Mrs. E.M. Williams on 'The Geometrical Notions of Young Children.'

Howson comments:

> "It was the first attempt of many by Mrs. Williams to convince the Mathematical Association, then totally preoccupied with the curriculum in grammar and independent schools, that the foundations of mathematics learning were laid prior to the age of eleven and that the needs to establish these foundations satisfactorily and then systematically to build upon them were matters of vital concern to all those involved in mathematics education.

A.W. Siddons 'Progress' Mathematical Gazette, Vol.20 (1936) p.7-26.
Mathematical Gazette, Vol.18, p.112-118 approx.
A.G. Howson 'A History of Mathematics Education in England' Cambridge University Press, Cambridge 1982. p.268, 188

> The paper is, however, of interest for other reasons, for it indicates both a recognition of the need for research in mathematics education and also serves to exemplify contemporary approaches to educational psychology and to research design."

Howson's comment if anything understates the intelligence, perception and tact which Elizabeth Williams brought to her task. The opening sentences reveal her perception of the contemporary narrow-mindedness about mathematical education. There cannot be many articles which have stated in such a distinctive manner as; "Perhaps my title will be thought to savour too much of the nursery, but I should like to reassure you I have no intention of boring you with stories of my own children....". She has the good sense to quote Poincaré before quoting authors in mathematics education and psychology; Piaget and his work is introduced carefully. There is the critical reasonableness, the concern to make the research as 'hard' as possible, rather than the frothy unfounded enthusiasm that can often form the charicatures of teachers of young children, displayed here to enable her readers to consider mathematics teaching and learning in a wider context.

Howson traces the influence on Elizabeth Williams of people as diverse as A.N. Whitehead, P. Nunn and Margaret McMillan and describes her career as a senior mathematics specialist in a secondary school, as a lecturer in the Education Department at Kings College, London and at Goldsmiths College, as Principal of the City of Leicester Teacher Training College and Whitelands College as well as 'to participate as a tutor at residential in-service courses mounted by various local authorities.' She contributed to the Mathematical Association report 'The Teaching of Mathematics in Primary Schools', being a member of the committee both in 1939 and in 1946.

A.G. Howson, 'A History of Mathematics Education in England' Cambridge University Press, Cambridge p.191

Mathematical Association (1956) 'The Teaching of Mathematics in Primary Schools' - G. Bell, London. p.vii.

1.18 In 1939 the proposal was that the report should focus on the content of the syllabus in Junior Schools. After the second world war and the Butler Education Act of 1944 which provided free secondary education for all and so defined primary (as opposed to elementary) schools, the committee was reformed in 1946 and included as new members Miss L.D. Adams, Miss M.V. Daniel and Dr. C. Gattegno. A third committee was convened in 1950 and it finally reported in 1956. Its concerns were rather different from those stated in 1939. Notions of children's mathematical development, of children's constructive play, experiment and discussion leading to an awareness of relationships and mathematical structure are considered alongside the mathematical content for infant and junior schools. 'At first sight the word Mathematics may seem pretentious when used of education in the Primary School. The words Number and Arithmetic, familiar in syllabuses and timetable are, in fact, equally so and they have the disadvantage of suggesting limitation of aspect rather than elementary treatment.'

1.19 The Plowden report in 1967 commented favourably on the positive influences on the mathematics curriculum in the previous 30 years, praising the efforts of teachers to make the subject more practical and interesting, commending the use of various kinds of number apparatus, realising the importance of the work of those teachers 'who directed the children's attention to the mathematical aspects of their environment and their play.' They recognised the influence of books - 'Piaget's researches, books about the history and nature of mathematics and the Mathematical Association's "The Teaching of Mathematics in the Primary School" which was a tremendous encouragement to change.'

HMSO (1967) 'Children and their Primary Schools' para. 649, p.235

1.20 The report was addressed to 'not only mathematical specialists and members of the Mathematical Association, but also the large body of teachers engaged in the work of Primary Schools and concerned with children's mathematical development as only one facet of their whole growth.' It is probable that the report did not have a wide circulation amongst the latter group of teachers.

1.21 One member of the committee, Miss L.D. Adams, (formerly Staff Inspector of Mathematics for the Ministry of Education and president of the Mathematical Association (1959)) described the committee meetings as 'most stimulating' and describes the development of opinion from discussion as 'inevitable.' She described her book 'A Background to Primary School Mathematics' as 'an account of personal experience and opinion based on many years of observation of children of primary school age.' It is an account, perhaps one of the most readable and accessible available in 1953, of children and their mathematics, with aposite illustrations from children's conversations and their written work (complete with errors and mis-spellings). She acknowledges her debt to the influence of Mary Boole's writings and shows the ability to cause the children to engage in serious thought by asking open questions that require extended answers.

1.22 In the early 1950s Dr. Gattegno and others founded the 'Association for Teaching Aids in Mathematics' which became in 1962 the 'Association of Teachers of Mathematics'. Bill Brookes (the informality is intentional to give some flavour of the organisation) in 1975 described the A.T.M. as 'a grass-roots organisation wedded to co-operative activity in working to solve teaching problems in mathematics'. The membership grew rapidly; there was a need for an organisation that was obviously attractive to teachers of the

L.D. Adams 'A Background to Primary School Mathematics' Oxford University Press, Oxford 1953

majority of secondary school children and of primary school children. The publication of 'Notes on Mathematics in Primary Schools' in 1967 gave many examples of starting points for open-ended investigational work and gave an example of an even more radical viewpoint than the 'children learn by doing' that was often used at that time.

> "We are concerned with the creative side of the child's learning and with minimizing the teacher's interference with this. Every time a teacher insists on his way of doing a piece of mathematics, rejecting any responses which do not seem to fit, he nibbles away at his pupils' 'ability to act mathematically. We believe in the value of the child's mathematics; that he should have freedom to make it and use it and talk about it.' The belief is that in the talking about his mathematics, a pupil will experience some of the demands that the mathematics be socially acceptable.
>
> Our experience with young children has shown us that we do not know the upper limit to the mathematics they can learn, and that we are always underestimating their powers."

1.23 UNESCO (1962) commissioned a survey which sent a questionnaire to the Ministries of Education in 81 countries about in-service training for primary teachers. The governments were asked to "mention any plans which may exist to encourage the further training of in-service primary teachers."

Bill Brookes 'Ten Years' in Mathematics Teaching. No. 72. **Sept. 1975**
ATM 'Notes on Mathematics in Primary Schools' Cambridge University Press, Cambridge 1967 p.5-6
UNESCO 'In Service Training for Primary Teachers' 1962.

The reply from the Ministry of Education for England and Wales was "Owing to the loss of young teachers on marriage, efforts are being made to persuade qualified married women teachers whose children are old enough to need less of their mothers, to return to the profession. Some Local Education Authorities are providing refresher courses for such teachers who return to teaching after several years' absence."

1.24 During the 1960s a remarkable number of teachers attended in-service courses in mathematics. H.M.S.O. (1970) gives data collected by the Statistics Division of the D.E.S. At primary school level in 1966-67 there were 548 mathematics courses reported (making mathematics by far the most popular subject area (c.f. 369 P.E. courses, 163 science courses). Over 21,000 teachers were reported as having attended (it is not clear from the data whether this excluded attendance on more than one course by an individual teacher). The majority of these courses were provided by Local Education Authorities.

1.25 Townsend in 1967 (reported as Part II of H.M.S.O. (1970)] carried out a D.E.S. research project into the in-service training of teachers in primary and secondary schools. A questionnaire was sent to a large sample (approx. 9822) of 1 in 32 of full-time primary and secondary teachers. 7224 questionnaires were analysed (response rate 73.5%). The teachers were asked to provide information about courses

HMSO 'Statistics of Education Special Series 2. Survey of In-Service Training for Teachers 1967' 1970

they had attended between 1.9.64 to 31.8.67. Primary mathematics claimed 13.3% of the total courses. Almost 20% of all teachers had attended one or more courses in primary mathematics. Meetings of specialist subject organisations attracted their greatest membership 'from heads of departments and holders of graded posts' (H.M.S.O. (1970) p.41) so the meetings of the M.A. and A.T.M. probably were not mainly attended by primary school teachers.

The Schools' Council publication "Mathematics in Primary Schools' had been read by over 21% of all teachers, and read in part by a further 23% (That some 60,000 teachers have read 'Mathematics in Primary Schools completely and 70,000 have read it in part, gives this publication strong claim to be regarded as the grearest single contribution to in-service training that has so far been made' (HMSO (1970) p.44). It had the smallest free distribution of all the publications listed in the questionnaire.

Similar interest showed that primary school mathematics was the most attractive subject area for teachers watching or listening to BBC television and radio programmes for teachers in the school year 1966-67. The estimated numbers are 28,500 watched 'Children and Mathematics' regularly and 96,000 occasionally.

Teachers were asked to select not more than 4 of a list of 48 topics for courses which they would wish to attend if all the circumstances were convenient. Some 41% of primary school teachers chose primary school mathematics as a topic area (c.f. 30% chose teaching of reading, 15% science for primary schools).

Data about the duration of courses is given (HMSO (1970) p.69) of the courses on mathematics for primary school; 36% were 1 day or less, 43% lasted 2-4 days, 18% lasted 5-14 days, 2% lasted 15-40 days, 1.2% were one term courses, 0.1% were 2 term courses and 0.2% lasted one year or more. Part time courses were represented on the basis of 5 hours of instruction equalling one day.

1.26 In HMSO (1967) the Plowden Committee commented 'Rapid revolutions are not common in English education.... Changes of this nature and magnitude probably only occur when there exists a fairly widespread dissatisfaction with the current state of affairs and a

predisposition to look in new directions. The dissatisfaction ... was associated with the growing need of society for mathematics at an advanced level ... There was ... a growing conviction that the accepted approach laid too exclusive an emphasis on mechanical operations, was too little concerned with the practical uses of mathematics and that the traditional syllabuses included much useless lumber.'

1.27 The combining effects of a number of factors were probably responsible for the high interest in in-service courses at this time.

Selection at eleven-plus was gradually being phased out, and some teachers must have experienced freedom when the perceived constraint of the 11+ test was removed from the mathematics curriculum for older junior school children.

An increased awareness of the work of the developmental psychologists, particularly that of Piaget, helped to focus attention on the child learning rather than the teacher teaching, and so towards activity methods and 'learning by discovery.'

Structural apparatus, such as Stern, Cuisenaire and Dienes' multibase blocks for arithmetic together with the supporting booklets and books 'Children Discover Arithmetic', 'Now Johnny can do Arithmetic', 'Building up Mathematics' deflected some attention away from the practising of arithmetical skills to a concern for 'understanding' the processes involved.

HMSO 'Children and their Primary Schools' 1967 p. 235.
C. Stern 'Children Discover Arithmetic' Harrap, London 1953.
C. Gattegno 'Now Johnny can do Arithmetic' Education Explorers, Reading 1963 .
Z.P. Dienes 'Building up Mathematics' Hutchinson, London 1960.

1.28 The phrase 'modern mathematics' was used frequently. It was often used to mean an inclusion of new content material. Other people were more critical. The writers of A.T.M. (1967) say

> "It is clear that we associate with the words 'modern mathematics' an attitude to mathematics rather than a list of particular mathematical topics. There is little point in making a simple value distinction between 'modern' and 'traditional' topics and using the former to oust the latter. Apart from a reduction in the amount of time spent on doing imitative routine work, there is no need to jettison any of the mathematics that is traditionally taught in the primary school. But although the mathematics will stay, the methods of teaching it must change."
>
> "We approve the teaching of some plane and solid geometry, the use of co-ordinates, graphs, simple numerical algebra and some topics usually called 'modern': sets, simple examples of algebraic structures, elementary topology and so on. But what do these words mean? 'Plane geometry' may just mean the tedious and useless ruler and compass construction brought down unchanged from the first year of the secondary school; 'sets' may stand for the manipulation of Venn diagrams to solve pseudo problems; 'graphs' may mean a formalised routine for illustrating relationships. If these are the meanings these words carry in practice, we want none of them."

At least in the professional subject organisations there was discussion that would help the in-service education of a teacher who had reached the independence and maturity associated with Stage IV on Beeby's model.

1.29 Howson (1983) reports that "during 1900-1910 the membership of the Mathematical Association more than doubled; presumably reflecting the belief that the Association could provide assistance at a time of stress. No such expansion took place from 1962 onwards when the Association adopted a neutral stance towards reform. In contrast, the membership of the A.T.M. rose from 1570 in 1962 to 6025 in 1967. Since that time there have been no significant changes in the membership of either association."

A.T.M. (1967) 'Mathematics in Primary Schools' p.5, 6.
A.G. Howson 'Curriculum Development and Curriculum Research' N.F.E.R., Nelson 1983. p.9

1.30 Many teachers centres had been set up by the Nuffield Mathematics and Science projects. These were valuable as they provided a venue for courses and meetings for teachers, a collection of resource material which the teachers could examine and a relaxed atmosphere in which discussion could take place. In 1965 the Joint Mathematical Council supported their work and encouraged their proliferation in their "Report on in-service training for teachers of Mathematics". In 1967 the Schools Councils issued an interim report about teachers' centres which was not widely circulated. Mathematical Association (1970) 'Primary Mathematics - a further report' comments that about 300 centres were reported to be at work and approximately 40% of these were devoted to mathematics or mathematics and science and many of the others included mathematics along with other studies. At least a further 125 centres were planned.'

1.31 R.J. Stone (1975) described his work as warden of Stapleford Maths Centre near Cambridge (and senior advisory teacher in mathematics) which was a specialist mathematics centre. He suggests that the crucial question for evaluating the work of the centre is "What is going on in the schools as a result of the Centre being in existence?"

The centre appeared to be well used. 99% of the centre's activities were arranged purely at the request of the teachers; bookings for activities needed to be made a term in advance. The centre organised an obstacle course for activities for children,

Mathematical Association (1970) 'Primary Mathematics - a further report.'
R.J. Stone 'Running a Maths Centre' in Mathematics Teaching, No. 72, September 1974. p.28-29

courses and meetings for teachers, sessions for P.T.As and for students preparing to become teachers and a sink full of water for a white duck that was getting too hot in a teacher's car! He saw Stapleford 'as a centre for school mathematics at all levels, a place and atmosphere that persuades even the most doubtful visitor to pick up something and start doing some mathematics.' His job is 'to ensure that the teacher has what he needs to do the job of teaching, whether it is expertise, equipment or advice, or simply a reassuring hand to hold in the dark.'

1.32 In 1959 Miss Edith Biggs H.M.I., 'was seconded almost full-time to the task of organising courses and conferences for teachers.' 'The aim was to introduce teachers to new ideas to encourage them to set up local groups for further study and exchange of experiences, and to remove the insecurity and inadequacy of which many were all too conscious. These groups were an essential part of the development that took place. Some mathematics specialists from secondary schools took part in all courses.'

The popular Schools Council Bulletin No. 1 'Mathematics in Primary Schools' was prepared by Miss Biggs from her own wide knowledge of the work of teachers in primary schools and from other sources including the Schools Council/Nuffield Foundation's Development Projects.

1.33 The Nuffield Primary Mathematics Project was set up in 1966 with Professor G. Matthews as director. The first publication was the guide 'I do and I understand'; this and the subsequent guides

HMSO (1965) 'Mathematics in Primary Schools' Schools Council Bulletin No. 1.
HMSO (1967) 'Children and their Primary Schools' p.236

were aimed at teachers. They contain suggestions for developing into classroom ideas. The guides are difficult to use in retrospect - a lack of an index does not enable useful ideas for children's work in them to be found quickly.

The check-up guides are particularly interesting; they were produced in association with members of Piaget's team and aim to help teachers find out about the levels of attainment of concepts by children.

Only a small amount of pupils' material was published. Films, TV programmes, a magazine 'Nuffield Mathematics Teaching Project Bulletin' and annual conferences were organised for teachers. Watson (1976) suggests that 'when it finally drew to a close in 1971, the project could fairly claim to have made a major contribution to developing and extending the changes in primary mathematics education which had preceded it.'

1.34 The Plowden Report (HMSO 1967) suggests that although the influence of all this activity was difficult to measure precisely, the general impression of H.M.I. is that 'at least a majority of schools have been influenced by the developments... and that a substantial minority have completely rethought and reorganised their mathematical syllabus and teaching methods.'

It sounded two warnings:-

(i) that the newer ways of working were heavily dependent on the qualities of the teachers and on the continuation of the teachers groups. 'The future will depend upon the extent to which we can produce teachers with the necessary knowledge and understanding to

F.R. Watson 'Developments in Mathematics Teaching' Open Books, London 1976.
HMSO 'Children and their Primary Schools' p.238, 239. 1967.

use and improve upon the material made available to them, and to keep themselves up to date. This is the responsibility of the colleges of education, supported by whatever permanent arrangements are made, locally and nationally, for in-service training.'

(ii) that while they were full of enthusiasm for what they had seen and of hope for the future 'we must emphasise that the last thing we wish to see is a hardening of the new approach into an accepted syllabus supported by textbooks, workbooks and commercially produced apparatus and consecrated by familiarity. The rate of change must obviously slow down, but the initiative must remain firmly in the practising teachers' hands.'

1.35 In-service education had to this time been largely of an informal nature. The more committed teachers had become involved in the work of the professional subject organisations or other groups of like-minded teachers. They had attended courses provided by Curriculum Development Projects, L.E.As, Colleges of Education and University Departments of Education, but in-service education was voluntary and depended on the enthusiasm of the teachers.

In the 1970s there was an increasing sense that these informal arrangements were not adequate to cope with the needs of all teachers who are faced with rapid developments in the teaching and learning of mathematics. There were, in addition to the informal activity, Committees of Inquiry, reporting to the central government, national surveys by H.M. Inspectors reported in forms designed to be helpful to teachers and others involved with providing mathematical education, an increased number of L.E.A. mathematics advisers and a rather surprising development by some members of the Mathematical Association - the Diploma in Mathematical Education.

1.36 In 1968 the House of Commons set up a select committee, with chairman, F.T. Willey, which decided to undertake an enquiry into teacher training. No official report was issued because the 1970 general election intervened.

F.T. Willey, R.E. Maddison 'An Enquiry into Teacher Training' University of London Press, London. 1971

F.T. Willey and R.E. Maddison (1971) report a lack of national and regional planning for in-service education. N.F.E.R. were quoted as describing the provision of in-service education as in a 'confused and inchoate state' and 'the absence of any national overall strategy is distressing but true.' A number of witnesses stated 'It is clear that if all teachers are to be encouraged to attend in-service training financial inducements will have to be offered.'

The National Union of Teachers suggested that one term of in-service training per ten years of service was economically feasible and educationally desirable.

The authors state that in-service education may fare badly in times of financial stringency because 'it deals essentially with the quality of teaching rather than the quality of teachers available. It is easier to recognise a shortage of teachers than to realise the gulf between good and bad teaching and the ultimately appalling consequences to children of the latter.'

1.37 The James Report (HMSO 1972) considered that the third cycle of professional training had prime importance, that a 'much expanded and properly co-ordinated programme of in-service education and training is essential to the future strength and development of the teaching profession. Changes in curriculum (the first example quoted is 'modern mathematics') may make new demands which teachers have to be equipped to meet. Sometimes the needs of the school (such as a shortage of teachers of science or mathematics...) imply in-service education. The report considered that 'In-service training should begin in the schools. It is here that learning and teaching take place, curricula and techniques are developed and needs and deficiencies revealed.'

HMSO 'Teacher Education and Training - The James Report' 1972. Chapter 2.

A principal recommendation was that 'As soon as better staffing and the expansion of full time courses allow, all teachers should be entitled to release with pay for a minimum of one term...' in every seven years (with a future recommendation that this should be reduced to five years, implying that 3% of the teaching force would be absent from school at any one time.) They accepted that this would create problems of organisation, particularly for small primary schools.

1.38 The white paper, HMSO (1972) "Education: A Framework for Expansion" accepted the James Report proposal of one term's secondment for every seven years of teaching service. 'The recommendation will need to be implemented over a period as increases in the teaching force permit larger numbers of teachers to be released.'

These proposals still have not been implemented even though there has been a surplus of trained and qualified primary school teachers.

1.39 H.M. Inspectors contributed much more directly to the discussions about in-service education. HMSO (1977) reported that 'not enough schools are aiming to achieve both 'understanding' and basic skills. A further concern was 'the quality of mathematical education available to those children ablest in the subject. Too often schools provide insufficient challenge to the highly gifted. In primary schools the problem is every bit as important as it is at the secondary stage.' They conclude by commenting on the need for in-service education.

> "A problem almost as large as that of supply and training is that of ensuring that the teachers we already have

HMSO 'Education: A Framework for Expansion' 1972, para.61, p.18.
HMSO 'Mathematics in the maintained schools of England - a general appraisal by H.M. Inspectorate' 1977.

possess suitable knowledge and skill. In spite of the great efforts which have already been made over recent years, it is still the case that too many teachers have to teach mathematics without knowing enough about the subject, or about current ideas of teaching it. Enhanced in-service provision is especially important in shortage subjects; but the provision of in-service training is only part of the larger problem of enhancing the quality of the teachers' professional life. Teaching innovations fail unless the teachers are fully conversant with, and convinced by, the reasons underlying the innovation. In-service training must be directed above all to the development of the teacher's own capacity to make judgements.'

1.40 The Primary Survey (HMSO 1978) reiterated that 'more able children often work at too low a level' in mathematics. It saw the need for mathematics co-ordinators in primary schools, realised that 'much needs to be done through in-service training, which may require secondment, to help them carry out their functions and to extend expertise in their main field.'

The mathematical, educational and management knowledge and skills needed by such a co-ordinator is listed (paragraph 8.64, page 124). This is an important instance of a report prescribing appropriate areas of in-service education and going beyond just stating a general need.

1.41 HMSO (1982) Education 5 to 9, highlighted that 'Many teachers did not sufficiently encourage individual, independent investigations; this suggested a lack of confidence in extending the investigations or utilising the discoveries and it should continue to an objective of in-service training to increase the teacher's confidence.' In contrast with HMSO (1978) this recommendation for

HMSO 'Primary Education in England - a survey by H.M.Inspectors of Schools' 1978. p.112.

HMSO 'Education 5 to 9: an illustrative survey of 80 first schools in England', 1982. p.23.

in-service support could be more specific; it would be helpful to know in what or in whom should the teacher's confidence increase. It is not clear how some teachers are able to see interesting mathematical problems arising from children's play, or other activities whereas other teachers miss these opportunities. It is still less clear apart from providing many examples of children's work and encouraging teachers to listen to children, how to improve the insights of the weaker teachers.

Similarly HMSO (1980) may be criticised in that it may possibly have been a more helpful document if the authors had been prepared to make more specific suggestions (if necessary in a tentative manner) for in-service support, derived from their experience of observing in a large number of mathematics classrooms and departments.

1.42 External pressures on the mathematics curriculum were now more prominent; decimal currency was introduced in 1971, metric measures were introduced but at a much slower rate than had been anticipated, calculators and microcomputers became cheaper and much more widely available.

1.43 In primary schools the lack of written pupil material from the Nuffield project probably was a cause of commercially produced schemes of textbooks or workcards with supporting materials to be produced. Some in-service work was directed towards helping schools to select and implement such material. Many LEAs appointed an Adviser or an Inspector with special responsibility for promoting the quality of mathematics teaching in the LEA.

HMSO 'Aspects of Secondary Education in England - Supplementary Information on Mathematics.' 1980. p.42-44

1.44 There was some criticism voiced about the level of attainment particularly the mathematical skills of school leavers. (Presumably some of the school leavers in the years 1975-80 would have been the same children who in the 1960s were involved in the curriculum developments). This led to the Government setting up a commission of inquiry 'to consider the teaching of mathematics in primary and secondary schools in England and Wales, with particular regard to the mathematics required in further and higher education, employment and adult life generally, and to make recommendations.'

The Cockcroft Committee first met in 1978 and its report was published in 1982.

The report makes several important contributions to the work of in-service education in primary mathematics;-

1. The use of the phrase 'In-service support for teachers of mathematics' with the defined purpose of the support being 'to enable those who teach mathematics to extend and develop their professional skill' shows an enlightened and broad view.

2. A thorough survey of the varying types of in-service support that was available is given and recommendations made from the evidence supplied by the providers and users.

3. The report was largely positive and helpful which provided much needed encouragement to teachers.

1.45 A further report on Primary Mathematics which attempted to put in perspective all the activity of the 1960s was prepared by a subcommittee of the Mathematical Association in 1970. More significantly two of the members of the committee wrote a book, E.M. Williams, H.B. Shuard (1970), which was influential (mentioned by teachers in the course of the Research Project as being the most useful for the Diploma course.)

HMSO 'Mathematics Counts' 1982. Chapter 15.
Mathematical Association 'Primary Mathematics - a further report' 1970.
E.M. Williams, H.B. Shuard 'Primary Mathematics Today' Longman 1970.

1.46 'Mathematics in School' a journal mainly concerned with mathematical education of primary and the under-16 secondary school children was first published in 1971 by the Mathematical Association and continues to be a valuable source of ideas and comments, some of which are appropriate for the mathematical development of young children.

Similarly in 1975 the Association made the first moves to establish the Diploma in Mathematical Education. The subsequent developments are described in Chapter 2 of this document.

1.47 But why should it have been the Mathematical Association rather than the Association of Teachers of Mathematics which proposed and developed the Diploma? Of course, many of the people involved were members of both organisations. A comment of Griffiths & Howson (1974) may apply here as well as to the report M.A. (1955) Teaching of Mathematics in Primary Schools.

> "As we stated earlier, a large representative body is unlikely to move quickly on subjects which are of interest to all its members. However, it still remains true that even large organisations can produce far-sighted and avant-garde proposals on topics which are to them of minority interest. Thus the most forward looking report to be issued by the Mathematical Association in recent years was its 'Report on the Teaching of Mathematics in Primary Schools (1955).' This was possible because the Association had in the past been almost entirely concerned with secondary education - and that mainly in grammar and public schools - and those few members of the Association who were interested in the primary sector were deeply committed enthusiasts and not by any means representative delegates of teachers in the primary school.'

H.B. Griffiths & A.G. Howson 'Mathematics: Society and Curricula' Cambridge University Press, Cambridge 1974. p.131

For example, the prime mover of the idea of the Diploma was Douglas Quadling whose publications in the field of teaching mechanics and analysis would certainly qualify him as other than a representative delegate of teachers of mathematics in the primary school.

1.48 In 1983 in-service teacher training grants were given by the D.E.S. in response to the Cockcroft report. The areas of designated courses were:

1. training of mathematics co-ordinators for primary schools
2. teaching low attainers in mathematics in secondary schools
3. training for heads of departments in secondary schools
4. training for teachers of mathematics in secondary schools who are inadequately qualified in the subject.

Of the courses suggested for eligibility under the first heading of training primary mathematics co-ordinators to start in September 1983, over three quarters were M.A. Diploma in Mathematical Education courses. The new financial arrangements gave a far greater number of teachers the benefits of a day release course (described in 5.7-5.10), but meant that colleges had to restructure the course to fit a pattern consistent with the D.E.S. requirements (minimum length 20 days made up from periods not less than whole working days, duration of the course must not span more than a 12 months period) and the M.A. guidelines (no more than 5 hours of teaching contact time per day, duration of the course must be not less than 200 hours). Colleges and other providing institutions have in general welcomed this initiative but currently (1986/87) are in something of a quandary because of radical changes to arrangements for funding in-service education.

1.49 Evans (1980) in conducting a preliminary evaluation of the In-Service BEd. degree found that in BEd. degrees where there was a choice of curriculum subject studies that mathematics did not show the overwhelming popularity for primary school teachers that may have

N.Evans 'Preliminary Evaluation of the In-Service B.Ed. Degree' N.F.E.R. Publishing Co., Slough 1980.

been expected from Townsend (1970). It may have been that teachers' perception of mathematics as a difficult subject may have made them reluctant to opt for it as part of a degree course where their degree classification may have been important for them financially and in terms of career enhancement. This or similar hypotheses seems not to have been explored.

1.50 Sturgess (1980) quotes an interesting example of teachers forming mutual help groups, each with a chairman using non-directive facilitating strategies. The work of Carl Rogers seems to have been influential in developing this model of in-service education.

Local groups of teachers with their chairmen mention the course of a year to identify problems of concern to them and to choose an area of enquiry, to conduct the enquiry with others and to analyse and report on the findings. Regular meetings were organised for the chairmen.

Sturgess comments "The teachers were highly selective, either by self-selection or by being known to be able teachers interested in in-service activities. It would not be reasonable to expect this kind of activity to be valuable with conscripts, but it could be a very powerful method of helping teachers to reflect on their professional expertise."

It may be an appropriate method of encouraging particular teachers to acquire the confidence and independence associated with Stage IV of Beeby's model (1.7). It is not clear how useful it would be generally.

David Sturgess 'The Problems of Teachers of Mathematics - a report of an experiment in group enquiry' Nottingham University School of Education 1980.
Carl R. Rogers 'Client-Centered Therapy' - Constable, London 1951

1.51 Rudduck (1981) argues that a short outside course gives teachers access to ideas that they can explore in the company of professional colleagues whose reactions are likely to be less predictable than those of their own colleagues and whose experiences are likely to be less familiar.

1.52 The Cockcroft Committee (HMSO 1981) stated 'We are in no doubt that school based in-service support for teachers is of fundamental importance. It can be directed specifically to the needs of the school and its pupils, so that those who teach mathematics develop professionally as a result of working together to improve the work of the school. Above all, it can and should be a continuing process which is not limited to the length of a lecture, a discussion or a course.'

1.53 It would be helpful to hear accounts of school based in-service support which show how to avoid the extremes of introspection and how to encourage and enable the mutual exchange of experience that will lead to mathematical and professional skills and confidence developing.

1.54 After the observation that in 1982, 99% of primary school teachers had not taken the Diploma course, the report to the D.E.S. from the research project concluded (11.19)

> "The problem remains. How do we ensure that all primary school children enjoy the sort of teaching that will enable them to develop into confident and creative users of mathematics."

Jean Rudduck 'Making the most of the short in-service course - Schools Council Working Paper, No. 71.' Methuen Educational, London 1981. p.171.

J. Stuart Maclure 'Educational Documents, England and Wales. 1816 to the present day' Methuen, London 1965. p.99.

It is of interest that this should have unwittingly (a pity to have missed the appropriate quotation from Hansard) have echoed the comment of W.E. Forster in introducing the Elementary Education Bill into the commons in 1870,

> "The first problem is this. 'How can we cover the country with good schools.'?"

CHAPTER 2

THE DEVELOPMENT AND ORGANISATION OF THE DIPLOMA IN MATHEMATICAL EDUCATION

2.1 This chapter consists of a brief account (sections 2.2-2.4) of the setting up and evolution of the Diploma and a more substantial part (sections 2.5-2.27) describing the complex organisation of people that operate and sustain it.

The Development of the Diploma

2.2 The Mathematical Association had successfully operated a Diploma in Mathematics (Teaching) for some years. The purpose of that Diploma was to improve the mathematical qualifications of teachers to enable them to teach in sixth forms. The content was almost entirely mathematics and it was assessed by nationally set, timed examinations.

Competition from Open University courses and BEd degrees were factors in causing the Council of the Mathematical Association to note in December 1974 "some of the financial and other difficulties" under which the Diploma in Mathematics (Teaching) was operating and to start a consideration of "the part the Association should play in in-service training."

The Finance and General Purposes Committee set up a committee which met and reported back in May 1975 that "We agree that the present Diploma should be phased out in favour of a new Diploma geared to the needs of those teaching children in the age range of 5-14 years. Such a Diploma would only be available to teachers after a period of, say, 2 years of teaching and would aim at preparing teachers for leadership and the organisation of a team of teachers rather than mere competence in mathematics although this is obviously important."

It was recommended that a working party be set up "to consider and work out the detailed plan for such a Diploma". It was suggested to the working party that the assessment for the new

Diploma should consist of a Mathematics examination, a piece of work done by the teacher, possibly in school, and a form of examining the teacher's knowledge of Mathematical Education and its practical application to the primary school.

2.3 Invitations were sent to a number of organisations concerned with mathematics teaching (National Union of Teachers, University Departments of Education Mathematics Study Group, National Association of Mathematics Advisers, Association of Teachers of Mathematics, National Association of Teachers in Further and Higher Education Mathematical Education section) to send representatives to the working party and the group of 10 members met in July and October 1975 and in February 1976.

The content of the proposed course was discussed in detail. Members of the group produced papers on the development of mathematics teaching in schools, learning and teaching mathematics, starting points for Mathematical Investigations, the history of mathematics, Special Studies from personal observation in the classroom and Mathematics as suitable components for the Diploma.

Preliminary soundings were taken from college lecturers who were enthusiastic, from branches of the Mathematical Association, from mathematics advisers and from teachers, amongst whom the Primary Advisory Group of the National Union of Teachers thought that "such a Diploma would be invaluable"; it was hoped that "expertise from first schools would be used in planning the curriculum."

In April 1976 the Council of the Mathematical Association received a "Proposal for the Institution of a Diploma in Mathematical Education". The working party suggested that:

(i) the purpose of the Diploma course be "to equip suitable and interested primary and middle school teachers to provide leadership in mathematics teaching within their schools";

(ii) the Diploma course should not compete with similar courses already offered by institutions but should offer suitable institutions the opportunity to use the Diploma as a ready-made and externally validated qualification to offer local teachers;

(iii) three years' teaching experience be a pre-requisite for admission to the course;

(iv) the course normally be offered part-time over two years including approximately 200 hours attendance at the providing institution but in suitable circumstances be built round a one term full-time course, with part-time study before and afterwards;

(v) the spirit of the course will be such that it is relevant to practising teachers of the 5-13 age group";

(vi) teachers be required to carry out a Special Study over a fairly extended period of time, based on regular and detailed observations of children learning mathematics;

(vii) teachers be required to investigate the mathematics implicit in some simple situation;

(viii) the course be treated as far as possible in a unified way, not as separated courses in mathematics, psychology, pedagogy.

A suggested syllabus for the course was given. The assessment suggested was by examination papers, set and marked by the Mathematical Association, and by Mathematical Investigations and Special Studies, which would be marked by the providing institution and then moderated by the Mathematical Association.

2.4 Council appointed a committee to produce draft regulations and to investigate in detail the implications of the proposal, giving particular attention to the financial implications.

The first meeting of the committee was in May 1976 and the fifth and final meeting in February 1977.

The financial implications of two forms of organisation were considered: the Mathematical Association acting as an examining body for the Diploma or as a validating body. The latter model was favoured as "it would involve the Association in a smaller and more easily controlled financial commitment". The costing was on a basis of 10 students per year in each of 20 colleges.

The committee considered how this might work out in detail.

"The Mathematical Association's control would be invested in a Diploma Board of about 10 members selected so as to give a wide national coverage. The Board would consider written submissions from colleges (or other providing institutions) giving details of proposed teaching arrangements, course contact, staffing etc. A local team would be recruited under a member of the Board to visit the college and discuss the submissions in detail. If the local visiting team agreed, the Board would approve the college for the purposes of the course. The Board and the college would then agree on a nomination of a moderator whose fees and expenses would be met by the college. At the conclusion of the course the college and the moderator would submit to the Board a report on the performance of candidates with recommendations for the award of Diplomas; the conferment of the award would be the responsibility of the Board."

Draft regulations were prepared and considered. They were incorporated together with an outline syllabus, specimen examination papers and suggestions of books suitable for the course into a document of explanatory notes for providing institutions.

Representatives of the Universities Council for the Education of Teachers, Council for National Academic Awards, the Open University, and Department of Education and Science and the Burnham committees were informed of the progress towards the Diploma.

Council, meeting in December 1976, accepted the new model of validation for the Diploma and authorised an information letter to be sent to the press, colleges and LEAs. In April 1977 it accepted the main proposals for the Diploma and approved a 'Shadow' Diploma Board. The new bye-laws of the Association to authorise the Diploma were passed in December 1977 and a Diploma Board of 15 members was elected.

The Organisation of the Diploma

2.5 The Mathematical Association acts as a validating body for the Diploma which is supervised by a Diploma Board consisting of 15 voluntary members. The members include practising teachers, lecturers in colleges and university departments of education and mathematics, mathematics advisers and a representative from industry. Their geographical location enables centres which provide the Diploma

to have a local Board member who acts as a contact between the centre and the Diploma Board. The Board meets about five times per year at the Association's headquarters in Leicester. Most meetings last about three hours and have a substantial agenda; one per year takes part of a weekend and enables the Board members to be more reflective about the progress of the Diploma and to have time to consider improvements and innovations.

The work of Diploma Board members is discussed in greater detail in sections 5.27-5.30.

Guidelines for Diploma courses

2.6 In 1978 the Diploma Board constructed a booklet of information for centres wishing to provide Diploma courses. This was revised in 1982 ('The Diploma in Mathematical Education - A General Guide') and gives an account of the organisation of Diploma courses.

2.7 The purpose of the Diploma is stated:

"This Diploma is a qualification for teachers with its emphasis on teaching children in the 5-13 age range. Its purpose is to equip suitable and interested teachers to make a strong personal contribution to the teaching of mathematics within their own schools; it is particularly appropriate for those who hold, or hope to hold, positions of responsibility for mathematics in first or middle schools."

2.8 Students must be qualified and experienced teachers:-

"Candidates for the Diploma must have at least two years' teaching experience, but the Mathematical Association does not require them to have a formal mathematics qualification."

2.9 The commitment of time is outlined:-

"Diploma courses involve at least 200 hours of teaching contact time, usually spread over two years of part-time study, and occasional tutorial sessions; in addition candidates are expected to undertake in their own time a substantial amount of private reading, mathematical enquiry and observational study of mathematics learning in the classroom."

Areas of Study

2.10 Courses contain two main areas of study:-

1. Mathematical content for teachers including the Mathematical Investigation.
2. Mathematical Education including the Special Study.

"These two areas should not be regarded as distinct and both the syllabus and the teaching arrangements for the course should be such as to allow the development of linking themes between the 'Mathematics' and 'Mathematical Education': each should be taught with constant reference to each other as well as to the classroom experience of the teacher."

The Four Components of Diploma courses

2.11 The aim of the Mathematical content for teachers is to extend the students' own mathematics sufficiently to give confidence in handling topics which might arise in school with pupils in the age range 5-13.

"It will therefore include such themes as:-

The development of the idea of number.
Spatial perceptions: shape, measurement, symmetry.
Operations on numbers, and algorithms for computation.
Relationships: functions, graphs, proportion, order, transformations.
Data analysis: variability, pictorial representation, the language of statistics.
Use of computational aids, electronic calculators and microcomputers.
Generalisation and the use of algebraic symbolism.
Abstraction from particular systems to formal structure: equivalence classes, groups.
Mathematical reasoning and the nature of proof.
Use of simple combinatorial arguments."

2.12 The Mathematical Investigation is undertaken personally by a student with appropriate tutorial help. It is an open ended mathematical enquiry involving, where appropriate, the use of symbolism, creation of mathematical models, conjecture, generalisation and proof.

2.13 The Mathematical Education component of the Diploma course develops in relation to classroom experience such themes as:-

The history of mathematics.
The mathematics curriculum: content and method.
Organisation of mathematics teaching, within the classroom and through the school as a whole.
How mathematics is learnt.

2.14 Candidates for the Diploma are required to undertake a Special Study based on regular detailed observations of a child or a small group of children learning mathematics. The Special Study should be presented in the form of a report of approximately 5000 words.

Assessment for the Diploma

2.15 The assessment for the Diploma allows for each of the four components: Mathematics, Mathematical Investigation, Mathematical Education and the Special Study, to be assessed on a scale A to E with the only proviso that the grade for Mathematics must be based wholly or mainly on some form of examination.

A distinction is awarded to candidates who achieve:

(i) all grades C or better

and (ii) grade A in either Mathematics or the Mathematical Investigation

and (iii) grade A in either Mathematical Education or the Special Study.

Candidates with one grade E or three grades D will fail. Up to two complete elements that were graded D or E may be resubmitted within one year; the grade awarded must be at best only one grade higher than the original.

Reading List

2.16 Institutions must include a reading list with their submission to run a Diploma course. The books and articles are classified under the headings "Essential", "Desirable" and "Background". Students are expected to buy the "Essential" books.

The guidelines contain advice on some useful books for the course, in the original edition noting some of those which had appeared on the book lists of institutions and in the revised version giving more detailed guidance to ensure the reading list is appropriate to the course and shows awareness of particular trends and developments.

Administration for the Diploma course

2.17 The guidelines contain an account of the administration for the Diploma course that is done by a providing institution. This will include:-

(i) writing a submission for the course and receiving two Diploma Board members who visit the centre to discuss the submission and assess the provision of resources for the course;

(ii) suggesting one or two external moderators for the course to the Diploma Board and after its consent appointing the moderators and paying their fees; (the workload of moderators is considered in sections 7.13-7.22);

(iii) setting up a College Board which includes tutors teaching the course, the external moderator(s), possibly other members of staff of the institution (e.g. one who has responsibility for in-service education) and possibly an LEA adviser;

(iv) ensuring that registration forms for the course are accurate, in particular that all students are qualified teachers and have at least two years' teaching experience, and collecting the registration fee (currently £30 + VAT);

(v) the College Board approving the results of the Diploma course and sending them to the Diploma Board for ratification;

(vi) informing the Diploma Board of changes in the course.

Procedure for a centre wishing to run a Diploma course

2.18 A centre wishing to provide the Diploma course will normally first contact the secretary of the Diploma Board. The booklet 'Diploma in Mathematical Education - A General Guide' will be sent and arrangements made for a local Diploma Board member to visit the centre for an informal discussion. A submission is then prepared using the guidelines and sent to the Diploma Board.

A formal visit, normally of two Board members, to the centre is arranged. The purpose is to consider the capability of the staff to run the course, the support of the providing institution and of the LEA, the availability of suitable teaching rooms and of the appropriate equipment for the course and the provision of refreshment for hungry and thirsty teachers. A check is made that the library possesses the relevant materials and has suitable opening hours.

The report on the visit is discussed at the next Board meeting. The Board's decision is generally one of the following:

(i) a three year licence to run a Diploma course is given if the report is favourable;

(ii) a one year licence if there are doubts about the ability of the providing institution to sustain the standard of provision for the course;

(iii) instructions to re-present parts of the submission;

(iv) the submission is not accepted.

Outposts

2.20 Some institutions run Diploma courses at outposts. These are generally of two types:

(i) a teachers' centre in a rural area;

(ii) a teachers' centre in an urban area in an adjacent local authority which wishes to offer some of its teachers, say, day release from school to attend the Diploma course.

In validating outposts to run Diploma courses, Board members attempt to ensure that the resources available are equivalent to those in the providing institutions. (See sections 5.22-23).

2.21 A large number of teachers have enrolled for Diploma courses since 1978:-

	January	April	September
1978	34	7	485
1979	72	49	521
1980	120	20	666
1981	120	16	not recorded

2.22 Courses are operated at centres in England, Wales and Northern Ireland. (See map on following page).

All the centres apart from one have a history of providing initial teacher training for primary schools. A few of these institutions no longer have initial training courses but continue to provide in-service education for teachers.

2.23 Arrangements can often be made for students who have moved to another part of the country to resume their studies for the Diploma at another centre. This obviously depends on the agreement of the tutors concerned.

However the lack of courses in some areas has meant that at least one student has been disappointed that she has not been able to continue her study:-

> "I will be working till 3.45 and there is no chance of time off for the course. I live about 5 miles south of Wincanton in Somerset. I could travel one evening a week a reasonable distance. I won't be able to spend much of my own money and can't get any help from my school - WHERE and HOW can I complete the course? I was so enjoying it and finding it very useful."
>
> (A woman teacher, aged 40-44, having a scale 1 post in a 4-11 school, who withdrew after successful completion of one year of the course because her family moved to the rural south west).

MAP OF DIPLOMA CENTRES (1981)

- denotes a Diploma centre currently running courses
- * denotes a Diploma centre (with outpost(s)) currently running courses
- denotes a Diploma centre no longer running courses
- * denotes a Diploma centre (with outpost(s)) no longer running courses

2.24 There are four main types of course:-

Evening course, one evening per week for six terms with occasional whole day special meetings. A typical arrangement would be to start at 4.45p.m., have a 15 minute coffee break at 6.15p.m. and to finish at 8.00p.m.

Afternoon course, similar to an evening course but requiring half-day release from school.

Day course, requiring day release from school starting for example at 9.00a.m., finishing at 4.00p.m., and having a 15 minute coffee break and an hour long lunch break. This variant is sometimes used by LEAs who wish to use the course for teachers who are, or are in a position to be, mathematics leaders in their schools.

One term full-time, plus two or three terms of part-time evening study.

2.25 In 1979 it was agreed that the Diploma should be accepted for a merit addition under Appendix 3 of the Burnham Document and that the award should be retrospective to the date of the completion of the first course.

2.26 The Diploma Board organises an annual conference for moderators and annual regional conferences for tutors and moderators. These provide an opportunity for an exchange of views about the Diploma.

A typical programme is:-

10.00	Introduction and general sharing of experiences in running the Diploma
11.00	Coffee
11.30	The Mathematics content, the Mathematical Education content, and how we can most effectively ensure their integration
12.45	Lunch
2.00	The Special Study and the Mathematical Investigation (participants are asked to bring examples)
3.30	Tea

Opportunity has been taken at these meetings to provide feedback for the research project to tutors and moderators.

2.27 The administration of the Diploma has involved the Executive Secretary and the members of staff at the Mathematical Association headquarters in a substantial amount of extra work.

Initially the work included typing and printing the guidelines, designing and printing the registration forms and the Diploma certificates, preparing notepaper for Board members and opening a special bank account to pay Board members' expenses.

The day to day running of the Diploma includes organising Diploma Board meetings, typing reports of visitations from Diploma Board members, processing students' registration forms and fees (and dealing with queries arising from them), collecting Diploma results and issuing pass lists and Diplomas as well as much general correspondence.

The workload is not evenly spread over the year. There is a maximum in September and October when the bulk of the new registration forms has been received and the results of the courses which finished in the summer term are approved at the September meeting of the Diploma Board. As a rough estimate a figure of approximately 10 hours per week would serve as a measure of the average amount of administrative time spent on Diploma work.

CHAPTER 3

THE RESEARCH PROJECT

3.1 The research project, which was funded by the Department of Education and Science for two years from 1st September 1980, was based in the University of Durham School of Education.

3.2 The twin aims of the project were:

(i) to monitor the progress of the Diploma

and (ii) to assess its effectiveness.

Appendix 4 contains further details of the research design.

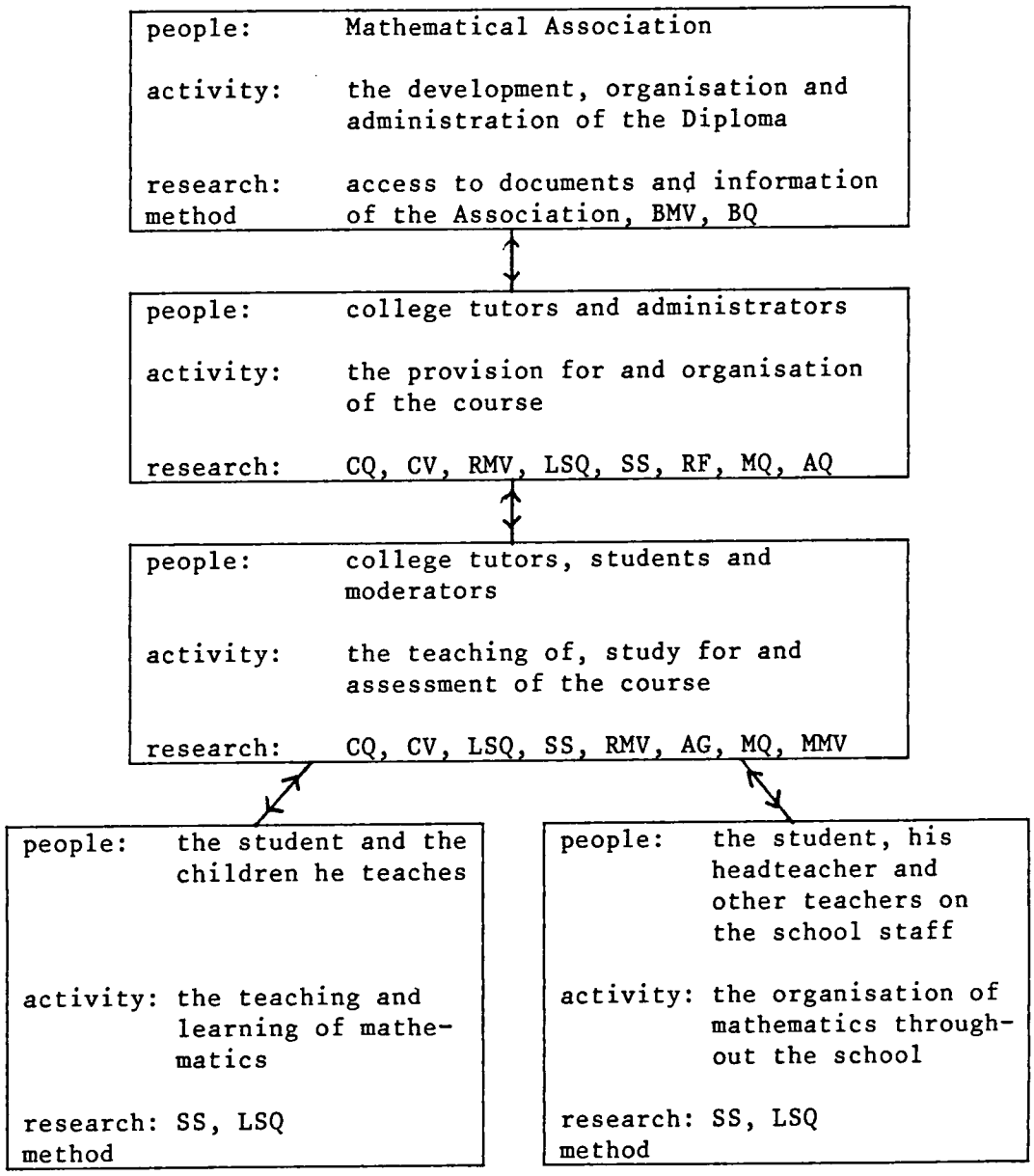
Research method

3.3 To attempt to achieve the project's aims, the following information was collected and visits were made:

(i)	Registration forms of 2108 students	(denoted by RF)	See section	3.7
(ii)	Assessment grades of students	(denoted by AG)	" "	3.9
(iii)	A large sample postal questionnaire sent to 983 students	(denoted by LSQ)	" "	3.8
(iv)	A small sample of 41 students who were interviewed in their schools	(denoted by SS)	" "	3.10
			" "	3.11
(v)	Two questionnaires to colleges	(denoted by CQ)	" "	3.13
(vi)	A questionnaire to moderators	(denoted by MQ)	" "	3.14
(vii)	A questionnaire to mathematics advisers	(denoted by AQ)	" "	3.15
(viii)	A questionnaire to Diploma Board members who were also asked to keep a log of their work	(denoted by BQ)	" "	3.16
(ix)	Visits to 20 centres	(denoted by CV)	" "	3.12
(x)	Visits to Diploma Board	(denoted by BMV)	" "	3.16
(xi)	Visits to regional meetings of tutors	(denoted by RMV)	" "	3.16
(xii)	Visits to moderators meetings	(denoted by MMV)	" "	3.16 3.14

3.4 A simplified model for the Diploma that indicates only some of the feedback, monitoring and moderation that is necessarily built into the system is illustrated in the diagram:-

A simplified diagram of the Mathematical Association Diploma and the work of the research project



Note: The abbreviations are defined in section 3.3.

3.5 The work of monitoring the progress of the Diploma concentrates on looking at the activities in the diagram at various points in time.

3.6 The work of assessing the effectiveness of the Diploma concentrates in part on considering the Diploma course that is taught at each of the 20 chosen centres, examining the organisation, teaching and assessment of it, and seeing how effective it is in helping the two teachers selected in the small sample to develop their teaching of mathematics and the organisation of mathematics in their schools.

3.7 Registration forms for 2108 students who commenced courses before September 1981 (1 form was not traced) were analysed. Information was gained about the educational qualifications and the teaching experience of the population of teachers who registered for the Diploma courses.

Large sample questionnaire

3.8 A questionnaire (Appendix 1), after pilot work with about 30 students, was sent in March 1981 to 983 students who were selected from the first 1820 students who registered for the Diploma. Students involved in pilot work for the questionnaire were not included. Otherwise those students whose registration number was even or whose registration number gave a remainder of 9 after division by 20 were chosen.

Twenty members of the small sample were members of the large sample; the other 21 members of the small sample were also sent questionnaires. These 21 teachers' questionnaires were included with the large sample questionnaire for analysis.

The response was:

	No. of returned questionnaires
Students who have not withdrawn from the course	602
Students who have withdrawn from the course	116
Letters returned by the Post Office	35
Total (large sample)	753

The response rate is $\frac{718}{983}$ = 73.0%. Including the extra 21 questionnaires from the small sample, 739 questionnaires were analysed.

However analysis of Diploma results has shown (see section 8.3) that 25.3% of students withdraw from the course so any conclusions from the analysis of the returned forms must take into account the small proportion $\frac{116}{983}$ = 11.8% of those who had replied who had withdrawn.

The questionnaire was designed to build on the information gained from the students' registration forms and to find out:-

(i) characteristics of the teachers and their schools and where appropriate to make a comparison between them and the total teaching population as represented by data collected by the DES (Statistics in Education 1979, Vol.1 Schools, Vol.4 Teachers);

(ii) teachers' views about the organisation and content of the course;

(iii) information about the teacher's own teaching of mathematics and the influence of the Diploma course upon it;

(iv) information about the organisation of mathematics in the teacher's own school and the influence of the Diploma course upon it;

(v) further information, e.g. reasons for withdrawal (where appropriate), and attitudes to mathematics.

There was space in the questionnaire for teachers to make any additional comments relating to the course.

The information gained from each questionnaire was linked to the information from the appropriate registration form (preserving the promised anonymity), coded and analysed.

3.9 Details of assessment grades of students completing the course in or before July 1981 were available; these were cross-tabulated with information derived from the registration forms and the large sample questionnaire and characteristics of three sub-populations of students who

(a) gained a distinction

(b) passed

(c) failed or withdrew from the Diploma course

were compared.

Selection of the small sample of students

3.10 To obtain a small sample of students in order to carry out a detailed in-depth study of the effectiveness of the Diploma, a stratified random sample of 40 teachers, 2 each from 20 centres, was chosen. Centres were chosen:-

(i) in pairs to save making two journeys;

(ii) to represent all parts of the country;

(iii) to include different types of institutions which had well established courses.

Two centres were excluded as they were used for pilot studies.

A three-way cross-tabulation (Men/Women v. Status in school v. Age range taught) from the first 1197 registration forms suggested that teachers should be chosen as follows:-

(I = Infant J = Junior S = Secondary

I = under 7 years, J = 7 - 11 years, S = 11 years and over)

Women

	Age range taught					
	I	I/J	I/J/S	J	J/S	S
Scale 1	3	2		6	1	2
Scale 2 or above	2	1		4	1	
Deputy head				1		
Head						

23 teachers

Men

	Age range taught					
	I	I/J	I/J/S	J	J/S	S
Scale 1				4	1	1
Scale 2 or above				5	1	1
Deputy head				1	1	
Head				1		

16 teachers

In order to obtain a more complete picture, two modifications were made:-

(a) an extra teacher, a woman headteacher of an infant school, was chosen, and

(b) in order to have one man with infant teaching experience, a man with a scale 1 post teaching the infant and junior age range was substituted for a woman with equivalent status and teaching the same age group.

An extra student was chosen who had taken the evening course at a centre and who teaches in a Social Priority Area school in the London borough of Newham because:-

(i) the two students originally chosen from the centre were members of different day release courses and did not adequately represent the relatively large number of courses that have been run there;

(ii) no student had been chosen from London;

(iii) when the students were contacted, it became apparent that inner city schools (as defined in the Primary Survey[1]) were probably under-represented.

Of the 41 students chosen (the following categories are not mutually exclusive):-

five took the course at outposts of centres;

five took a variation of the course which involved half-day, day or a one term release from school;

two were supply teachers and were interviewed at home;

one was a part-time teacher;

one teacher, because of difficult relationships in his school (confirmed by tutors teaching the Diploma course), was interviewed at the centre in 1981 and at his school in 1982;

one had withdrawn a short time after starting the course. (Three teachers who were finally selected for the small sample subsequently withdrew from the course and a further four withdrew after the completion of the research project.)

Four teachers refused to take part in the research and the teacher who had withdrawn a short time after commencing the course was replaced. Details of the replacements are shown in the following table:-

1 HMSO (1978) 'Primary Education in England - A Survey by H.M. Inspectors of Schools'

Reason for replacement	Stratum of the teacher used as a replacement
Personal reasons and pressure from school	Same
No reason given	Same, except junior instead of junior/secondary age range
No reason given	Same
Promotion to deputy headship, change of school, pressure of work	Same, except scale 1 instead of scale 2
Withdrew after only a short time	Same, except junior instead of secondary age range

Visits to the small sample of students

3.11 It was planned to interview the teachers twice and they were normally visited in their schools during the Spring term of 1981 and again in the Spring term of 1982. The opportunity was taken to talk to the teachers, their headteachers and other teachers on the staff.

The subjective impression on meeting the teachers was that they were better dressed than expected (surely not a quarter of the national population of men primary school teachers wear their best 3-piece suits for everyday school!) and initially more apprehensive and nervous than was anticipated. The interviews were tape recorded with the teachers' permission. An assurance was given that the information would be extracted from the tape anonymously and then the tapes would be cleaned. Nevertheless switching off the tape recorder at the end of the interview and disconnecting the micropohone often prompted an increase in the quantity and quality of information.

The interview schedules for the first and second round of interviews are contained in Appendix 3.

Predictably questions which sought the teacher's advice, that put him or her in the role of an expert, were successful in

removing apprehension and establishing a friendly atmosphere. The pressure diagrams (see Appendix 3) were valuable not only in that they gave information in a form which enabled comparisons to be made but also in that they set the mode in the interview of the teacher talking authoritatively about the mathematics in his or her school or about the value of the Diploma course and the interviewer listening appreciatively and carefully.

Headteachers and teachers frequently went out of their way to make special arrangements for the visits. It was necessary to tape-record interviews in a quiet place, the teacher's classroom during the lunch hour or after school, a spare classroom, the staff room or the headteacher's study. Teachers' classrooms were visited in order to attempt to gain some details of the mathematics done by their pupils. Obviously at some times during the day children were more likely to be doing mathematics but even visiting a classroom at 4p.m., half an hour after the end of the school day, it was still possible to estimate the potential for mathematics in the classroom displays and to look at and listen to the teacher talking about the work of a pupil who was "good at" mathematics, of one who had difficulty with mathematics and of one whom the teacher considered to be "average". Sometimes the teacher produced the very neat work of a pupil (always a girl rather than a boy) and described her as being co-operative and good but did not mention any example of good mathematical thinking. On other occasions the teacher was not able to say with any degree of certainty what the child who was weaker at mathematics could do ("He's hopeless - you can see that by looking at his work" was the most horrific explanation but frequently explanations were given purely in terms of the child's social background) let alone suggest ways of building on his strengths and helping his difficulties. With a few teachers, it was not altogether clear to the interviewer that the "average" pupil was in fact weaker at mathematics than the child who was "good at" mathematics.

Such judgments are necessarily subjective, but the teachers were, in general, keen to talk about the work done by their pupils in mathematics and to talk about the mathematics scheme for the school.

Some of the assignments and course work for the Diploma were examined; the teachers were willing to explain where they had difficulties and which parts of the work were most beneficial to them.

The large sample questionnaire was sent to all members of the small sample and an abbreviated questionnaire was also circulated prior to the second round of interviews.

Visits to centres

3.13 A questionnaire was circulated to centres in October 1980 (response rate 92%) and, in order to monitor the progress of the Diploma from the colleges' point of view, a second questionnaire was sent in September 1981 (response rate 84%). Tutors were asked to state reasons why individual students had withdrawn from the course; this information has proved valuable as it supplements that gained from the large sample questionnaire.

Other sources of information

3.14 A short questionnaire was sent to moderators in February 1981 (response rate 80%). In addition their views of the Diploma were sought by reading their reports on individual courses (54 reports received by the Diploma Board from 76 courses) and by attending the national moderators' conferences that were held in March 1981 and 1982.

3.15 A short questionnaire was circulated to mathematics advisers in June 1981 (response rate 80%). Information was thus gained of advisers' views and afforded some comparison with those of tutors, students and moderators.

3.16 Members of the Diploma Board were asked to keep a log of their work connected with the Dipoloma from March 1981 to March 1982. It seemed important to form a picture of the amount and nature of the workload undertaken by this voluntary body.

A questionnaire allowing a considerable amount of free response was presented to them in October 1981. They were invited to discuss some of the more adverse criticisms of the Diploma made by students in the large sample questionnaire, how the Diploma could be improved locally and nationally and how the workload of Board members could be reduced.

The research fellow has attended all the meetings of the Diploma Board, regional meetings of tutors and national day-conferences of moderators.

CHAPTER 4

DIPLOMA STUDENTS AND THEIR SCHOOLS

4.1 Information from students' registration forms (RF) and their responses to questions included in the large sample questionnaire (LSQ) made it possible to build up a picture of the population of teachers who are or have been students for the Diploma in Mathematical Education. The population of Diploma students may be compared with the total teaching population by using data from:-

HMSO(1981) Statistics of Education 1979, Volume 1 Schools (denoted by S.E.S.)

HMSO(1981) Statistics of Education 1979, Volume 4 Teachers (denoted by S.E.T.)

HMSO(1978) Primary Education in England - A Survey by H.M. Inspectors of Schools (denoted by P.S.)

Similarly it is possible to compare the schools of Diploma students and their organisation for mathematics with those of the total teaching population.

Diploma Students

4.2 The table compares the numbers of women and men who registered for Diploma courses before September 1981 (RF) with the numbers of women and men teachers in primary and middle schools (S.E.T.,pp.29,31).

	Women	Men	Total
Diploma students	1262 60%	845 40%	2108 100%
Total population of teachers (primary + middle deemed secondary)*	160444 76%	51795 24%	212239 100%

*Middle schools "cover varying age ranges between 8 and 14. Depending on their individual age range they are deemed either primary or secondary by Order of the Secretary of State for Education and Science or (for age range 9 to 13 by choice of the local education authority)....S.E.S" p.xi, note 6.

The proportion of women Diploma students is significantly (at a <0.1% level) less than in the teacher population. Speculation suggests two possible hypotheses:- a married woman teacher feels that she has little time left to give to a substantial evening course after a full-time job and running a home or the course may be less suited to the infant age range which has a higher proportion of women teachers.

Slightly less than 1% of all teachers in primary and middle schools had registered for a Diploma course before September 1981.

4.3 The ages of teachers who are or have been students for the Diploma course (LSQ) are compared in the table with the ages of all teachers in primary and secondary schools (S.E.T., p.6).

Women teachers

Age	Number of Diploma Students	% of women Diploma Students	All primary and secondary women teachers % of total
Under 25	9	2%	12%
25-29	81	18%	23%
30-34	61	14%	12%
35-39	98	22%	11%
40-44	99	22%	13%
45-49	69	15%	13%
50-54	25	6%	9%
55 and over	4	1%	7%
	446		

Men teachers

Age	Number of Diploma Students	% of men Diploma Students	All primary and secondary men teachers % of total
Under 25	1	<1%	6
25-29	54	19%	21%
30-34	95	33%	21%
35-39	48	17%	13%
40-44	33	11%	11%
45-49	30	10%	10%
50-54	20	7%	8%
55 and over	9	3%	11%
	290		

Diploma students must have 2 years' qualified teaching experience so the group of students aged under 25 is not directly comparable with the population of teachers aged under 25.

Only a small number of teachers who are aged 55 and over have registered for Diploma courses (section 8.16(a) contains evidence of poorer performance on Diploma courses from older teachers).

4.4 Diploma students indicated the length of their teaching experience (RF):-

Teaching experience in years	Number of students	% of total
5 or less	673	32%
6-10	842	40%
11-15	348	17%
16-20	144	7%
21-25	64	3%
more than 25	30	1%
no response	7	<1%
Total	2108	100%

72% of Diploma students have 10 years' or less teaching experience and 88% of Diploma students have 15 years' or less.

4.5 Comparative figures for English and Welsh teachers and those teaching in Northern Ireland who registered for Diploma courses before September 1981:-

	Number of Diploma students	Number of primary (+ middle deemed secondary*) teachers	% of primary teachers in the country who are Diploma students
England	2020	198453	1.0%
Wales	47	13786	0.3%
N.Ireland	41	8444	0.5%

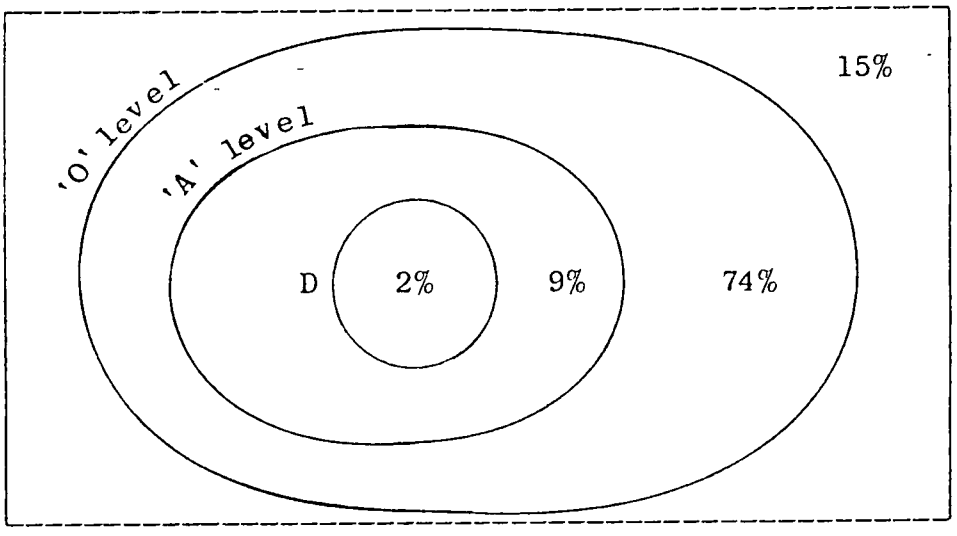
* see footnote for section 4.2.

In Wales, South Glamorgan Institute of Higher Education has run Diploma courses starting in September 1979, 1980 and 1981, the

Polytechnic of Wales started a Diploma course in September 1980 but they report that this will be the only stream of students on the course because two of the course tutors have accepted redundancy arrangements and have left the college, and both West Glamorgan Institute of Higher Education and Gwent College of Higher Education have expressed interest in the Diploma but had not run any courses before July 1982.

Tutors at St. Mary's College, Belfast have been running Diploma coures since 1979 (both evening courses and courses requiring release from school) against the background of the difficulties caused by the prevailing sectarian troubles. They suspect that teachers from country schools may be wary about coming into Belfast each week for the Diploma course.

4.6 The mathematics qualifications of Diploma students are illustrated in the diagram below:



(when D denotes Degree in Maths or BEd(hons) Maths or Physics, Chemistry, Engineering, Economics + 'A' level Maths)

Approximately three quarters of the students have 'O' level but not 'A' level mathematics.

The registration forms give details of the general educational qualifications of students:-

	Number of 'A' levels			Other qualifications	Total
	0	1	2 or more		
Number of students	1028 49%	304 14%	751 36%	25 1%	2108 100%

Of the 2108 students 417 (20%) RF are graduates. This excludes teachers with an Open University degree or with a 3 year BEd degree. Some 134 (6%) RF of the teachers had completed some Open University units but the information was not sufficiently detailed to draw any further conclusions. The number of students who have a 3 year BEd degree is still small. Graduate status may possibly be an unhelpful generic label, when considering students' performance in Diploma courses (see section 8.11(ii)).

4.7 Students who completed the large sample questionnaire (Appendix 1) gave details of their work in keeping up to date with current developments in mathematical education.

Some 44% had attended short in-service courses, 7% had attended longer in-service courses (e.g. 1 week duration or 1 term of 2 hours per week) and 4 teachers (less than 1%) had attended in-service courses that required secondment of, say, a term, but 49% had attended no in-service courses related to mathematics.

Similarly 80% were not members of any local or national mathematics teachers' group or organisation, 11% had joined the Association of Teachers of Mathematics, 4% were members of the Mathematical Association and 2% mentioned various local groups (including those that developed from the Nuffield project).

If this information is juxtaposed with the fact that 36% of teachers found no books that were particularly useful for the course (which perhaps they might have bought and continued to use after the end of the course) then a bleak picture emerges of the developing education of primary mathematics teachers.

4.8 Of the 739 teachers who completed the LSQ, 683 (92%) were full-time teachers, 9 (1%) were not teaching, 12 (2%) were part-time teachers, 9 (1%) were supply teachers with a permanent contract, 14 (2%) were temporary supply teachers, and 12 (2%) teachers gave other information or did not respond to the question.

Diploma Students' Schools

4.9 Teachers stated (LSQ) the type of school in which they teach:

	Frequency	
Nursery	4	1%)
Infant	47	(6%)
First	78	(11%)
Junior	168	(23%)
Infant + Junior	224	(30%)
Middle	101	(14%)
First + Middle	19	(3%)
Secondary	60	(8%)
Special Schools	12	(2%)
Preparatory Schools	5	(1%)
Observation/Assessment centres	2	(<1%)
Permanent supply teachers	2	(<1%)
College of Further Education	2	(<1%)
Education lecturer in an Institute of Higher Education	1	(<1%)
No response	14	(2%)
Total	739	(100%)

4.10 The population of teachers answering the LSQ who teach in infant, junior, first, middle, infant and junior or first and middle schools was compared with the total population of teachers in those schools:-

	Infant	First	Junior	Middle	Infant+Junior and First+Middle	Total
Diploma Students (LSQ)	47 7%	78 12%	168 26%	101 16%	243 38%	637 100%
All Teachers (S.E.T.pp.29, 31)	33144 16%	22401 11%	46371 22%	22716 11%	83748 40%	2089390 100%

A χ^2 test was used to determine whether the Diploma students are a representative sample of teachers from the types of school mentioned. The result was significant at a <0.1% level. There are fewer infant school teachers and more middle school teachers in the sample of Diploma students than would be expected if the sample were selected at random.

4.11 Teachers were asked to state (LSQ) the age groups of children they were currently teaching (Note: many teachers, especially those teaching the older children, taught more than one year group):-

Age of children taught	Number of teachers	% of population
Less than 5	53	7%
5-6	118	16%
6-7	136	18%
7-8	175	24%
8-9	192	26%
9-10	234	32%
10-11	241	33%
11-12	130	18%
12-13	91	12%
13 and over	65	9%

4.12 The combined evidence of sections 4.9 and 4.10 suggests that fewer teachers of children aged 5-7 than would be expected from a consideration of the proportion of teachers in different types of school are taking or have taken Diploma courses.

4.13 The other speculative hypothesis of section 4.2 suggested that women teachers may find it more difficult (perhaps because of family and domestic commitments) to find the time for the Diploma course.

If the proportion of women and men junior school teachers who answered the LSQ is compared with the proportion of women and men in the population of all junior school teachers (S.E.T.,p.29) then the following table is obtained:-

The pagination jumps from 71 to 74 but no content is missing.

	Women	Men	Total
Diploma students who teach in a junior school	82 49%	86 51%	168 100%
All junior school teachers	29971 65%	16399 35%	46371 100%

The proportion of women students is less than (significance <0.1%) would be expected in a random sample of junior school teachers.

The picture for middle schools is more complex. The proportion of women teachers in middle schools who are Diploma students is 52%, the proportion of women teachers in middle schools (deemed primary) is 64% and the proportion of women teachers in middle schools (deemed secondary) is 53%.

4.14 Teachers were asked (LSQ) to classify the catchment area of their schools as "inner city", "rural" or "other urban" as defined in the P.S. (see section 4.1). No response was obtained from 21 teachers (3%).

	Catchment area of school			
	Inner City	Rural	Other Urban	Total
Diploma students (LSQ)	107 15%	213 30%	398 55%	718 100%
% quoted in P.S.	17%	39%	45%	100%

4.15 Details of the number of children in Diploma students' schools (LSQ) are given in Appendix 1.

In 34 of the schools visited, it was possible to compare the numbers of children attending in 1981 and in 1982. Two schools were newly built and expanding in numbers and their numbers of children had increased by the equivalent of more than two classes (assumed to be 30 children). Twenty-two schools had minor fluctuations in numbers; an increase or decrease of less than one class. Some headteachers were facing problems of organisation of the staff and schools that were caused by decreasing numbers of children on the roll.

One school had a decrease equivalent to more than four classes, two schools had a decrease equivalent to between 2 and 3 classes and seven schools had a decrease equivalent to between 1 and 2 classes. A few headteachers were clearly very worried and anxious.

4.16 The status of Diploma students' jobs in school was recorded on the registration form as:-

Status (RF)	Frequency
Scale 1	1023 (49%)
Scale 2 or above (not Maths)	578 (27%)
Scale 2 or above (Maths)	226 (11%)
Deputy head	173 (8%)
Head	90 (4%)
Other (e.g. college lecturer	5 (<1%)
Missing data	13 (1%)
Total	2108 (100%)

The table indicates that approximately 50% of the teachers had scale 1 status when they started on the Diploma course.

However the large sample questionnaire gives in response to "When you started the Diploma course what scale of post were you on?":-

Status (LSQ)	Frequency
Scale 1	197 (27%)
Scale 2	339 (46%)
Scale 3 or above	94 (13%)
Deputy head	58 (8%)
Head	36 (5%)
Missing data	15 (2%)
Total	739 (100%)

This table indicates that less than 30% of the population of teachers had initial status of scale 1. This is a significant discrepancy. It is unlikely that from a population of approximately 2000 teachers, half of whom had scale 1 posts, a random sample of size 739 could be chosen with only 27% having scale 1 posts.

The data has been checked carefully; it does represent accurately what is written on the registration forms and on the questionnaire.

The teachers completed both documents and there seems to be no reason why they should report their status differently. A probable explanation of the discrepancy is that some scale 2 teachers may have put "Assistant Teacher" or "Teacher" on the registration form which was coded as scale 1. The information from the questionnaire has been adopted as being more likely to be reliable.

4.17

	Scale 1	Scale 2	Scale 3 or above	Deputy head teacher	Head teacher	Total
Diploma students	197 27%	339 47%	94 13%	58 8%	36 5%	724 100%
Teachers in primary + middle (deemed secondary schools, S.E.T., pp.29,31	68421 32%	81437 38%	17534 8%	20524 10%	24323 11%	212239 100%

Direct comparison between these two sets of figures is impossible for the proportions of women teachers and of infant school teachers is significantly different in the populations of Diploma students and of all primary teachers.

4.18 158 (21%) teachers reported that their status in school had changed since starting the Diploma course and 157 of these gave details of the change:-

Change in Status

		to					
		Scale 1	Scale 2	Scale 3 or above	Deputy head teacher	Head teacher	Other
from	Scale 1		52	1			
	Scale 2	1		38	22	2	13
	Scale 3 or above			1	8	4	4
	Deputy head					6	1
	Head					4	0

Approximately 20% of Diploma students are gaining promotion or greater recognised responsibility for mathematics in their schools.

Of the Diploma students who appear in the "other" column, the person promoted from deputy headteacher is now in charge of the infant department in a 5-11 school, the four teachers who formerly held scale 3 posts now have scale 3 posts for mathematics, and 5 of the 13 scale 2 teachers now have scale 2 posts of responsibility for mathematics.

4.19 Diploma students were asked (LSQ) about their teaching of mathematics and the organisation for mathematics in their schools (see Appendix 1.)

Obviously the organisation for mathematics depends on the size of the school and the age range of children in it. Nevertheless there are some fairly accessible points of comparison with the Primary Survey (P.S.)

78% of teachers (LSQ) reported that their schools have written guidelines or a scheme of work for mathematics (P.S.p.40 quoted 88%).

62% of teachers (LSQ) reported that their schools have a mathematics specialist or consultant (P.S.p.39 reported that 31% of one form entry schools, 49% of two form entry schools and 65% of three form entry or larger schools had a teacher with special responsibility for mathematics).

38% of teachers (LSQ) reported that they were the mathematics specialist or consultant for their school

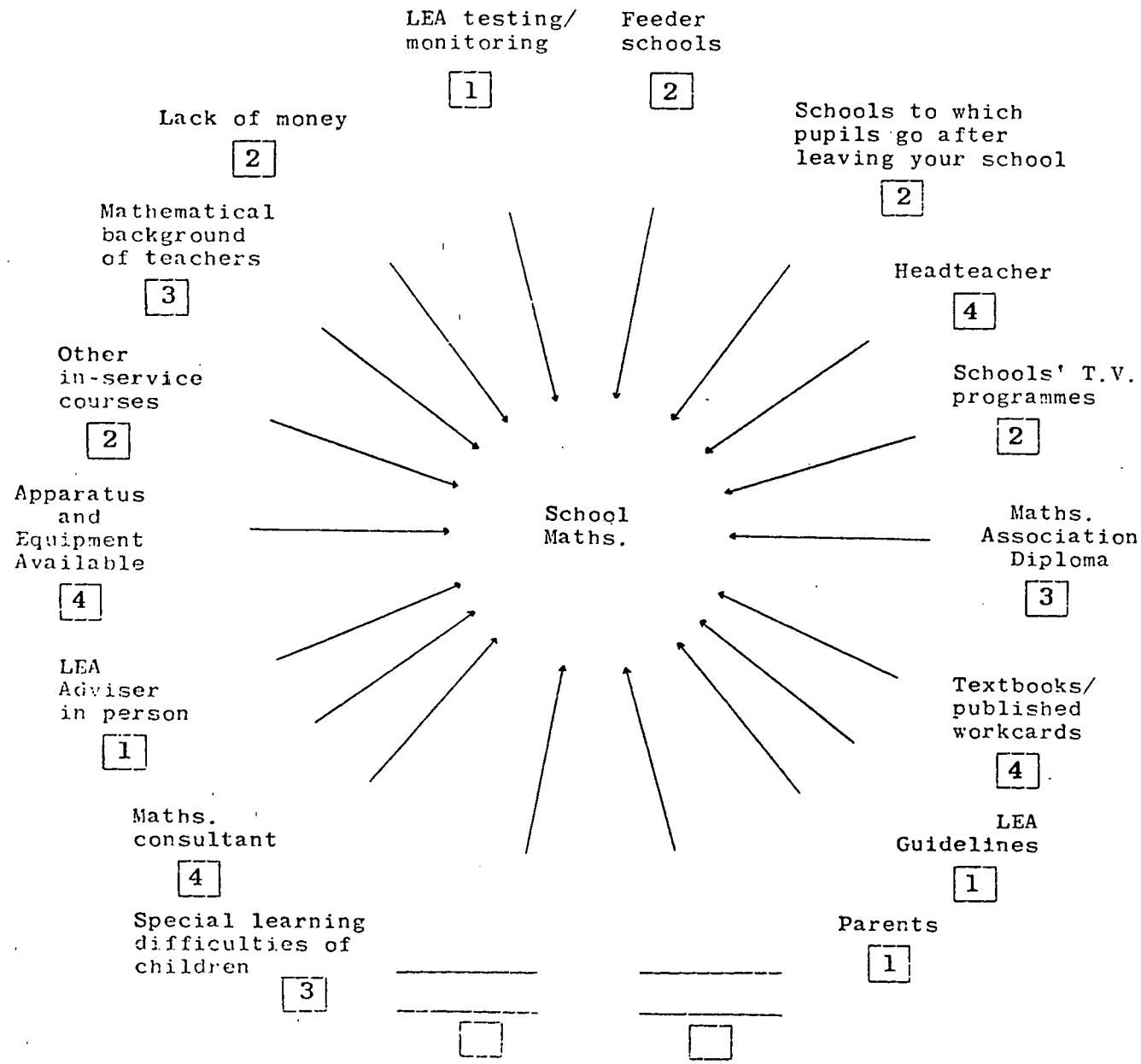
4.20 In 1981 teachers and their headteachers in the small sample were asked to complete a diagram which gives a picture of the strengths of various pressures which may bear on the school mathematics curriculum (see Appendix 3.)

Seventy-one diagrams were completed and the median scores for each of the pressures are entered in the diagram opposite. Only 30 responses were entered for "Feeder Schools" as many of the schools visited had five year old (or younger) children as pupils.

4.21 It was possible to examine 29 matched pairs of diagrams i.e. for a Diploma student who was a classroom teacher and his or her headteacher.

A <u>discrepancy</u> is defined to occur when the difference between the score of the teacher and the headteacher for a particular item is 2 or greater.

Median ratings given by 71 teachers and headteachers of the influences on the school mathematics



1 No effect or influence whatsoever

2 A limited influence on a few teachers

3 A limited influence on most teachers

OR

A significant influence on a few teachers

4 Influences the mathematics in the whole school

5 Is a dominant influence on the mathematics in the whole school

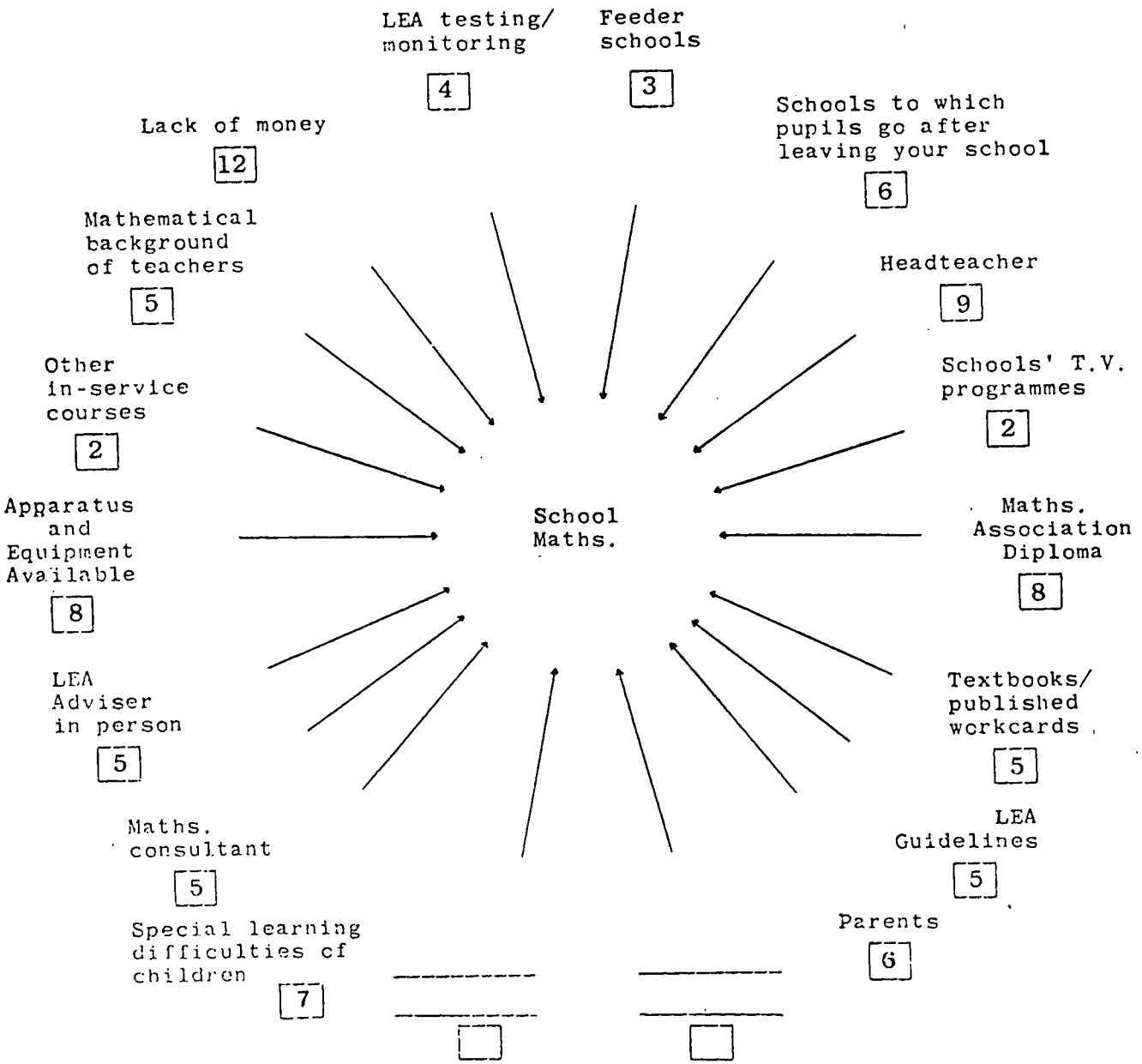
Number of discrepancies (total possible is 16)	Frequency
0	2
1	5
2	5
3	4
4	5
5	4
6	3
7	1
	29

The Diploma student who records 7 discrepancies has a mathematics degree and is doing first rate work in organising the school mathematics and increasing the confidence of her colleagues. Her headteacher seems to have delegated the task of the organisation of mathematics almost completely. On the first visit he explained at length that he had recently been appointed and consequently it would be a waste of time talking to him. He was not a mathematician and the time would be more profitably spent talking to the teacher who was the Diploma student. In any case her philosophy on mathematics was the same as his!

4.22 The diagram on p80 shows the number of discrepancies from 29 pairs of responses for each item.

Headteachers gave greater stress than the teachers to the importance of headteachers, the LEA adviser, LEA guidelines and the mathematics consultant. Teachers gave greater stress to the influence of textbooks or published workcards.

Number of discrepancies from 29 matched pairs



CHAPTER 5

ORGANISATION AND PROVISION FOR DIPLOMA COURSES

5.1 The environment in which a Diploma course takes place and the organisation needed to provide the course are far from being incidental considerations. Indeed good organisation and provision is a necessary, though not sufficient, criterion for a successful course.

Teaching rooms

5.2 The Diploma course at the twenty centres visited was nearly always taught in specialist mathematics rooms. There was easy access to appropriate equipment and materials for primary school mathematics.

Some tutors had used the available display space imaginatively to show examples of children's work, examples of work done by teachers on the course, new books or series of books of interest and relevance to teachers of mathematics in primary schools, examples of commercially available posters and photographs or diagrams and charts providing challenging starting points for mathematics.

At other centres the opportunities were not so well used.

Day of the week

5.3 College tutors reported (CQ) in 1980 and again in 1981 that no Diploma course was taught on a Friday. Thursday seems a slightly more popular choice than the other remaining weekdays.

	1980	1981
Monday	17 (23%)	13 (19%)
Tuesday	17 (23%)	18 (26%)
Wednesday	17 (23%)	16 (23%)
Thursday	23 (31%)	22 (32%)
Friday	0 (0%)	0 (0%)
Total number of courses reported	73 courses (1 course met on 2 days per week)	64 courses (5 courses met on 2 days per week)

Starting time

5.4 The starting times for currently running courses were reported by tutors (CQ) in 1980 and again in 1981.

Frequency of starting times of Diploma courses

Starting time	1980	1981
9 a.m. - before 10 a.m.	5 (7%)	3 (5%)
1 p.m. - before 2 p.m.	4 (5%)	2 (3%)
2 p.m. - before 3 p.m.	7 (10%)	6 (9%)
3 p.m. - before 4 p.m.	2 (3%)	3 (5%)
4 p.m. - before 5 p.m.	14 (19%)	12 (19%)
5 p.m. - before 6 p.m.	21 (29%)	24 (38%)
6 p.m. - before 7 p.m.	20 (27%)	14 (22%)
7 p.m. or after	0 (0%)	0 (0%)
Total number of courses reported	73 (100%)	64 (100%)

The majority of courses (75% of those currently running in 1980 and 79% of those running in 1981) take place entirely in the teachers' own time. Some allow the teachers sufficient time to return home after school to have something to eat; other courses start earlier and consequently finish earlier.

Types of course

5.5 The regulations for the Diploma specify that courses should have a minimum of 200 hours contact time. Four main types of course have been devised:-

Evening course, one evening per week for six terms with occasional whole day special meetings. A typical arrangement would be to start at 4.45p.m., have a 15 minutes coffee break at 6.15p.m., and to finish at 8.00p.m.

Afternoon course, similar to an evening course but with half-day release from school.

Day course, requiring day release from school, starting for example at 9.00a.m., finishing at 4.00p.m., and having a 15 minute coffee break and an hour long lunch break. This variant is sometimes used by LEAs who wish to use the course for teachers who are, or are in a position to be mathematics leaders in their schools.

One term full-time, plus two or three terms of part-time evening study.

The frequencies of the different types of course that centres have run so far (the information for 1981-82 is incomplete) is shown in the table below:

Frequencies of the different types of course
(Source CQ, AG)

Type of course	Frequency	
Evening course	109	(73%)
Evening course starting at e.g. 3.15p.m. and so requiring teachers to be released early from school	3	(2%)
Afternoon course	20	(13%)
Day course (for 2 years)	4	(3%)
Day course (for 1 year) + 2 or 3 terms part-time evening study	5	(3%)
One term full-time + further part-time evening study	6	(4%)
One year full-time	2	(1%)
Total	149	(100%)

Since Diploma courses first started 73% have taken place entirely within the teachers' own time, 26% partly in school time and partly in the teachers' own time and 1% entirely within school time (although the teachers still have all the assignment work to do in their own time).

Additional day meeting for evening courses

5.6 Evening courses are normally supplemented by one or two full day meetings per year. These may take place at a weekend or during a school holiday. They provide a good opportunity to look at the use of calculators or microcomputers in school, to spend time initiating the Investigation or the Special Study, to visit a school (which has a different half-term holiday) or to spend time doing mathematics in a workshop session.

The advantages of day courses apply; the teachers and tutors have more time for tutorials and they work when they are less tired and more relaxed. Some tutors adopt a policy of having a day (or weekend) meeting early in the course so that the teachers get to know each other and form a good working relationship.

Day and half-day release courses

5.7 A group of teachers attending a day course talked during a coffee break about the advantages of that form of the course over an evening course. They were full of admiration for teachers who managed to cope with the work and pressures of the course after school. ("I don't think I could manage it and survive.")

They thought that in a day course there was:-

more time for lectures, discussions and workshops
more time for tutorials
more opportunity to talk to tutors informally
and more time to talk to the other teachers

and it was:-

more relaxed
more enjoyable
and more fun.

From the tutors' point of view the students were certainly less tired and more much receptive to new ideas and approaches.

5.8 Tutors who have the experience of teaching both evening courses and courses requiring day or half-day release were asked for their comments.

Not surprisingly, they are strongly appreciative of the benefits of day and half-day release courses. Their reasons can easily be summarised under the following headings:-

(i) There is less pressure on the students

> "There is no doubt in our minds that teachers are fresher when they can start immediately after lunch than when they attend at 6.00p.m. after a full school day. The effect on the rest of the week, too, can be considerable when, after a course ending at 9.15, a teacher has an hour's drive home, school the following morning and a couple of evenings' follow-up work to do in addition to any school work which he must do (plus household chores in some cases!)"

> "Half-day release is what it says - release from normal teaching time to give their energies to the course. Evening courses are always in addition to teaching which puts added pressure on the student."

(ii) Tutors, too, are less tired than in the evening

> "Again tutors are fresher and relaxed in the afternoons though I'm not sure that the teachers' employers are interested in that."

(iii) Tutorials are easier to arrange in a day or afternoon course

> "The chance of a teacher staying for tutorial advice at 9.15p.m. is much less than at 5.15p.m. and to say that he should therefore arrive early and seek advice before the session is more easily said than done."

(iv) College resources

> College resources and facilities may be less good in the evening than during the day; in particular the library may well be closed at the time when the evening course ends.

(v) Recognition of the value of the course by the school and the LEA

> Day or half day release indicates that the LEA recognises and can help the school to realise the value of the course.

"Half-day release is an indication that either the school or the LEA or both are giving overt support and recognition to the course and this is valuable to the student."

"The schools perforce noted the attendance of students so the effect on the school was more marked and consequently the course was more influential on the work of the school."

A tutor summarised the argument:-

"There is no doubt that although afternoon release is costly the benefit to the teachers is considerable and since they are more receptive to new ideas and the better able to cope with the course, the authority must gain, too, in the end. On a purely selfish note the authority must realise that for every hour that they 'give' to the teachers, the teachers give at least one, and on average I would think two, of their own."

5.9 All headteachers of teachers in the small sample who attended day release of half-day release courses were asked if there had been any problems in connection with the provision of supply cover. Apart from one school in which no supply cover was provided (the teacher's class was either taken by the headmaster or split up between two other classes), they all reported that the quality of the teacher appointed as a supply teacher had been good and that the children had not suffered as a result.

5.10 There have been isolated difficulties associated with the arrangements in schools so that a teacher can be a member of a Diploma course requiring release from school.

(a) One LEA provided supply cover for the first year of an afternoon course and then, presumably for financial reasons, reversed the decision and withdrew it for the second year of the course (reported by the tutors and students at a centre visited).

(b) A teacher who has a scale 1 post in a 5-11 school reported on the effectiveness of the supply cover in her school:-

"Half day release from school put a strain on me as I had to leave prepared work for the children to undertake. Then, I was presented with its marking the following day!"

(c) The difficulties of making arrangements in school for a course that starts at 3.00p.m. are reported by a woman teacher who has a scale 1 post in a small 5-11 school (LSQ):-

> "I would have preferred the course to take place completely in our own time. We only missed one hour of school, but it relied on good will of colleagues which is very difficult if other staff were absent. It will be even more difficult in the future with cuts in staffing in school."

Starting times of and journeys to courses

5.11 The starting times of courses (section 5.4) indicate that students are often travelling to courses at times when the traffic is likely to be dense.

A majority (90% LSQ) normally make the journey by car and their travelling times are:-

Time	Frequency	
Less than 10 mins.	75	(10%)
10 mins. to less than 20 mins.	177	(24%)
20 mins. to less than 40 mins.	322	(44%)
40 mins. to less than 80 mins.	137	(19%)
80 mins. or more	21	(3%)
No response	7	(1%)

The commitment of the teachers needs underlining; 44% make a journey of approximately half an hour and 21% are prepared to travel for approximately an hour to attend courses.

Arrangements at home

5.12 Over a third of the students (170, 38%, LSQ) reported that they had to make special arrangements at home as a result of doing the Diploma course.

Teachers classifying themselves as	Special arrangements at home		Total
	YES	NO	
Mr.	86 30%	199 70%	285 100%
Mrs.	179 48%	192 52%	371 100%
Miss	5 8%	57 92%	62 100%
Total	270 38%	448 62%	718 100%

When teachers were asked for further details of the arrangements, 13% mentioned their spouse alone, 31% mentioned children alone, 34% mentioned both spouse and children and 22% gave other reasons.

Some of the recurring themes in the responses were:

(i) that husbands and wives cover for each other with transport, care of children, meals, housework etc.

(ii) that evening meal arrangements on the day of the course are modified,

(iii) that either paid babysitters or friends, neighbours or relatives look after young children,

(iv) that arrangements for doing assignment work at home (a quiet room and a quiet time) are made,

(v) that other members of the family organise the feeding and exercise of animals (e.g. "My husband now has to take the dog for a walk. The exercise will do him good.")

5.13 Students were given the opportunity at the end of the LSQ to make any further comment about the course. 12% spontaneously made comments to the effect that the workload of the diploma course is substantial on top of school, home and family commitments.

A married woman teacher, aged 25-29, having no children, who has a scale 2 post in a 5-11 school and who gained a distinction on the Diploma course, commented:-

> "The biggest problem I found was finding time to complete all of the work on time, teach full-time and run a home. I was continually torn between neglecting my home, spending less time on lesson preparations or not doing all of the homework that I felt I needed for the course.

The day on which the course was held was also very exhausting. After teaching all day, I then had to leave school by 3.45 to reach the centre in time for the course, spend 3 hrs. with a short break studying and then get home again. There was not time for me to get food between leaving school and starting the course, so I had to go without until 8.30p.m. or 9.00p.m.

Either a less demanding course or some release arrangements from work would have helped on a course of this length. Coping for 2 years is more difficult than just for a few weeks."

5.14 Teachers in the small sample talked about the pressure associated with the course. Eleven of them estimated the time required for study and background reading in addition to attending the course at the centre. Generally it amounted to the equivalent of an evening per week, or half a day per week ("most Sunday afternoons in front of the fire with a load of books and paper and the air thick with expletives" - a second year student), with additional work in the school holiday. One teacher reported that she thought there was "as much work as an Open University degree".

A further 17 teachers gave details of the difficulties they experienced, e.g.

(a) "I take the boy to flute and cook the tea so that when I've collected him from flute we can eat straight away. Then I just have time to do a packed lunch for tomorrow for everybody and partly wash up because my husband has not eaten yet. Then he gets home and eats and then takes the boys to swimming. I get home at quarter to ten-ish, by which time they are in bed. So it's a pretty tight schedule."

(b) "A neighbour looks after the children for half an hour until my husband comes home from work and he gets tea."

(c) "I'm in my second year, I'm finishing my next to last piece of work at the moment. My wife's pregnant and the baby's due within the next few days and I'm spending every waking minute working on this piece of work. By the time I've packed the kids off to bed it's 9 o'clock, and then I'm up till 12 o'clock ploughing through this last piece of work. You have to be really sold on it and get sufficient enthusiasm from somewhere."

(d) "Don't get heavily committed with anything else other than the Maths Diploma, because I play badminton, squash and hockey and I had to drop most of the sport. Don't try

coming to the centre by bus because it will take you an hour and a half after teaching all day. Watch the pressures on you.

I don't have children and my husband is very good at looking after himself. He will cook."

There were nine teachers for whom the pressure of work and lack of time did not seem to be too great. Of these, one attended a one year full-time course, two attended day courses, two attended afternoon courses, one was a part-time teacher and three were single teachers who did not seem to have substantial commitments, e.g.

(e) "I don't find any particular difficulty. I think the day release helps an awful lot. If I was doing it in the evenings, it would be tough because you are tired at the end of a day; you have your preparation and marking to do as well.

The only thing about day release is that it puts pressure on other days of the week. You have got that much more to put into the four days even though there is a supply. You have not got that day to do any of the organisation things you would otherwise do.

The arrangements with the supply teacher are working very well. I've been lucky knowing the teacher before."

(f) "There is one teacher on the course who does not teach at all and the rest teach full-time and they are having a struggle. It's those teachers who haven't handed in their investigations and are behind with their essays. It is a struggle and some have said if they had known how much work it was going to be they would not have done it.

I've been very fortunate though in being part-time. I've had plenty of time to do the work but I think you just have got to keep up to date. You have got to put time aside. Once you fall behind, you are lost."

One teacher considered that teaching was much more than a 9-4 job; another was quite happy to spend his spare time thinking about mathematics teaching ("It continues to be a hobby with me ") Another teacher was prepared for a large amount of work ("We had a meeting before the course started, so I knew what I was letting myself in for.") and yet another thought that if the course was going to be worthwhile then "you have got to be prepared to put yourself out."

Advertising of courses by the centres

5.15 Centres normally advertise courses by sending a circular to local schools and teachers' centres, mentioning details of the course in the LEA circulars, by word of mouth from the mathematics adviser or from teachers who had previously attended the course or, most commonly, by several of these means. Only about 30% (CQ) of centres advertise the course in the local press.

One teacher (CV) pointed out that she had had difficulty in finding information about the course; she taught in an independent school.

Selection of students

5.16 Tutors were asked (CQ) how they checked prospective students' suitability for the course. There were 421 responses, 3 centres (7%) did not feel a check was necessary; the remainder used one or more of the following means:- 31 (76% of the total) held interviews, 14 (34%) held a preliminary meeting for all their would-be students and 6 (15%) used other means (e.g. asking for a reference).

The 31 centres who interviewed prospective students gave information about interviewers. At 7 centres (23%) one tutor (often the course leader), at 19 centres (61%) two (or sometimes three) of the tutors, at one centre (3%) tutors and the college director of in-service education and at 4 centres (13%) tutors and the mathematics adviser conducted the interviews.

Obviously when the course involves day or half-day release from school, the Diploma course becomes much more expensive for the local authority and so a mathematics adviser may be interested in the selection process to ensure that the needs of the schools as well as the needs and backgrounds of the individual teachers are considered.

One centre left the selection of students for the first run of an afternoon course to the local adviser. Of the 17 students selected, 6 withdrew and 4 others have not completed the course. Selection for subsequent courses is being left to the tutors.

Information about the number of prospective students dropping out at the preliminary selection stage was given by 27 centres.

No. of teachers deciding not to take the course	Frequency		
0	10	37%	
1-5	11	(41%)	
6-10	3	(11%)	(one of these courses
11-20	2	(7%)	(is whole day release
more than 20	1	(4%)	

Course fees

5.17 The Mathematical Association charges students a fee (in 1981 £30 + VAT) for the Diploma course. In addition the centre charges an annual fee (median fee is between £30 and £40) and the student will have to finance his travelling to and from the centre and buy books for the course.

Financial support for students

5.18 The Diploma course is included in those in-service courses which are either full-time and last for more than four weeks or are part-time and last for at least sixty hours. In recognition of this, and because the courses are usually provided at establishments of further education, most if not all the existing courses are listed in the DES handbook 'Long Courses for Teachers'. Under administrative and financial arrangements in force[1] in 1981, a proportion of the

1 In-Service Courses for Teachers: Financial and Administrative Arrangements, DES Administrative Memorandum 26/70.

salary of a teacher attending such a listed course full-time and the whole of the tuition fees and travelling expenses incurred through attending a listed course full-time or part-time, are recoverable by the teacher's employing authority from the "pool" - provided of course, that the teacher is a serving teacher.

5.19 Local authority advisers were asked (AQ) how much financial support students receive from the LEA towards the course.

Financial support given to students by the LEA as reported by advisers

	All	Some	None	Number of Advisers replying
Mathematical Association fee	33 47%	22 31%	15 21%	70 100%
College/Institute/ Polytechnic fee	38 53%	22 31%	12 17%	72 100%
Travelling expenses*	30 39%	36 47%	10 13%	76 100%
Residential weekends	1			1
Supply cover	2			2

(*Since most teachers travel to the centre by car, public transport rates for travelling expenses were classified as "some".)

Of the 87 advisers replying, 60 thought the provision was not likely to change in the near future, 4 thought it would become worse, 2 thought that it would improve, 8 reported the position unclear and 13 made no response.

An adviser in a large city reported that the provision for students receiving travelling expenses was "not applicable since the centre lies just over the (LEA) border".

5.20 Students were asked about the level of LEA financial support (LSQ).

Financial support given to students by the LEA as reported by students (LSQ)

	All	Some	None	Total replying
Mathematical Association fee	445 64%	94 14%	159 23%	698 100%
College/Institute/ Polytechnic fee	428 62%	112 16%	147 21%	687 100%
Travelling expenses*	309 45%	201 29%	183 26%	693 100%
Residential weekends	8 1%	12 2%	660 97%	680 100%

(*Other expenses included fees for residential weekends, and allowances towards meals on a day course).

Note There is bound to be some discrepancy between this table and the one quoted in section 5.18 since not all LEAs have equal numbers of teachers attending Diploma courses.

75% of students thought the financial provision adequate, 17% thought it inadequate. (8% did not reply).

Difficulties can occur where:-

(a) a supply teacher rather than a full-timne teacher takes the course.

(b) a student chooses (say for convenience to minimise the journey home after the course) to take the Diploma course at a centre outside the LEA in which they are employed in preference to a centre within the LEA;

(c) the students pay the fees in October and the LEA does not reimburse them until the following July.

The commitment of many students is indicated when they say that they are satisfied with other than full repayment of expenses. Teachers go on the courses voluntarily but one wonders in what other jobs people make a financial contribution to their in-service training.

LEA involvement in courses

5.21 Both tutors (CQ) and mathematics advisers (AQ) were asked about involvement in Diploma courses.

Advisers do valuable work in generally making teachers aware of courses and encouraging suitable teachers to attend and most

"The successful teachers are being asked to help with the LEA's more general in-service programme. The maths advisers are attempting to monitor the work of the teachers in its effects on schools. With 180 middle schools this is an enormous task."

Outposts

5.22 Of the twenty courses that were visited, three had current courses that were taught at outposts, one had previous experience of teaching the course at an outpost, two taught the course on different sites and one taught the course only at a teachers' centre. It is important that the provision of resources for and the organisation of such courses should be comparable with that provided at centres which are established teacher training establishments.

In practice there may be difficulties with:-

(i) ensuring comparable library facilities;

(ii) providing sufficient mathematical apparatus for the group of teachers to use;

(iii) payment of tutors' travelling expenses and travelling time;

(iv) having more than one tutor to take a three hour session

(v) organising tutorial time.

Tutors at two centres in rural areas talked about how they attempt to deal with these difficulties.

(i) Library facilities. One outpost had been stocked with books from the library of a College of Education that had been closed, and the LEA provided funds for up-to-date series of textbooks and other materials. At another the LEA had provided books of a more practical nature specifically for the course (which could remain at the teachers' centre after the course was complete) and the college provided the background education and mathematics books.

(ii) Mathematical apparatus. Although the teachers' centres that were visited were well equipped (overhead projectors and other common audio-visual aids were available), quantity and variety of materials for mathematics varied. Tutors reported that they took "a bootful in the car" when necessary and that "if there is anything you

need there is someone at hand down there and they are very helpful and friendly."

(iii) Travelling. Tutors in general reported travelling times of around an hour to outposts and adequate travelling expenses, but at only one centre (CQ) was there an agreement that the travelling time of tutors be partially included in their timetabled teaching load.

(iv) Number of tutors taking a 3-hour session. At one centre two tutors travelled independently to the nearer outpost and each taught half the session; they travelled together to a more distant outpost and again shared the teaching. At another centre the tutor reported "With a course at the college we would split the evening. That seems to me, from the point of view of teaching the course, the best arrangement. At (the outpost) one of us was teaching the whole time and that, with seeing to students for tutorial work and all the travelling on top, is a positive disadvantage. That happened in the second part of last term when we taught from 2p.m. to 5p.m. For the first part of last term the sessions were from 2p.m. to 7p.m. and then we did have to split them."

(v) Organisation of tutorials. Generally tutorials are organised before or after the session or during the coffee break. A tutor and a moderator (from different centres) described the difficulties:-

> "I think you need to realise that it is a rural area. It is not just the staff who travel a long way to courses; it is the students too. You just have to do tutorials within sessions. It means that the students have to fit in the tutorial time as best as possible."
>
> The location of the courses seems to pose no particular problem, though obviously that at (the most distant out-post) imposes more strain on the teaching staff. Only in the matter of tutorial contact..... does there seem to be a problem, for even if the staff could arrive early or leave late, it appeared that the students did not find it easy to extend the three hour duration of their attendance."

Day meetings and weekend meetings that are held at the centre are especially valuable to complement the provision for Diploma courses since they give another opportunity for tutorials or seeking books or meeting fellow students.

5.23 Tutors reported that members of the Diploma Board had taken great care to examine the availabiity of resources at outposts in their visits to consider the licensing of courses.

Nevertheless in view of the Cockcroft Committee's recommendation that ".... energetic efforts should be made to explore ways in which diploma courses can be made available in areas which are remote from training institutions", there may be difficult instances where the need for the course in the locality has to be balanced against the standard of provision that can be made.

Monitoring of resources for Diploma courses

5.24 It is important that Diploma Board members continue to monitor the provision of resources for their local courses. Closing a library or snack bar half an hour erlier may be an effective way of saving money but it can reduce the effectiveness of an evening Diploma course.

Pressures on tutor

5.25 Tutors at many centres were setting up and organising Diploma courses against an unsettled background of cutbacks in initial training courses for teachers or of mergers of colleges into large institutions.

One tutor has described how a reorganisation affects the progress of a Diploma course. He defines three stages:-

"Stage 1

> The preliminary discussion, rumour, visitation stage where there is nothing positive (about reorganisation) stated but views are sounded and it is clear that something is in the wind.
>
> This stage can be psychologically draining both on tutor and student raising doubts in both about future continuity and resources, though physically both must continue as normal. Inevitably it affects recruitment in the doubtful area.

Stage 2

> The decision and transition stage when courses have to run out in one institution and be reestablished in another. This inevitably stretches resources for they must be maintained in the one in fairness to existing students and at the same time reorganised or built up in the other. Distribution of available finance can cause problems, all the time ensuring the continuity of coures structure during transfer of administrative authority.
>
> This stage is physically very demanding on tutors who must maintain standards in both new and old institutions while coping with changing administrative methods along with the extra administration involved in the transfer. It must be said that everyone concerned endeavours to ease this task but it is nevertheless there.

Stage 3

> Consolidation of the new stage. At least the future should be clear, but building a tradition for a particular course is never easy if it did not exist before. Again this is physically demanding but if the future is ensured it can be rewarding."

He comments "However in the present unsettled climate one could easily find oneself back in Stage 1 before Stage 3 begins." He has done so twice.

He recommends "When decisions (about reorganisation) are made they should be made with determination for a workable future and not for temporary alleviation of a particular problem."

The future of Diploma courses

5.26 There are five centres who have run Diploma courses who by 1982 have ceased to do so. Two centres have closed, one has insufficient suitable staff remaining, one has merged with a university and now offers an in-service BEd in the area of mathematics and science for teachers in primary and middle schools, and one has given no information.

Tutors have reported difficulties with operating the Diploma at two centres:-

(a) (an independent college)

"The college is under great pressure to increase its staff-student ratio. However under present regulations In-Service work is given such low ratios in the national guidelines that we have to seriously consider our position - especially as one member of staff is to retire."

(b) (a polytechnic)

"Briefly, the decision not to start the Diploma course this September (1981) was taken because of the Staff shortage in Mathematical Education.

Although we could possibly have run the course for 1981/82, our staffing position for 1982/83, when our new CNAA BEd enters its third year and therefore puts increasing strain on our Maths Ed. staffing, is such that our commitments are far in excess of the 3½ staff teaching time which we have available, despite the fact that we have already stopped all of the short in-service courses in Maths Ed. which we have run in the past few years.

The in-service BEd was itself a casualty last January. We ran a 3rd year Maths Ed. option for this degree in 1980, but were unable to find time in 1981. That degree will survive without us, but other courses would collapse if the Maths Ed. element were withdrawn. Thus, it is not a question of higher-level work, but of choosing priorities according to other criteria - mainly survival."

In the summer of 1982 many tutors reported at the regional meetings that they were concerned about the future of the Diploma course.They felt that the funding arrangements published early in 1982 would mean that, making assumptions of

(i) a staff student ratio of 10.9 full time equivalent students,

and (ii) a notional teaching load of 15 hours per week,

a Diploma course would need a minimum of approximately twenty students to be economic in its own right. If the teaching group for the Diploma course were less than the required minimum then it would have to be offset by larger teaching groups in other courses. The Diploma Board has insisted for educational reasons that twenty students is a maximum for a Diploma course.

In many institutions there may be a conflict between educational and economic priorities.

Many tutors fear that irreversible and irreparable damage mnay be done but it will take some time for the position to become clear.

The development of Diploma courses from 1982/1986 is described in paragraph 1.46.

The work of Diploma Board members

5.27 Members of the Diploma Board were asked to keep a log of their work (which is voluntary and unpaid) for one calendar year from 16th March 1981.

Normally a Board member will:-

(i) have a special responsibility for centres in his or her locality (maintaining a good contact with the tutors, moderators and students) and will visit centres with another Board member for the purpose of licensing or re-licensing (denoted by Visits in the table below);

(ii) attend Board meetings, regional meetings of tutors and moderators and the annual moderators' meeting (denoted by Meetings in the table);

(iii) deal with correspondence and other administration (denoted by Additional Work).

The table denotes the time spent by Board members. In total the Diploma Board spent in excess of 1700 hours and travelled in excess of 18000 miles in running the Diploma during the year.

Time spent by 12 out of the 14 current Diploma Board members in 1981-82 (to the nearest hour)

Visits	Meetings	Correspon-dence etc.	Additional Work	
34	104	16	40	Chairman
23	126	29	118	Secretary
20	66	11	11	Treasurer
70	92	18	17	Moderators' Secretary
36	68	23	—	(see case study below)
27	87	1	10	Checking registration forms
56	88	34	—	
38	92	18	—	
55	46	33	—	
29	45	15	—	
12	31	2	—	
19	50	25	—	

5.28 In order to see the details of the nature, timing and organisation of the work, the log of a Board member without additional responsibilities is quoted in full:-

(See table on following page)

5.29 One member of the Board, a teacher in a middle school, has in 1982 started to experience problems. He wrote to the Chairman of the Diploma Board:-

> "At the last Board meeting I gave warning that the time might come when our LEA would withdraw permission for a supply teacher to be called in when I am away from school on Board business. With the entire country facing sterner and sterner financial pressures we have now been informed that this situation has indeed arisen.
>
> In a school with 15 or so staff I could not contemplate making my colleagues responsible for covering my absences which are around 6-8 full days a year for Board meetings, regional meetings etc. (I try to arrange visitations etc. on occasions when I am not due to teach, but this isn't always possible, so the other staff do already have to cover a proportion of my time off.) There is the immediate consequence that I am unlikely to be able to attend both the Board meeting and the moderators' meeting next month and also I will not be able to take on the visitation."

Date	Time spent (hours)	Travelling Distance (if any)	Nature of Work (See Section 5.28)
10.4.81	0.5	-	Letter to Centre A and letter to moderator re. re-licensing.
11.4.81	1.0	-	Letters to Board members attending 1981 Conference to join mini-presentation of Diplomas.
14.4.81	2.0	-	Setting up and running sherry reception following mini-presentation of Diplomas at '81 Conference.
13.5.81	2.0	-	Drafting notice of regional meeting and addressing envelopes etc.
17/18.5.81	24.0	220 miles	Informal + formal Board meetings.
4/5.6.81	2.0	-	Drafting documents for regional meeting and addressing envelopes etc.
6.6.81	1.0	-	Letters to Centres A, B and C re. re-submissions.
11.6.81	6.0	-	Regional meeting - organiser + chairperson + discussion group leader.
12.6.81	0.25	-	Letter to Centre C re. re-licensing.
6.7.81	9.5	160 miles	Re-licensing visit to Centre D.
8.7.81	5.5	36 miles	Re-licensing visit to Centre C.
9.7.81	0.5	-	Report on visit to Centre C.
17.9.81	9.0	220 miles	Board meeting.
21.9.81	0.5	-	Letter to Centre C concerning award of 1-yr. licence.
23.9.81	0.5	-	Letters to Centre E and Centre F concerning resubmissions.
23.10.81	1.0	-	Reply to questionnaire on views of Diploma Board members about Diploma.
26.10.81	0.25	-	Letter to Centre A re. re-licensing.
3.11.81	9.0	90 miles	Re-licensing visit to Centre G and Centre H.
6/7.12.81	26.0	220 miles	Informal and formal Board meetings.
8.12.81	2.0	-	Letters re. re-licensing and visitations to Centres F, C and A.
17.12.81	0.25	-	Arranging visitation to Centre B.
4.2.82	3.5	12 miles	Visitation to Centre B.
	1.0	36 miles	Informal visit to Centre C.
25.1.82 to 10.2.82	1.0	-	Letters and phone calls arranging visitation to Centre A.
15.2.82	8.0	76 miles	Visitation to Centre A.
16.2.82	1.0	-	Draft report on visitation to Centre A.
3.3.82	9.0	220 miles	Diploma Board meeting.
4.3.82	1.0	-	Letters to Centres A and B re. new Licences.

Since then his LEA have agreed for the next year, at least, to be supportive of his work for the Diploma Board.

5.30 The Diploma Board were asked (BQ) how the work-load of Diploma Board members could be reduced. Some of their replies are quoted:-

> "The haggard faces of Diploma Board members derive not from their Diploma Board work but from other areas of their lives. Therefore we should find members who are warmly recommended but who are not already 'eminent', 'well known' and carrying heavy responsibility elsewhere. Such people will be rarer and rarer as cuts in higher education proceed. The Board itself is happy and well organised - it is nice to be dealing with work which is so specific and so worthwhile."
>
> "Typing my own letters/reports takes ages and getting it done in school is not always easy - it's often more trouble than it is worth. (Must not be a problem for some Board members.)
>
> Being in a rural area, distances to colleges are long - so visits to courses in the evening are very tiring (200+ mile drives!). As a result I have not felt able to do more than one visit to each set of students in my colleges (most colleges are running 2 concurrent courses) as well as official visitations etc.
>
> Time off school - my colleagues cover, but it is extra to leave work and then mark it - even though I manipulate it so that I only have to mark 50% or less of what I leave.
>
> Board members closer to colleges - O.K. - larger Board, more expensive Board meetings, cheaper college visits - more people on Board hence more diffuse ideas, people known less well - but more people involved - has something to recommend it. We need more teachers not fewer."
>
> "..... with a voluntary organisation it will have to be run in this way with tight business meetings but other things being done as and when members can fit them in."
>
> "Not easy to see a solution unless we switch to an examination set nationally! (I would also like to think that there is a wider benefit from the large input of man-hours in terms of quality, satisfaction by Board members etc.)"
>
> "Not easily since most of us are not directly involved in teaching or managing particular courses we need to gather experience and real knowledge."

CHAPTER 6

THE TEACHING AND LEARNING AT DIPLOMA COURSES

Qualifications of tutors

6.1 The questionnaire to centres in 1981 asked the names of tutors currently teaching on the Diploma course. The information for the eight centres who did not reply to the questionnaire was gained from their response in the 1980 questionnaire or from the college submission.

The qualifications and school teaching experience of 171 tutors currently teaching on Diploma courses were examined. No information could be found for 4 tutors (2%). Of the remaining 167, 134 (74% of the total population) had an honours degree in mathematics, 135 (79%) had taught in a secondary school, 44 (26%) in a junior school, 9 (5%) in an infant school and 140 (82%) had experience of providing initial teacher education for those intending to teach in primary schools.

6.2 McNamara and Ross (1982) found that of teachers of the BEd degree in 17 institutions (including 2 university Departments of Education), 18% had no secondary teaching experience, 71% had no junior teaching experience, 92% had no infant/junior teaching experience and 94% had no experience of teaching in an infant school. A detailed comparison of these figures with the data quoted in section 6.1 of the Diploma is impossible because of discrepancies in the samples of institutions, but nevertheless both sets of figures indicate a fairly low level of junior school teaching experience and a very low level of infant school experience.

McNamara and A.M. Ross (1982) 'The BEd Degree and its Future' University of Lancaster School of Education.

Tutors' continued primary school teaching experience

6.3 A few tutors regularly spend time in primary schools working alongside teachers or teaching classes or groups of children. This is a valuable way of increasing their direct practical experience of teaching younger age groups of children and of ensuring that they have first-hand experience of the difficulties and problems that may arise.

Emphasis of the course

6.4 Students were asked (LSQ Appendix 1) how they felt about the time spent on various topics in the course. If just the responses of the teachers who started the course in 1978 (who would have completed the course) and those who started the course in 1979 (who would have completed at least three-quarters of the course) are considered, then parts of the information show:

(i) that the balance of the work in number and shape is about right:

	None or None so far	Not enough	About right	Too much	Total
Number and arithmetic operations	5 1%	87 20%	328 76%	9 2%	429 100%
Properties of shapes	22 5%	82 20%	294 71%	19 5%	417 100%

(ii) that the highest totals in the "too much" column were recorded for vectors and matrices, and history of mathematics:

	None or None so far	Not enough	About right	Too much	Total
Vectors	46 11%	102 25%	216 52%	49 12%	413 100%
Matrices	32 8%	65 16%	260 63%	59 14%	416 100%
History of Mathematics	48 11%	68 16%	241 58%	61 15%	418 100%

(iii) that work on calculators and on mathematics in relation to other parts of the curriculum was considered insufficient by many teachers:

	None or None so far	Not enough	About right	Too much	Total
Calculators	89 21%	123 29%	192 45%	18 4%	422 100%
Maths in relation to other parts of the curriculum	100 24%	223 53%	90 21%	6 1%	419 100%

(iv) that some of the aspects of teaching and organising mathematics in a school may need more emphasis:

	None or None so far	Not enough	About right	Too much	Total
Constructing a school maths scheme	89 21%	222 53%	105 25%	6 1%	422 100%
Getting a good sequence of work for the children to follow	76 18%	225 53%	117 28%	3 1%	421 100%
Selecting a maths textbook (or published workcards)	53 13%	185 44%	176 42%	7 2%	421 100%
Coping with children's mistakes in maths	92 22%	221 52%	110 26%	0 0%	416 100%
Priorities in buying equipment	161 39%	173 42%	81 19%	1 0%	416 100%
The responsibilities of a maths consultant	145 35%	159 38%	113 27%	1 0%	418 100%
Assessing children's progress	72 17%	203 48%	142 34%	4 1%	421 100%

The general impression made by these comments is that the time spent on mathematics is about right whereas the time devoted to the practical aspects of teaching and organising mathematics is not sufficient. The students were not asked directly whether that thought the duration of the course should be extended to, say, three years; nevertheless the evidence of section 5.13 suggests that the pressure of a two-year part-time course is considerable for many teachers and so the time on the course should not be extended.

Criticisms of the course

6.5 At the end of the large sample questionnaire (Appendix 1) the students were asked to make any other comments about the Diploma. A substantial minority (20%) highlighted that the course needs to be relevant to the classroom experience of teachers and presented in an appropriate way.

As this is, arguably, the most serious criticism of the Diploma courses, several comments of students from different centres are quoted:-

(a) (A man teacher aged 40-44, having a scale 2 post in a junior school, who withdrew from the course after 1 year)

"As a teacher in a primary school I had hoped to find in the course a greater emphasis upon primary mathematics, 'how and what' to teach or, more precisely, methods and techniques, how to plan a constructive programme of concept formation suitable for application throughout a primary school.

As an ex-maths student, I was bitterly disappointed and frustrated to find that I had embarked upon a course supposedly designed to assist teachers hoping to secure scale 3 posts of responsibility in a primary school, but I found that I was simply repeating a college main maths course that lacked only calculus. I feel deeply resentful and feel that I lost a year's study time, a year wasted."

(b) (A woman teacher aged 30-34, having a scale 3 post in a junior school, who gained a distinction)

"It is all discussion/theory. We had no chance to see other teachers at work etc.

A number of our lecturing team seemed to lack the necessary expertise for the Maths Education component - they even seemed to lack general education theory. It would therefore be better if they were confined to the Maths area leaving the knowledgeable to the Education part. Even then those who knew the theory lacked personal contact with primary children as was shown by the comments on some essays - our classroom experience was greater, in which case it would be better either to stick to pure theory or draw in real experts with practical knowledge."

(c) (A woman teacher aged 40-44, who is a deputy headteacher in a 5-12 school, and still doing the course)

"I would largely replace the history content by work related to teaching and organising maths in schools. Deficiencies in:

- Diagnostic testing
- Assessment
- Record keeping
- Bright children/slower children
- Role of co-ordinator
- Organising specific topics in classroom
- Constructing schemes of work.

My own teaching has been up-dated, and improved. Information about new books and equipment from lecturers and teachers is invaluable as is the discussion between teachers. It has been possible to extract good ideas from many schools.

Overall view of the course, very worthwhile!"

(d) (A woman teacher aged 30-34, having a scale 1 post in a first school, who is still doing the course)

"It was for first and middle school teachers but I feel it was biassed towards upper middle and upper school maths.

More help with actual teaching to lower age ranges is what I expected. I feel my maths knowledge has improved slightly - but I'm not sure if my teaching to my age groups has been helped."

(e) (A woman teacher aged 45-49, having a scale 2 post in a 7-12 school, who is still doing the course)

"I was told that the course would cover the following:

(1) Curriculum development and change
(2) How children learn mathematics
(3) Organisation of mathematics teaching
(4) Schemes of work and guidelines
(5) Methods of assessing and recording children's work.

So far I have not had a lecture on any of the above points - or if I had I did not recognise it as such.

Forget about teaching maths to 'A' level and give me something concrete which will help me in the classroom. All the lecturers - except one who is a practising teacher - are out of touch with the classroom situation. I find most of the lectures boring and consider them a waste of time. The coffee break is the most interesting part of the session because I find out from other teachers the problems they have and how they go about solving them. After a day's work I need stimulation and frankly it is never there. It could have been a great course if properly organised."

The criticism was not just confined to courses which had problems with staffing or organisation; it was from most parts of the country.

6.6 Some 16% of the students made comments which indicated that they were experiencing some difficulty with the Mathematics component. (Approximately half of these had also made comments about the lack of relevance to the course.)

e.g.

(a) (A man teacher aged 30-34 , having a scale 3 post in an 8-12 school, who is still doing the course)

"The lecturers know their subject but forget that many of us have not done some maths for 20 years. They presume too much."

(b) (A woman teacher aged 40-44, a deputy headteacher in an infant school, who has passed the course)

"The statement that 'No formal mathematical qualifications are required' is questionable, since the level of mathematics tackled to develop the students' confidence in basic mathematical skills and techniques was such that those students without qualification or previous practical study were often out of their depth.

The bias, in my own experience, was too much in favour of extending mathematics at a personal level. I feel that the majority of time should be spent instructing students how to teach all aspects of mathematics from pre-number through to top juniors/middle school ranges."

6.7 The large sample questionnaire (Appendix 1) affords yet more information as to the teachers' views about:-

(i) the Mathematics component:

The Mathematics in the course is too hard	Agree	Undecided	Disagree	Total
Starting date				
1978	41	26	116	183
	22%	14%	63%	100%
1979	54	58	148	260
	21%	22%	57%	100%
1980	30	84	159	273
	11%	31%	58%	100%
Total	125	168	423	716
	17%	23%	59%	100%

The calculated χ^2 value is significant at the 1% level.

The course has increased my confidence in doing maths	Agree	Undecided	Disagree	Total
Starting date				
1978	127	20	35	182
	70%	11%	19%	100%
1979	170	38	52	260
	65%	15%	20%	100%
1980	164	67	41	272
	60%	25%	15%	100%
Total	461	125	128	714
	65%	18%	18%	100%

The calculated χ^2 value is significant at the 1% level and so for each of these views there is a difference in response between teachers who are at different stages of the course or who have finished the course.

If we assume that there is no significant difference between the ability (as measured by the qualifications) of the students in 1978, 1979 and 1980, then a picture emerges of approximately two-thirds of the students being happy with the standard of mathematics and their confidence in mathematics gradually increasing.

(ii) The relevance of the course to the classroom:

	Agree	Undecided	Disagree	Total
The Maths Education assignments/ essays should draw on classroom experience and incidents	561 79%	104 15%	47 7%	712 100%
The course is out of touch with the problems of teaching children maths	138 19%	189 27%	386 54%	713 100%

Neither of these variables when tabulated against year of starting the course gave a χ^2 value that was significant at the 1% level.

6.8 Students in the small sample were asked in 1982 how helpful the Diploma course had been to them in selected aspects of their teaching and of the organisation of mathematics in their schools. Their views are reported in sections 9.2-8.

6.9 Members of the Diploma Board have stressed the importance of not teaching the Mathematics component and the Mathematical Education component of the course as separate entities but when appropriate making crosslinks between the two.

It is also important, in view of the students' comments, that their experience as teachers in their classrooms and schools should be linked to each of the Mathematics and the Mathematical Education components.

Visits to taught Diploma sessions

6.10 In 1982 tutors at the centres from which the small sample of students was selected were asked if a lecture session of the course could be visited. The purpose of the visit was threefold:-

(a) to enable good practice to be reported;

(b) to provide some feedback to the college;

and (c) where possible (8 times) to observe the work of a small sample student and the contribution he or she made to the course.

Of the 20 centres, one was not running a current course and at another the monitored lecture was given at a two-day meeting in April 1981. So in all 19 of the taught sessions have been monitored by:

(i) asking the students' views of the value of the session by giving a short questionnaire that took 5 minutes at the end of the session to complete;

(ii) asking the tutor's view of the purpose and success of the session by means of another short questionnaire;

(iii) comparison of the view of the students, tutor and research fellow.

The students' views were summarised and copies sent to the centre to enable tutors to compare their view with the students' and to provide some feedback about the course.

In 13 of the 19 sessions the tutor teaching the session was the course leader.

6.11 Approximately 70% of the students found the observed taught sessions either very valuable or valuable. Questionnaires were completed by 225 students at 19 centres (mean size of group was 12). They found the session:-

Very valuable	Valuable	Of limited value	Of no value at all
32	134	65	4
14%	55%	29%	2%

6.12 The tutor described the purpose of the taught session at the two-day meeting that was monitored:-

> "'Introduction to computing' (flow charts already looked at 4 weeks ago). To give hands-on experience at a play stage and see what happens when certain BASIC instructions are used. Also to discuss non-mathematical uses of computers in schools with programs to illustrate various aspects of this."

The views of the thirteen students as to the value of the session are summarised below:-

"Very valuable (8 teachers):

I wanted more time (2)

New and interesting/whetted the appetite (4)

Made me aware of potential uses (1)

Made me realise that a maths degree is not necessary to use a computer (1)

Valuable (3 teachers):

My first introduction to computers (1)

It could be of use in my classroom (1)

Fascinating - needs follow-up work if it is to be of lasting value (1)

Of limited value:

Computer unlikely to be available in my school (2)"

The interest of all the students was evident.

6.13 Visits were made to day courses that were operating at two centres.

The programme for the second year students at one of these started with a lecture on making conic sections accessible to middle school children. It was followed after coffee by a tutorial session in which some of the teachers worked in groups investigating further some of the conjectures made in the lecture and others were revising work on algebra (particularly simultaneous equations). The tutor was answering queries and helping with difficulties.

In the afternoon two of the teachers on the course gave seminars: one talked about the mathematics arising from a school trip to Austria; the other looked at some of the possibilities for investigations starting from the commercially produced Centicube workcards.

This was followed by a short lecture on algebra that was aimed at extending the students' knowledge of the subject to a level slightly beyond that of the middle school. By this time the students were obviously tired (they had been thinking and working hard since 9.30 in the morning) and the tutor recognised that further development of the topic was needed including geometric representation of common algebraic identities.

The students' view of the course organised as day sessions included many comments about their increasing confidence with and enthusiasm for mathematics, e.g.:-

> "It has changed my approach to teaching and made me think more about what I am doing. Interesting maths content and methods of teaching middle school children.
>
> I have completely re-thought my ideas and approaches to maths teaching. I now use a 'try and see what happens if' approach much more. I have gained confidence and experience which I hope I can spread to my colleagues."

6.14 Seven of the remaining taught sessions that were observed could reasonably be classified as Mathematics rather than Mathematical Education, although one of the sessions on data collection and presentation was skilfully linked to the teaching of the subject in school and also to the appropriateness of methods of analysis of children's marks for assessment purposes.

The style of teaching the Mathematics was predominantly 'class teaching' supported by carefully graded sheets of questions. Appropriate visual aids, including good software packages on a microcomputer, were well used.

All the mathematics seen was taught in a manner that was sympathetic to the teacher whose mathematics background was fairly weak. The tutors were patient and developed the subject carefully. The teaching groups were sufficiently small that tutors knew which students were likely to be experiencing difficulty and had established a good relationship with them, e.g. a student comments "I didn't understand too well, particularly at the end, but I know that the lecturer will go over it when I ask."

The more skilful of the tutors were capable, at the same time, of giving the better qualified students pause for thought by leaving loose ends to be explored and statements to be proved ('Does it always work?). Some of the students' comments reflect this approach e.g. "I was challenged to find the equation for an ellipse", "It extended me", "Thought provoking".

6.15 Tutors at one centre have expressed concern about teaching the 'mixed-ability' group of students:-

> "We are endeavouring to improve our techniques of mixed-ability teaching to cope at the same time with teachers who gave up mathematics at the age of 13 and with specialist middle school teachers and an infant teacher who had suspended her work for an OU mathematics degree while she does the Diploma. It would be ludicrous to expect these teachers to study mathematics at the same level, and we should be failing in our duty to these teachers if we did not try to provide them all with some new understanding in mathematics, at whatever level they have reached."

They have adopted a system of an introductory lecture for each topic followed by a system of assignments and worksheets at different levels that can be attempted by students either individually or in groups.

6.16 Another cause for concern is difficulty experienced by some tutors in making appropriate reference to the Mathematical Education component or to the classroom experience of the students when they are teaching the Mathematics component of the course.

Examples of inadequate practice from two centres were observed during the visits.

(a) Neither the tutor nor the course leader have experience of teaching primary school children nor of preparing initial-training students to teach in primary schools.

The tutor stated the purpose of the session as:-

> "To practise the addition, subtraction, multiplication and division in base 2. To introduce other bases and form a general rule for conversion to and from this base to base 10."

He felt it had been reasonably successful:-

> "Most of the students have met other number bases than 10 before, and are already competent at conversions and the underlying theory. Multiplication and division in base 2 only seemed well understood."

The evening was very foggy and there was an unusually small attendance of six students out of a total of fourteen. The students were highly appreciative of the work of the tutor; 3 thought the session very valuable and the remaining 3 classified it as valuable. The comments about the session made by the 6 students are:-

"It gave greater insight into work on number bases in school.

It's interesting to see what problems children may encounter when working with basework.

I'm so hopeless at working in different bases that any work would be of value.

Not of use in my present situation ....but will obviously be useful when teaching older children.

Always a good session - very helpful background maths for my own benefit - well taught and explained.

We were given methods of working which are helpful in teaching basework to children."

Nevertheless, in spite of his having set up a very good rapport with the students, subtraction was explained in terms of 'borrow and pay back' and '.' rather than '0' as a place holder was used in long multiplication. The following was done on the blackboard and also appeared on an example sheet:

Ex Evaluate $1101_2 \cdot 101_2$

$$\begin{array}{r} 1101 \\ \underline{101} \\ 1101 \\ \underline{1101..} \\ 1000001 \end{array}$$

Ans = 1000001_2

(b) The tutor did not have experience of teaching primary school children nor of preparing initial-training students to teach in primary schools. She had not been told about my visit by the course leader.

The tutor stated the purpose of the session as "Further development of concepts of area, calculation of areas based on rectangles" and commented:-

"It appears to have achieved its purpose as far as can be seen in the short term. Frequently we receive feedback from the students the following week after they have had time to think over the work and produce the exercises. During the problem-solving period there have not so far been too many queries."

There were fifteen students present and they assessed the value of the session as:-

Very valuable	Valuable	Of limited value	Of no value at all
1	8	5	1

and gave their views:-

Very valuable

"Tonight we learnt about perimeter and area. We found that we were in a state of conflict when teaching this particular subject area since metrication has been introduced. We use the measurements of area and perimeter in our everyday life and it is most practical."

Valuable

"It covered work not encountered since leaving school, and the exercises especially have been useful in converting different measurements - something I have no need to do at school, e.g. cms, mm, m, kilometres, etc."

"Revision of work not encountered in my day-to-day teaching."

"It was valuable but not much relevance to the teaching situation or how best to teach the children this particular topic."

"In as much as points covered included area of both regular and irregular 2D bodies."

"(a) Useful to show method of tackling problems dealing with calculation of area.
(b) Brief discussion of conflict between imperial and metric measure."

"The reference to the fact of the units - particularly difference between units square and square units, extremely valuable."

"After having worked in primary school with 5-7 year olds it is good to have a brief revision period and to work up to a higher standard."

Of limited value

"Too far advanced for infant work."

"The work covered is very basic and I feel that the subject could be studied in greater depth."

"I always feel I would welcome much more practical help in teaching children the particular topic under consideration. I would also like a much more coherent approach to the subject of maths rather than isolated topics as it does not help in building up a picture of unity."

"Maths: The work is really too basic for a diploma course, though I appreciate that it is relevant of middle school teaching."

"I am able to do area and would have welcomed a more challenging subject which I find more difficult."

Of no value at all

"The reason this particular meeting was of no value was because I already understand the work covered and there was nothing really relating to the teaching of it which might have indicated a way to make it easier for children to understand."

The content of the lecture was taken from Snell & Morgan 'New Mathematics', Book I, p.167 onwards. (The teachers had bought copies of this book for the course.) The starting point of the lecture (the second one of the subject of area) was that the area of a rectangle was length x breadth and then the area of more complicated shapes was found by combining or subtracting a number of rectangles. No mention was made of a possible link with the work of Piaget, for example, or with conservation of area.

The problems of metrication were discussed and calculations were done in imperial as well as metric units. However there was no attempt made to get the teachers to visualise the size of a hectare. The questions in the textbook that involved practical calculation of area or one such as to consider the area of possible rectangles that can be made with a perimeter of 200 centimetres did not appear to be emphasised by the lecturer. A lot of multiplication (without calculators) was done and a considerable amount of changing quantities, both metric and imperial, into more appropriate units e.g. one of the examples worked by the tutor on the blackboard was to calculate the number of acres (to 2 significant figures) that would be ploughed in 2 hours by a plough travelling at 2 miles per hour with a furrow width of 2 feet 6 inches.

Moderators' comments about the teaching of the Mathematics component

6.17 The moderator at another centre commented in his report on the course which started in 1979:-

> "The four members of the teaching team divided themselves naturally into two sets - two tutors teaching the Mathematics and two the Mathematical Education component. The professionalism of the team showed itself through the fact that all members attended most of the sessions throughout the two years whether on Mathematics or Mathematical Education. Despite the fact that two members of the team were based in the Polytechnic Department of Mathematics and Statistics they presented the Mathematics in a meaningful way and clearly demonstrated a sound understanding of mathematics in the Primary School context. The students continually praised this aspect of the course."

6.18 Another moderator has commented about the rationale (or lack of it) behind the Mathematics component (it is of interest to compare these comments with section 6.5):-

> "In some ways the examinations, and in particular the mathematics examination, were the most troublesome part of the course for the tutors as well as for a few of the students. A lot was learned by all concerned about such a situation and there now follows an attempt to be more detailed about this. Certainly the course team have agreed to give a great deal more thought to the technical and presentation aspects of examining in the coming year, so as to try to take advantage of the considerable scope for flexibility offered by the Board's Guidelines.
>
> The form and nature of the mathematical content of this Diploma requires further thought and discussion generally, and not just in this college. To begin with we must bear in mind that the membership of the course is made up of mature experienced teachers, mainly working at primary level, and that there is no entrance requirement that demands any special mathematical competence. If we add to this the responsibility that we bear to those whom we accept on the course, then there can be genuine difficulties about the formal mathematics to be taught, about how it is to be taught and about how it is to be examined.
>
> (The general information booklet of the Mathematical Association describes some possible themes and some books are listed. It also contains one paragraph which tries to suggest a pedagogy. There may, of course, be further guidance which I have mislaid.)

One of the main reasons why it was felt necessary to establish this Diploma course is to do with the difficulties that many students at all levels have with the learning and teaching of mathematics. It must be assumed that these difficulties continue to exist even within a course created to try to alleviate them. It is not enough simply to 'try again' to teach them some mathematics.

Because of the complexity of this situation, it is very likely the case that there is a fairly wide spectrum of opinion among all concerned as to the level of difficulty that the mathematics on the course should reach. Because of this it might be helpful if the Mathematical Association itself should try to produce a more elaborate analysis of what is to be expected in mathematical terms of such diplomas and about its teaching and examining. As well as helping to stimulate a much-needed debate about the nature of mathematical knowledge and competence it would also help potential students to make judgments about whether or not they ought to undertake such a course."

The revised version of the booklet of information (Mathematical Association, 1982: 'Diploma in Mathematical Education - A General Guide') lists Mathematical themes such as the development of the idea of number, spatial perceptions etc. and then explains:-

"Although all these themes are likely to be included, they would not necessarily be developed in full theoretical detail. The aim is rather to extend the studenmt's own mathematics sufficiently to give confidence in handling topics which might arise in school with children in the age range 5-13. Thus themes should be developed so as to bring out the interaction between the physical and social environment, the structuring activity of the mathematician, and the links with mathematical education, rather than as mathematics for its own sake. The course should emphasise the unity of mathematics and the links between the various topics which make up the curriculum at this level."

Mathematical Education sessions

6.20 To give a picture of the Mathematical Education sessions, reports of three sessions are quoted below:-

(a) Purpose of the session as stated by the tutor was:

"(1) To establish the need for criteria in the selection of objectives in mathematics at 11+.

(2) To draw attention to factors needing to be considered when evaluating objectives."

This was achieved by considering the main objectives for the majority of children of 11 years as listed at the back of Mathematics 5-11.[1]. Many groups of the teachers found the list too demanding for the majority of their pupils although appropriate for their better mathematicians. Few of the teachers realised the source of the material.

Problems of assessment were then considered. A lively discussion ensued. Finally a copy of a test used by a comprehensive school mathematics department to group the first year children and given to children in their last term of the junior school was viewed in a fairly uncompromising light.

The tutor commented on the success of the session:-

"It promoted thought, generated discussion, clarified ideas.

Group often expressed unexpected views, which were difficult to co-ordinate within the framework."

Of the eleven students present for the session, 2 thought it very valuable, 7 found it valuable and for 2 it had limited value (one was an infant teacher who found it difficult to assess the expected standard of work of an 11-year-old, the other had done an in-depth view of tests the previous term).

(b) The purpose of the session as stated by the tutor was:-

"To discuss the teaching of decimals both as members do it and as shown by CSMS[2] project."

1 HMSO(1979) HMI series: Matters for Discussion 'Mathematics 5-11, A Handbook of Suggestions'

2 ed. K.M. Hart (1981) 'Children's Understanding of Mathematics: 11-16' John Murray

The first part of the session was taken by a member of the group explaining how he taught decimals. He was a good speaker and only seemed to be moderately perturbed by the presence of a research worker. Nevertheless the specific details of the work and the problems that children have might have been brought out more clearly if the tutor had provided him the previous week with some acetate sheets to prepare material to show on an overhead projector.

A useful discussion followed but it was firmly led by the tutor. The second part of the lecture consisted in the tutor talking about the CSMS[1] findings about secondary school children's difficulties with decimals. A few aspects of this formed a harsh contrast with the first part of the session and I was left wondering how a less-confident member of the group would feel about talking of some aspect of his or her teaching of mathematics in a subsequent session.

Of the fourteen teachers, eleven thought the session valuable and three found it of limited value. Their comments were:-

"A chance to compare what actually happens in the schools of course members" (3)

"Valuable to hear another teacher's views - helped me re-think my own" (2)

"The discussion enables you to see that your problems are common to other teachers" (2)

"Gave food for thought on the emphasis put on fractions and decimals in school"

"Decimals not appropriate for the infant age range, but it was one of the more interesting and lively sessions" (2)

"An insight into the teaching of decimals and into different teachers' priorities"

"Exchange of ideas is always valuable and stimulating" (2)

"Exposes the difficulties of teaching decimals but does not resolve them"

1 ed. K.M. Hart (1981) 'Children's Understanding of Mathematics: 11-16' John Murray

The tutor commented that:-

"Several interesting points have been made and will be followed up next week."

(c) The tutor explained the purpose of the session:-

It was "part of a series on evaluating various schemes and textbooks for use in schools - drawing on the personal experience of teachers using these schemes."

The previous week criteria for selecting a textbook or published workcard scheme had been discussed. Four teachers from infant and junior schools had been given the task of preparing a short talk on a series of textbooks (Peak[1], Fletcher[2], Nuffield[3] or Hey Maths[4]) and there was a general discussion after each talk.

Of the nineteen teachers present, 4 thought the session very valuable, 13 thought it valuable, 1 considered it of limited value and 1 found it of no value at all.

Their comments were (some teachers made more than one comment):-

"It is valuable to see schemes" (9)

"It is valuable to hear other teachers' opinions about schemes" (13)

"It is valuable to hear how other teachers use and organise the scheme in their schools" (4)

"I get ideas for topics from seeing different books" (1)

"Updated the maths language" (1)

".... but it was more relevant to junior teachers" (1)

"I felt we could have spent more time on each scheme" (1)

"I will be following up one of the schemes discussed" (1)

"My school is committed to one particular scheme so the discussion was of academic interest only" (1)

"I shall be unlikely ever to be asked to choose a maths scheme" (1)

1 A Brighouse, D.Godber, P.Patilla. 'Peak Mathematics' Nelson.
2 A.Howell, R.Walker, H.Fletcher. 'Mathematics for Schools' Addison-Wesley.
3 ed. E.A.Albany. 'Nuffield Mathematics 5-11' Longman.
4 L.Svensson et al.(1974) 'Hey Mathematics' J.Boucher ed. Holt Rinehart & Winston.

The tutor expressed some doubts about the success of the seminar:-

> "I had grave doubts about the feasibility and value of such an exercise but felt that it was essential that an attempt should be made at this exercise. Main troubles envisaged: either too much detail given or too little to be useful.
>
> In the event it did seem that the group found some enjoyment/value in the exercise - some seeing some material they liked and would perhaps introduce into their teaching schemes. All right for a one-off but not an exercise to be repeated often."

This seems a topic of direct concern to the teachers, particularly to those who have, or hope to have, some measure of responsibility for selecting resources for mathematics in a school. The teachers' comments were sometimes superficial or non-analytical "This is what we use and we like it".

There must be scope for the comparison of the teaching of and development of a specific topic in a small number of texts. Perhaps the discussion here was too wide-ranging.

6.21 Tutors at one centre have reported the effective use of video recordings of children working. Their work sheet for the students is quoted in full:-

> "What you should do:
> First read these notes.
> Then watch the video-tape, or parts of it, as many times as you wish. Discuss it with each other. Make notes. When you are ready, go into the writing room and write to up to an hour about the tape. If you wish to produce a cooperative piece of writing you may.
>
> What the tape is about:
> The tape shows some 11 year olds. They came and were filmed on two occasions. On the first visit they worked with cubes made of multi-link cubes, and dealt with the problem of how many little cubes there were on the outside of a 3x3x3 cube, a 4x4x4 cube, and so on.
>
> They came for the second visit a week later. Then they were split into two groups, and you will see the second half of the first group's session, and the first few minutes of the second group's. In each case the camera tends to concentrate on one or two children. The children you will see in the first group, in case you need their names, are Samantha, Peter, Matthew H. and Matthew P. (reading from left to right) and in the second group Stephen and Anthony.

On this visit they were given stacking cubes rather than linking ones. The problem posed was: given a 4x4x4 cube, how many little cubes do you have to remove to make a 3x3x3 cube? to change a 3x3x3 cube to a 2x2x2 cube? and so on.

What you should write about:

You are invited to write something about the thinking or learning or teaching that the tape shows. You may write about one aspect of the situation, or several, or about one particular incident, or the whole sequence. The main thing is to show you have thought carefully and critically about what is going on.

(Perhaps it's worth pointing out that we didn't set this up, or edit it, with any particular points in mind: there aren't any 'right' answers.)

Here are some questions which may start you off. You don't need actually to answer any of them, let alone all of them: they are just to give you some ideas.

Do the children show any evidence of ability to generalise?

Is there evidence that they can think independently or do they tend to lean on the teacher?

Do they show signs of being self-confident in their mathematical thinking?

Do they check results?

Would you have 'taught' in a similar way? Would you have asked different questions, given more/less help, had a more/less structured approach, ...?

Is the problem a reasonable/useful/interesting one? Have the children learnt anything?

Is the problem-centred teaching practical?

Compare the approaches of the first and second groups.

Comment on the children's apparent attitudes to the task.

What about Peter's method of counting?

Is there any evidence that language helps or hinders the children's learning?"

Reading and books

6.22 Students were asked (LSQ) to list any books they found particularly useful for the course. Of the 739 students who replied, 194 (26%) quoted Williams & Shuard[1], 122 (17%) Skemp[2] and no other single book was quoted by more than 40 students. A large number of students, 339 (46%) mentioned no book at all.

Not surprisingly, when the having found books useful is tabulated against students' success in the course, the calculated value of χ^2 is significant at a 1% level indicating a fairly conclusive difference of view of those who have failed or withdrawn from the course.

The results of students cross-tabulated against their views of the usefulness of books for the Diploma course

Results	One or more books were particularly useful	No book was particularly useful	Total
Distinction	55 67%	27 33%	82 100%
Pass	191 65%	105 35%	296 100%
Failed or withdrawn	28 25%	82 75%	110 100%
Total	274 56%	214 44%	488 100%

6.23 Teachers in the small sample were asked what advice they would give to a prospective Diploma student about preliminary reading for the course.

1 E.M.Williams and H.Shuard (1970) 'Primary Mathematics Today' Longman.

2. R.R.Skemp (1971) 'Psychology of Learning Mathematics' Penguin.

Eighteen of the forty-one teachers said that they did not do any preliminary reading, two avoided the question, two tried to read mathematics books but found them difficult and two teachers said that it would be better to do the reading as and when it was suggested during the course.

Seven teachers mentioned that tutors at the centre sent a booklist to them before the start of the course but one of these commented "We've been given a booklist and we have never been asked to read any of them. So any reading we have done is purely for personal reasons which probably means it won't get done."

Individual books were mentioned: Skemp[1] (8 times, though once rather hazily "That one on concepts. Is it Skemp?"), Williams & Shuard[2] (5 times), Mathematics 5-11[3] (3 times), How Children Fail[4] (3 times) and five other books were mentioned twice or once.

6.24 New books seem to take time to reach the attention of teachers. The questionnaire was sent in March 1981 and yet no teacher mentioned HMSO(1980) APU " Mathematical Development, Primary Survey Report No. 1".

Possibly more alarming is the fact that more than one of the centres who were applying in 1981 and 1982 to the Diploma Board for their licence to run Diploma courses to be extended, had to be instructed to revise their booklists to include some of the publications issued since 1978 that are pertinent to mathematical education in the primary school.

1 R.R.Skemp (1971) 'Psychology of Learning Mathematics' Penguin.
2 E.M. Williams & H.Shuard (1970) 'Primary Mathematics Today' Longman.
3 HMSO(1979) HMI Series: Matters for Discussion 'Mathematics 5-11, A Handbook of Suggestions'
4 J.Holt (1969) 'How Children Fail' Penguin.

Distribution of workload

6.25 The students who started the course in 1978 or 1979 (i.e. who had either completed the whole course or three-quarters of it) were asked about the spacing of dates for handing in work (LSQ).

	Agree	Undecided	Disagree	Total
Dates for handing in work have not been well spaced	104 24%	53 12%	282 64%	439 100%

Only one or two students in the small sample reported a build-up of work towards the end of the second year caused by poor planning for the course. One teacher in her fifth term of the course still had the Child Study, the Mathematical Investigation and two short essays to complete as well as preparing for the Mathematics examination. "I can't see anyone getting it done. Very sad - it's taken the joy out of the course."

The majority of courses are well organised with a timetable drawn up of the time and duration of the various aspects of the course. Diploma Board members check these details of the planning for courses at visits to centres in connection with licensing or relicensing.

It is important that tutors plan carefully the distribution of assignments and essays throughout the course so as to reduce the anxiety caused by an overbearing workload on students.

Tutorials

6.26 Students taking Diploma courses have varied mathematical backgrounds and have varied teaching experience. This makes the provision of tutorial support necessary and not just for the initiation of the Special Study and Mathematical Investigation.

Data from the LSQ about the provision for tutorials can be found in Appendix 1.

The problems associated with the organisation of tutorials at outposts are discussed in section 5.22(v).

6.27

Results of students who have completed the course cross-tabulated against their views about the adequacy of tutorial provision (LSQ)

Results	Provision for tutorials was		Total
	Adequate	Inadequate	
Distinction	48	30	78
	62%	38%	100%
Pass	191	95	286
	67%	33%	100%
Failed/Withdrawn	32	52	84
	38%	62%	100%
Total	271	177	448
	60%	40%	100%

The calculated value of χ^2 is significant at the 0.1% level.

There are very important differences in the views of sections of the student population about the adequacy of tutorial provision but nevertheless a third or more of each group thought that the provision was inadequate.

The population of students who completed the large sample questionnaire under-represents those students who have withdrawn from the course. So it is true to say that at least 40% of the students who completed the Diploma course before March 1981 found the provision of tutorials inadequate. Some typical comments from these students are:-

"There was not enough time for too many students."

"There were no tutorials though we required them."

"Major changes were made after the first term as a result of staff/student consultation."

"No help forthcoming even after several requests."

"The tutor .... for my child study had no knowledge of what was needed."

"I was assigned a tutor rather late in the course."

6.28 Tutors were asked in 1980 and 1981 (CQ) if tutorial time for the course is part of their timetabled teaching load.

	YES	NO	No response
1980	49%	47%	5%
1981	63%	33%	4%

It is pleasing to see that tutors and college authorities are recognising the importance of tutorial work.

The views of adequacy of tutorial provision of different groups of students

Students classifying themselves as	Provision for tutorials was		Total
	Adequate	Inadequate	
Mr.	177	73	250
	71%	29%	100%
Mrs.	196	147	343
	57%	43%	100%
Miss	37	15	52
	64%	36%	100%
Total	271	177	448
	60%	40%	100%

The calculated value of χ^2 is significant at the 0.1% level.

An explanation of the difference in views may be that married women students have to make special arrangements at home (sections 5.12-14) more frequently than other groups of students and so some tutorial time, e.g. after the weekly meeting of the Diploma course, is not available to them.

Subsequent courses

6.30 The results obtained by students who attended the first course run at a centre were compared with the results of students who attended subsequent courses:-

	Distinction	Pass	Fail/ Withdrawn	Total
First course run at a centre	93 13%	408 56%	229 31%	730 100%
Subsequent courses run at a centre	80 16%	280 55%	145 29%	505 100%
Total	173 14%	688 56%	374 30%	1235 100%

The incidence of students withdrawing from the course decreases slightly and the proportion of distinctions increases slightly when the course is taught on the second and subsequent occasions, but no significant differences are indicated.

Mathematical Investigation

6.31 The idea of a Mathematical Investigation is new to many teachers who are taking the course. Tutors prepare for this aspect of the course by including open-ended questions in the Mathematics component, perhaps by investigating one or more starting points by group discussion, often by giving students a list of possible starting points and by giving appropriate tutorial support.

One tutor has provided the following guidelines for his students:-

"Mathematical Investigations

Choose wisely from the ones suggested. You may if you wish use one of your own provided it is approved. Points to be noted:

(1) Books and articles may be used but only for inspiration as a starter. References should be given and investigations limited to extraction of material from these references will not score highly.

(2) What we are looking for is original thought, though this may be 'original' only to you. Even if it appears elsewhere it is 'original' to you if you haven't seen it.

(3) All progress should be shown even if apparently leading to a blind alley. Credit will be given to:-
   (i) a systematic approach;
   (ii) the use of mathematical knowledge and skills however elementary;

(iii) the recognition of short cuts and generalisation of conclusions, e.g. by the use of appropriate symbols;

(iv) some attempt at justification or proof of such conclusions where possible.

(4) A wise choice is one which interests you and about which you have some knowledge or easy accessibility to such knowledge.

(5) A concise presentation showing a variety of approaches is preferable to a long rambling effort following just one approach."

Nevertheless the moderators at three or four centres have highlighted problems associated with the Investigation:-

> "It is always difficult, both for the College staff and for the external examiner, in assessing the Mathematical Investigations, to know how much mathematical justification of hypotheses can be expected from students whose mathematics background is relatively limited, but difficulty in assessment should not take away from the value that most of the teachers clearly derive from this work. We also have the feeling that some subjects are much more amenable than others to investigation at the levels involved, and that some students have suffered a little, though not failed, because they have chosen a subject which, while they were enthusiastic about it, did not allow them to proceed easily or fruitfully."

Another moderator has reported a successful management of this aspect of the course:-

> "Students were required to submit a full report on a single investigation to include generalisations and proofs of any results discovered. A list of twenty investigations was provided, including both number and spatial investigations, and were chosen in an attempt to force the students to create some mathematics which for them was new. It was hardly possible in any of the listed twenty investigations for students to consult a text or reference book. One student was permitted to present two investigations - an unsuccessful attempt at one together with a successful attempt at a second. This component of assessment was carried out during term 6 of the course with half-an-hour supervision per week. The criteria laid down were quite demanding and most of the students responded very well. It was clear from the reports that all the students had thus become immersed in mathematical activity. Having seen the work of all students I agreed with tutors to award 3 x A, 3 x B, 5 x C and 3 x D grades."

Students' views on the helpfulness of the Investigation can be found in section 9.13.

Special Study

6.32 By contrast with the Mathematical Investigation which is new to many of the students taking the course, it might be assumed that the purpose of the Special Study of children learning and doing mathematics would be clear to the teachers and need little preparation by the tutors.

However, one moderator commented:-

> "The purposes and processes of the child study are not entirely clear to weaker candidates though they seem (even intuitively) clear to stronger ones. Consequently performance on this important section is variable and sometimes less perceptive than one would expect from experienced teachers. Special attention should be paid to establishing in candidates' minds the criteria that will be used to judge these studies. I know this has been done but it should be done even more strongly."

Tutors at one centre have prepared a sheet of guidelines for students about the Child Study:-

> "1 This is <u>not</u> a study of a child as a person. It is a study of the way a child learns mathematics, and his personality, social background etc. only become relevant inasmuch as they affect his learning of mathematics, e.g. a poor reader or a deaf child would pose problems of presentation and communication of mathematical ideas.
>
> 2 The structure of a child study should be:-
>
> (i) Introduction -
> background and past record of the child (or children)
> why these children were chosen
> a brief description of the way you will study the children
>
> (ii) Observations -
> what the child is asked to do
> the child's responses
> your perception of the children's difficulties and what you do about them
> examples of children's work (including mistakes)
> the progression of the child's work

comparison between, for example, spatial and numerical ability
comparison with other children
interesting remarks made by the children or activities undertaken by them.

In short, observations of the inter-action between teacher and child in the teaching of mathematics and your analysis of the child's thinking.

(iii) Conclusions -
a review of the term's/2 terms'/year's work
a comparison between the children
a retrospective review of the methods and materials you used
an analysis of the child's attainment level at the end of the study
any other comments of interest.

3 It should be possible for anybody reading the study to:-
(i) get an idea of the child's thinking
(ii) know what methods you have used and their effect
(iii) see the essential inter-action that has taken place between you and the child
(iv) know what mathematics has been learnt and what level of understanding has been reached."

The value of causing teachers to observe children doing mathematics and listen to them talking about mathematics is seen from a quotation from the conclusion of a student's Child Study for which he was awarded a grade A:-

"The first thing this child study has taught me is that I do not normally observe children enough. This is the first time for several years that I have really sat down, looked at children's work and talked to children for a comparatively long time about their work."

Students' views on the helpfulness of the Special Study can be found in section 9.12.

Visits to schools

6.33 Many students in informal conversation have said that they would like visits to schools where the mathematics is taught well or where interesting developments in the mathematics or in the organisation for mathematics are being tried.

The value of two such trips is described by a tutor:-

"While it is difficult to be precise about their effect, the two visits to schools were very helpful to the course members. The very fact of having to consider someone else's teaching was very stimulating and it would seem desirable to increase the number of visits. (It should be noted with regret that one or two heads were reluctant to release teachers - one refusing completely as he could not be given a list of how the teachers performance would be improved.)"

Conclusion

6.34 Generally the teaching of the Diploma course is seen to be valuable and worthwhile by the students. Tutors in many centres reflect on their experience and try to improve their methods of presenting different sections of the course. Each Diploma class does have teachers of a wide range of experience, mathematical knowledge and age-range taught. A class teaching approach was most often used with perhaps inadequate attention to offering suitable levels of work for students on the same topic. It seems clear that the purpose of questions, discussion and work set from any course activity should be related closely to work in school and should aim to make good use, where possible, of students' classroom experience. The work on mathematical knowledge should not perhaps aim for the same standard for all teachers, and should be more strongly related to the mathematics which will form an effective background to that taught in primary schools.

Students have to be prepared to grapple with new ideas and to work on their own, but at the same time tutors need to present their work so as to bring in teachers' experience and make the new work meaningful and where possible relevant to the teachers' daily work. The 20% of students who criticised their courses must have felt that the new content was not brought into sufficient relationship with their work as teachers. This is a serious criticism as ideally one would like the tutors to relate mathematical content to the work of the Mathematical Education component.

CHAPTER 7

THE ASSESSMENT OF DIPLOMA COURSES

7.1 The assessment of a student's work for the Diploma course is carried out by the tutors at the centre then externally moderated and the results are ratified by the Diploma Board.

Grading of elements

7.2 Diploma courses are assessed by work for each of the four elements of the course, Mathematics, Mathematical Education, the Special Study and the Mathematical Investigation, and graded on a five point scale defined by the Diploma Board as:-

A. Unusually well done; shows flair, originality and a comprehensive understanding of the issues involved.

B. Well done; a comprehensive understanding of the issues involved and evidence of an ability to organise the material so as to make a worthwhile statement.

C. Adequate; shows understanding of the major issues involved, but some weaknesses.

D. Barely adequate; either evidence of diligence, but limited understanding of the issues involved or evidence of misapplied energies resulting in irrelevance, or inadequate coverage of the major issues or both.

E. Unacceptable; no evidence of understanding of the issues involved; resulting either from lack of application, failure to produce work, refusal to consider advice, inability to comprehend or any other reason.

The Mathematics component

7.3 The mathematics component is required to be assessed wholly or mainly by examination.

About half the centres set a single examination towards the end of the course with most of the others setting an examination at

the end of each year. Information derived from college submissions suggests that seven centres have assessment by an examination and by setting regular assignments or examining course work. One centre sets short examinations at the end of each term of the course.

Mathematics examinations

7.4 In general the examination papers are unseen before the time of the examination. Ball (1980) describes an examination paper that was given to students four weeks before the examination. They were free to discuss the paper with the tutors or with anyone they chose and to bring notes for selected questions to the examination where they were required to answer questions on the original and on a supplementary unseen paper.

In a submission approved by the Diploma Board in 1982 tutors are proposing to assess the Mathematics component by setting four examination papers during the course:-

> "(a) Knowledge based and simple
> (b) To be worked at home
> (c) To be worked at college (seen and unseen)
> (d) To be worked at college (unseen)
>
> Note that the aims of such papers and their accompanying preparation are:-
>
> to bring out the content of the past term's work
> to emphasise the variety of problem solving techniques
> to examine the mathematical thinking of the teacher
> to help the teacher relate such thinking to his mathematical teaching."

The tutors at this centre have devised a system of examinations which should be helpful in coping with students' anxiety.

D.Ball (1980) 'The First Year' Mathematics in School, Vol.9 No.3

7.5 The setting of appropriate examinations is no easy task for the tutors. Comments from two moderators highlight different aspects of the problem and suggest ways of improvement.

> "The questions (on the Maths exam paper) were reasonably straightforward and tested both students' knowledge and understanding. The marks achieved were very high and most students answered more than the required number of questions. I am delighted with these results since all the students will now feel more confident about their mathematical ability (justifiably) since they have now proved to themselves that they can do some mathematics - even under examination conditions."

> "Teachers are inevitably anxious about the mathematics examination, and a way needs to be found of ensuring that they do not revert to former examination behaviour. In the first examination, both questions and answers had a flavour of CSE. The recently-set paper related much more closely to the primary classroom, and I hope that the quality of the response will similarly improve. I remain totally unconvinced that a mathematics examination is an appropriate method of assessing a course given to a mixed-ability group of adults, whose knowledge and understanding may easily span a ten-year difference in background. A file of mathematics course-work would, in my view, be much more appropriate and would make it easier for colleges to do mathematics at appropriate levels for students with a great range of background and ability."

7.6 Students were asked their views about examinations in the large sample questionnaire. In March 1981, when they received the questionnaire, the students who started the course in 1978 would, apart from a few exceptions, have finished the course, the majority of students who started the course in 1979 would have completed five of the six terms of their course and so the examination would be taken in about 3 months, and the majority of those who started the course in 1980 would be more than a year away from the examination.

(i)

Students get anxious about the exams	Agree	Undecided	Disagree	Total
Starting date				
1978	147	13	23	183
	80%	7%	13%	100%
1979	215	22	21	258
	83%	9%	8%	100%
1980	217	42	15	274
	79%	15%	5%	100%
Total	579	77	59	715
	81%	11%	8%	100%

This table gives some sense of the widespread anxiety felt; over 80% of the students recognised it either in themselves or in other students.

(ii)

My enjoyment of the course was spoiled by having to be assessed	Agree	Undecided	Disagree	Total
Starting date				
1978	23	14	145	182
	13%	8%	80%	100%
1979	44	46	168	258
	17%	18%	65%	100%
1980	50	65	154	269
	19%	24%	57%	100%
Total	117	125	467	709
	17%	18%	66%	100%

The anxiety, although widespread, is not overwhelming for many students.

(iii)

An examination is the best way of assessing the Mathematics component of the course	Agree	Undecided	Disagree	Total
Starting date				
1978	91	42	47	180
	51%	23%	26%	100%
1979	95	75	92	262
	36%	29%	35%	100%
1980	71	96	104	271
	26%	35%	38%	100%
Total	257	213	243	713
	36%	30%	34%	100%

Students' opinion seems to be fairly evenly divided. There is certainly no substantial majority stating that the examination is an inappropriate method of assessing the Mathematics in the course. There is however, progressive disagreement with "An examination is the best way of assessing the Mathematics

component of the course" and a reduction from 51% to 26% who agree with the statement.

(iv)

The Mathematics examination should be easy so that students get high marks and their confidence increases	Agree	Undecided	Disagree	Total
Starting date				
1978	3	31	146	180
	2%	17%	81%	100%
1979	19	62	180	261
	7%	24%	69%	100%
1980	17	70	184	271
	6%	26%	68%	100%
Total	39	163	510	712
	5%	23%	72%	100%

It is interesting to compare this table with the first moderator's comment that was quoted in section 7.5.

Anxiety about examination

7.7 At the end of the large sample questionnaire (Appendix 1), students were asked to make any other comments about the Diploma. Approximately 6% made comments which revealed anxiety about examinations (20% made comments about the lack of relevance of the course to their classroom experience (see section 6.5).

Two of these comments from students are quoted:-

(i) (A woman teacher aged 35-39, having a scale 2 post in a 5-11 school, who was still doing the course)

"The exam is a burden to all (in my group). To not have instant recall of facts etc in exam conditions seems irrelevant - I have found out where to go and from where to find information - I can only gain confidence by experience in classroom using my new knowledge. Would not continuous assessment of essays and investigations together with an outside individual assessment through discussion be more useful?

If we are expected to recall facts concerning new areas of mathematics with a very limited amount of experience, we must have a different learning process to the children we teach - one important thing that I have learned by being in a learning situation again is how difficult it is to retain new knowledge or processes, very often without concrete experience, and how difficult is the ability to recall this after a period of time without repeated experience and practice."

(ii) (A man teacher aged 25-29, having a scale 2 post in a 7-11 school, who was still doing the course)

"Although I have confidence in my own mathematical ability and have done all the set mathematics homework etc., I really do fear failing the mathematics exam. If I did that, I feel it would be the end of my promotion prospects for quite a while. Then I think did I really volunteer for this course - the answer is yes! I really want to do the course, but I don't like the idea of that maths exam. You see, it's not like any other exam I've taken - you can't waffle or write around the topic. You either get it all right, (2) the method right but wrong answer or (3) completely wrong - no marks and a fail. There is too much at stake on that exam. It could be the end of a promising career, for if you fail you'd be known as - oh yes - he failed the Diploma in Mathematical Education exam - not very nice."

7.8 Tutors and moderators were asked (CQ, MQ) what practical steps could be taken to reduce students' anxiety about assessment (particularly about examinations).

Suggestions were made about reducing anxiety by looking at specimen questions or trial papers, putting more emphasis on the coursework and playing down the examinations, setting an informal atmosphere, (e.g. coffee at half-time) using 'prepared' papers or 'open book' examinations, giving reassurance, or by doing away with examinations (5 moderators).

One tutor commented ".... but the results show the anxiety wasn't necessary". All tutors and all moderators except one were sympathetic to the fears and worries of the students. The exceptional moderator commented " I am not aware of any anxiety other than that before the course is under way."

The Mathematical Education component

7.9 The Mathematical Education is, in practice, assessed by one or more of the following methods:

(a) a timed unseen examination;

(b) an examination in which the answers to questions have been wholly or partly prepared beforehand;

(c) one or more assignments set at various times during the course.

Information derived from college submissions indicated that four centres assessed the Mathematical Education by examination alone, fifteen by assignments alone and twenty-six centres used both assignments and examinations. The nature of the optional mixture has caused a deal of useful discussion at the preparation stage of submissions and at regional meetings of tutors and moderators.

The unseen examination is useful for asking questions to which teachers with special responsibility for mathematics might reasonably be expected to supply 'on the spot' answers, e.g. comments on children's work and difficulties and suggestions for developing the mathematics, how to use to good effect certain pieces of mathematical equipment, and understanding the sequential development of some aspect of mathematics.

Anxiety is not only associated with Mathematics examinations (see sections 7.6-7.8). Four different groups of students who were preparing for both a Mathematics examination and an unseen Mathematical Education examination were asked which examination they were more apprehensive about. In each group opinion was more or less evenly divided; some students were worried about the right/wrong polarity of the Mathematics questions, others were worried about the nebulous nature of some of the Mathematical Education questions.

A moderator for one centre reported "The 'seen' paper was a new approach, and it must be deemed a success. Eleven questions were presented to students one week prior to the examination, and three answers were required. The results gave evidence of directed and purposeful reading by students in nearly all cases. The marking was approached in a more critical manner than would have been deemed appropriate for an unseen paper. The anxiety factor was considerably reduced and students were appreciative of this new approach."

Tutors have devised an impressive amount of relevant, interesting assignments that call upon the teachers' experience of teaching and organising mathematics e.g.:-

1. Construct a mathematical game, use it in your classroom, comment on its effectiveness and value in mathematics learning.
2. Outline a sequential development of a topic in primary school (mention relevant apparatus and organisation).
3. Assessment - what is it for and how can you achieve a successful balance betweem competency and understanding?
4. Production of a resource file for the teaching of shape to a particular age range.
5. Discuss what you consider to be the desirable characteristics of a teacher who is responsible for the development of mathematics teaching in a primary school.
6. Choose a historial topic and show how its study can enrich present day maths lessons. Your account should focus specifically on the mathematical content of your chosen topic and it should be supported by clear examples drawn from your own experience.
7. What justification does Dienes give for the use of his Multi-Base Arithmetic Blocks? How useful do you think his views are in the teaching of other mathematical concepts? Illustrate your answer with examples.

Whilst the best of the assignments done by students skilfully linked theory and practice and included perceptive analytical comments, other assignments were, by comparison, pedestrian. Many teachers have expressed anxiety about having to write essays and they have obviously expended considerable time and effort, but often the bulk of the work is made up of an uncritical re-statement of information gleaned from a single source.

The Special Study

7.10 The preparation for the Special Study is described in section 6.32.

The better studies are a joy to read. They tell implicitly of the sensitivity of teachers in listening to children who are

learning new ways of thinking about mathematics. The quotations from the children's speech and the selection of children's work are both apposite and illuminating. The teachers' comments on the children's learning and their analysis of what has taken place frequently show a remarkable level of perception.

Weaker special studies may focus more on the teacher's teaching than the children's learning, they may quote children's dialogue or children's work inappropriately and they may not present any picture of a child or group of children who are thinking deeply about mathematics.

The Mathematical Investigation

7.11 Assessment and moderation of Mathematical Investigations can pose problems. Students have varying backgrounds and the quantity and nature of the tutorial guidance given are not necessarily easy to determine.

Feedback to students

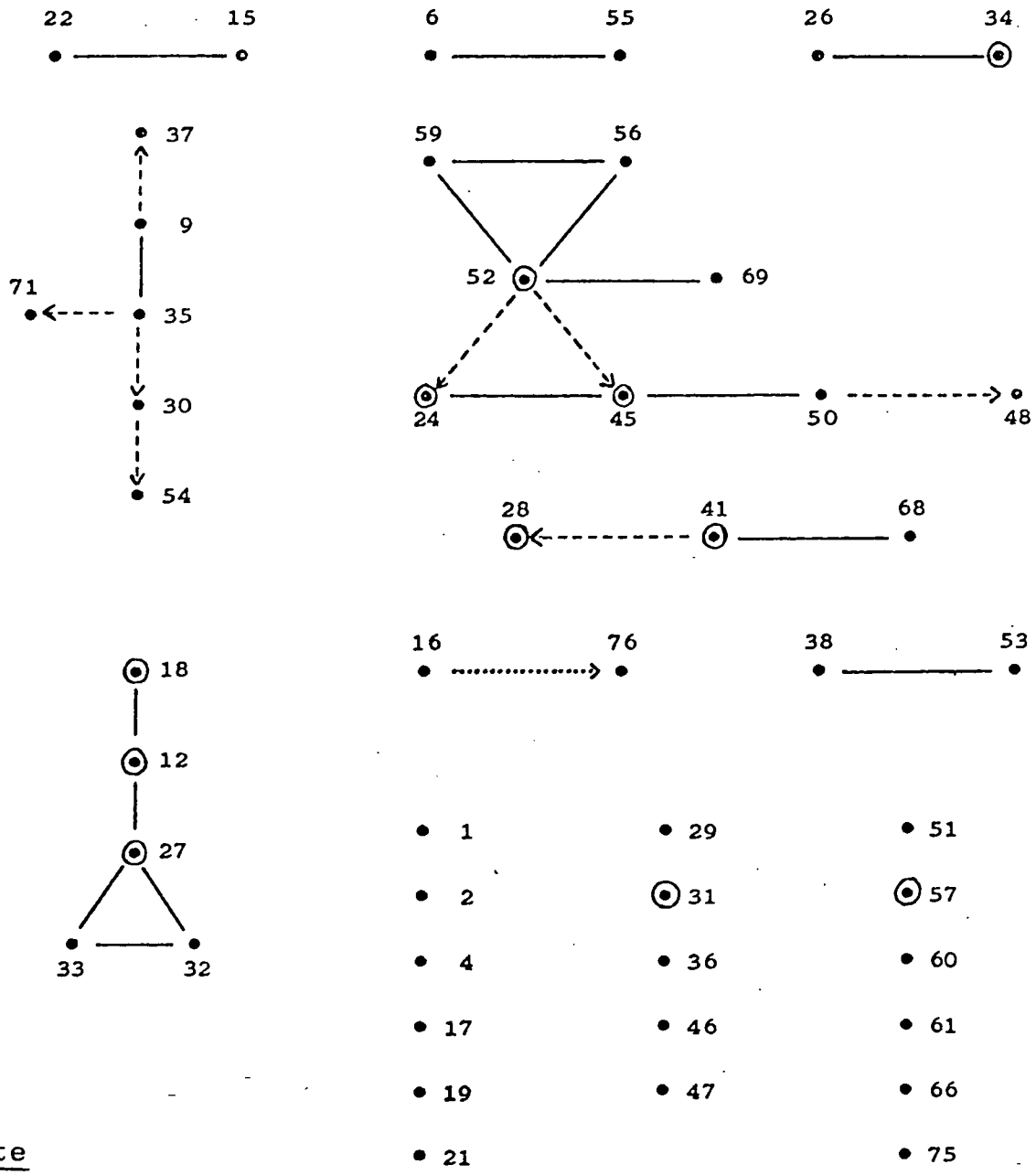
7.12 One of the regulations for the Diploma requires College Boards to "retain intact all marked examination scripts and records of all other assessed work for a minimum of five years".

A small minority of tutors have interpreted this by not returning any assignment work to the students. This cannot be good practice; it does not allow the students to learn from the feedback because they do not know whether their work is sufficiently satisfactory to justify further commitment of their spare time to the course. Above all, the teachers see it as educationally unsound. They realise the value of returning marked work to their children quickly and, whilst accepting that it will take longer for a piece of work to be marked say by two tutors and perhaps sent to the external moderator, they see little reason why the same value should not be realised on the Diploma course.

One student reported that she thought the tutors "ought to oversee a bit more, perhaps give a bit more work and directed

The network of Moderators in March 1981

7.14 The diagram below shows the network of moderators in March 1981.



Note

(a) The numbers ascribed to centres are in Appendix 2.

(b) The remaining symbols are defined as:-

- a centre with a single moderator
- a centre with joint moderators
- A ——— B centres A and B have a common moderator
- A - - - → B a tutor at centre A is a moderator at centre B
- A ·····→ B a former moderator at centre A is a moderator at centre B

reading. At least to let you have your work back. We had to assume that no news was good news, but we still have not seen any of the work." When the research fellow asked the tutor about the work of the students, and especially those in the small sample, he commented "There is no hurry to return the students' work. It originally got held up because of the moderator's illness. There is even a case for retaining it as assessment work."

The work of moderators

7.13 Moderators play an important role in the process of assessment. They and not the Diploma Board vet examination papers, check the marking of scripts and look at a sample of assignments, investigations and special studies. Their duties as external examiners are prescribed by the Diploma regulations.

The Diploma Board feels that it is desirable that no moderator shall moderate for a particular college for more than two consecutive 3-year licences. This may cause the network of moderators to become more connected. The expertise of tutors who have run effective and successful courses could be used to a greater extent in moderating courses.

7.14 See Diagram on the previous page.

7.15 The current work of moderators (or their last post if they have recently retired) is summarised in the following table:-

Work of Moderators	Number of Moderators
Primary school teachers	9
Secondary school teachers	2
LEA mathematics advisers	8
College mathematical education lecturers	11
University mathematical education lecturers	16
University mathematics lecturers	4

Ideally a moderator should have experience of teaching mathematics to infant and junior school children as well as the understanding of mathematics and mathematical education that provides the background to primary mathematics.

Some centres appoint joint moderators with complementary experience.

7.16 Approximately three-quarters of the moderators have a travelling time to the centre operating the Diploma of less than two hours; for approximately half the moderators, it is less than one hour.

7.17 Moderators were asked to give details of their work in moderating Diploma courses during the time interval from Easter 1980 to Easter 1981. The total time spent was generally in the range of 20 hours to 50 hours and most moderators made either two, three or four visits to the centre during that time.

7.18 The work of moderators seems to fall into three parts (*indicates that this is part of the work of all or most moderators):-

(i) being an external examiner for the course. This involves:-

* discussion of proposed exam questions
  discussion of proposed assignments (including Child Studies and Investigations)

* reading examination scripts (either all or a substantial sample)

* reading of Investigations, Child Studies and other assignments (either all or a sample)

* attending the college examiners' meeting

* writing a report to the College Board and the Diploma Board

(ii) meeting and giving encouragement to tutors and students, including some of:

* discussion of the progress of the course

* attending college Diploma board meetings

* meeting students
  meeting applicants for the course
  attending a Diploma presentation ceremony

* joining a day meeting or evening session of the course

(iii) meeting with other people including:-

* attending regional meetings and moderators' meeting
  consulting with the joint moderator.

7.19 Three case studies of the work of moderators follow:-

(a) A moderator for a centre in a rural area. He normally goes to the centre at lunchtime on days of visit "to talk with tutors in the afternoon before the evening visit to the course. Not all this talk is about Diploma work."

Details of visits (approx. 30 hours' work + travelling time):-

Month of visit	Purpose of visit
"May 1980	joining group for evening session
July 1980	social occasion/award of diplomas
October 1980	joining group for evening session"

Other work includes:-

"reading some projects and assignments
discussions with tutors
regional moderators' meetings".

A helpful covering letter included:-

"The difficulty in the case of local moderators is that people see each other often in other contexts. Thus I've met many of the teachers on the courses at other places and

we have sometimes talked about diploma matters e.g. projects and investigations, sometimes about other things."

(b) A moderator whose travelling time to the centre is ½ hour and who is able to look in on the course (which had some initial problems but which is now running well) fairly frequently.

(approx. 60-70 hours' work)

Visits:

Month of visit	Purpose of visit
April to July	"1st course Probably 4 visits to see the end of the course, seeing students, papers, moderating
July to April	2nd course 5 or 6 visits: To agree new schemes To vet students To meet students in the welcome meeting To meet students in course time To discuss essays"

Additional work:-

"Moderating final scripts, studies
" essays
Submitting report
Regional tutors/moderators' meetings
Moderators' meeting London"

(c) Unequal, joint moderation between:

(i) a college lecturer (12 hours + 2 hours' travelling, 1 visit)

The visit was

Month of visit	Purpose of visit
"June	See and moderate students' work with fellow moderator"

Additionally the work involved:-

"attending moderators' meeting, writing report

(Note: I am very much the second moderator working closely with first moderator who does most of work and receives most of fee. Being less closely involved with individual students enables a second moderator to probe more directly some of the issues raised in the moderation."

(ii) a primary school headmaster (20-25 hours + 3 hours travelling, 7 visits)

The visits were:-

Month of visit	Purpose of visit
"3 visits per year (once per term)	Talk to students on the course about primary maths, often together with a colleague.
2 visits per year	Discussion with tutors.
1 visit per year (July)	Meeting with other moderator, and college staff, for final marks.
1 visit (autumn)	To discuss with Diploma Board contact the renewal of licence.

"I meet twice during the year with the tutors to moderate marks given; usually at the end of the Christmas and summer terms. I moderate a sample of final scripts in the summer and then meet with the other moderator, who has also looked at sample scripts, to consider final marks for students, and meet with course tutors and college principal. This is in July."

A covering letter gives insight into the value of having a good primary school teacher as a moderator:-

"The form does not present the whole picture, nor can it, in the sense that being a local colleague to most of the people on the course, a great deal of my contact is of an informal and constant nature. If a student on the course wishes to discuss anything, they tend to call in at the school here, with the knowledge of the tutors; and very many of the students are teachers I meet in the normal round, due to my maths activity of an in-service training nature, in the area. I also see the tutors very regularly as they are in school supervising teacher-training students, so really I have constant contact with the courses, of a nature which it is difficult to show on the form.

I believe the fact that I am a practising teacher, and often take colleagues in to the course to talk to students, is a help - in fact, I think it's a distinct advantage to the course. On the other hand, because I'm in school, it is virtually impossible to find time to attend national discussions etc., which I recognise to be important, and in this sense I feel somewhat isolated."

7.20 Moderators were asked (MQ) "How do you think comparable standards of courses throughout the country can best be obtained?" Some of the 41 moderators made more than one response.

	Number of moderators	
Improve the flow of information		
Exchange of information at national/regional meetings	21	
Exchange of information at sub-regional meetings (of about 4 centres)	3	32
Circulation of sample exam papers	3	
Visits by moderators to other centres	2	
Discussions between moderators about particular pieces of work for assessment	3	
Improve the connectedness of the network of moderators		
Moderators responsible for more than 1 centre	8	
Joint moderation is helpful	2	
Some interchange of moderators from college to college (e.g. every 3 years, or in rotation)	2	14
More tutors involved in teaching the course to be moderators	2	
Central control		
An occasional super-validation exercise	3	
Stringent check on suitability of moderators	1	5
Comparability study between 3 or 4 centres	1	
Devolution of power		
Not sure it is possible - courses are different	5	
Not sure it is desirable - courses are different	1	7
A standard exam would be a retrograde step	1	

7.21 Moderators' reports for courses which finished before or in July 1981 were examined as part of the work of the research project.

Almost all the reports from moderators were penetrating, perceptive documents which discussed specific details and difficulties in an open and constructive way. They were supportive of and, in general, full of praise for those teaching the course.

7.22 Moderators' reports serve a useful purpose in that they give an account of the progress of the course by an external, informed person to the college and to the Diploma Board. From the viewpoint of the Diploma Board, moderators' reports together with the national moderators' meeting service to give an overall picture of Diploma courses which complements that obtained by members of the Board. The mode of validating the assessment of courses makes it important that all of the moderators' reports are seen by the Diploma Board. Just over 70% of the moderators' reports for courses which finished before or in July 1981 were available.

CHAPTER 8

THE PERFORMANCE OF STUDENTS

8.1 Two aspects of students' performance in Diploma courses are considered:

(i) the results obtained by students of different backgrounds (sections 8.2-8.18) and

(ii) information given by students who have withdrawn from the course including some case studies (sections 8.19-8.31).

The results obtained by students

8.2 This part of the report may be of special importance to tutors, to members of the Diploma Board and to other people responsible for planning mathematics in-service education for teachers so a summary of the findings is given in sections 8.7, 8.8 and 8.15 with reference numbers to the appropriate sections of the report.

8.3 The results of the courses that were completed in or before December 1981 were as follows:

Result	No. of Students	%
Distinction	173	(14%)
Pass	671	(53%)
Pass after resubmission	17	(1%)
Fail	41	(3%)
Not completed	28	(2%)
Withdrawn	333	(26%)
Total	1263	(100%)

A candidate who has "not completed" a course is one who, because of illness, pregnancy or other reasons, has been given an extension of time by their College Board in which to complete the course. "Distinction" and "Fail" are defined in sections 8.4 and 8.5 respectively. In subsequent sections the following notation is used:

D - Distinction

P - Pass (or Pass after resubmission)

F/W - Fail or Withdrawn from the course

and the candidates who have "not completed" the course are grouped with students who are currently in their first or second year of study for the course.

8.4 Originally a distinction was awarded to a candidate who achieved two A grades together with other grades of C or better. One particular reservation about this regulation was expressed by many people. To quote from a moderator's report that was received by the Board in September 1980:-

> "It particularly concerns me that a candidate who enters the course with a GCE Advanced level in mathematics might, with ease, obtain A marks in the Mathematics and Mathematical Investigation gaining a distinction even though the Mathematical Education operates at C level. Schools rightly expect potential for curriculum leadership through strength in Mathematics and Mathematical Education alike and inevitably promotions to posts of responsibility will be gained because of this."

(Such a student was fortuitously included in the small sample. For further details, see section 9.21) The data collected shows:-

Diploma Result

'A' level Mathematics	Other D*	D	P	F/W	Total
YES	28	8	37	19	92
percentage	30%	9%	40%	21%	100%
NO	59	80	649	355	1143
percentage	5%	7%	57%	31%	100%
Total	87	88	686	374	1235
	7%	7%	56%	30%	100%

where D* is a distinction including an A for Mathematics and an A for the Investigation. Candidates who have an 'A' level pass in mathematics do with relative ease gain distinctions with A grades in Mathematics and the mathematical Investigation; the contribution to the χ^2 sum from the top left hand cell alone was sufficient to ensure significance at a 0.1% level.

The Diploma Board agreed in May 1981 that "for courses starting after 31st August 1981, a distinction be awarded to candidates who achieve an A in at least one of Mathematics/Mathematics Investigation and an A in at least one of Mathematics Education/Special Study and who have no grades lower than a C." Suppose the new regulations had been in force for the students who completed the course in or before 1981. The relative numbers of passes and distinctions are different:-

	Diploma Result			
	D	P	F/W	Total
Old regulations	173	688	374	1235
percentage	14%	56%	30%	100%
New regulations	130	731	374	1235
percentage	11%	59%	30%	100%

When a χ^2 test was used to match the variables "'A' level mathematics", "BA/BSc not involving mathematics" and "Number of 'A' levels" with the results classified under the new regulations, they were still found to be significant at a 1% level (and "4 year Hons.BEd not involving mathematics" was not significant at the 5% level).

The table below is of the variable "'A' level mathematics " matched against the variable "result", classified both under the old and new regulations.

Diploma Result
under Old and New Regulations

'A' level mathematics	D		P		F/W	Total
	Old	New	Old	New		
YES	36	22	37	51	19	92
percentage	39%	24%	40%	55%	21%	100%
NO	137	108	651	680	355	1143
percentage	12%	9%	57%	59%	31%	100%
Total	173	130	688	731	374	1235
	14%	11%	56%	59%	30%	100%

8.5 Candidates with one grade E or three grades D fail the course.

Up to two complete elements that were graded D or E may be resubmitted within one year; the amended grade must be at best only one grade higher than the original.

8.6 The distribution of grades for the different components of the courses which were completed in or before December 1981 was:-

	Grade					
	A	B	C	D	E	Total
Mathematics	225	303	280	100	14	922
	24%	33%	30%	11%	2%	100%
Mathematical Education	96	354	388	69	10	917
	10%	39%	42%	8%	1%	100%
Special Study	155	298	328	105	18	904
	17%	33%	36%	12%	2%	100%
Mathematical Investigation	155	333	341	75	13	917
	17%	36%	37%	8%	1%	100%

8.7 The data from the students' registration forms suggests that the qualifications most likely to provide the basis for a good performance in the Diploma (see section 8.8) are:-

'A' level mathematics

a degree (other than a non-mathematical BEd), or

2 or more 'A' levels.

The information obtained from the large sample questionnaire suggests that other factors which appear to be associated in some way with Diploma results a teacher obtains (see section 8.15) are:-

the age of the teacher

an 'O' level mathematics qualification

tutorial provision during the course

use made by the teacher of his or her own workcards

the teacher's rating of the helpfulness of the Mathematics, Mathematical Education and the Special Study.

8.8 Students' results from Diploma courses (classified as distinction, pass (including those who passed after resitting part of the course), fail/withdraw) were crosstabulated against other variables derived from their registration forms. A χ^2 test was used to investigate differences between the three subpopulations (denoted by D, P, F/W).

(a) The calculated χ^2 values for the following variables were significant at the 1% level:-

'A' level mathematics - see table at 8.11(i)

BA/BSc not involving mathematics - " " " 8.11(ii)

Number of 'A' levels - " " "

(b) Only one variable was significant at the 5% level but not at the 1% level:-
Number of years' teaching experience.

(c) The calculated values of χ^2 for the following variables were not significant at the 5% level:-
Main or subsidiary level mathematics- see table at 8.13

4 year Hons.BEd. (not mathematics) - " " " 8.11(ii)

Starting date of course

Sex of student - " " " 8.12.

8.9 In section 4.16 the observation was made that data about teachers' status in school from the two sources of the registration form and the large sample questionnaire was inconsistent probably because of the design of the registration form.

A χ^2 test was used to match students' results against their status in school (LSQ) (with values of scale 1, scale 2 or above, deputy headteacher, headteacher). The calculated value of the statistic was not significant at the 5% level and so Diploma results do not appear to be associated with the Diploma student's status in school.

8.10 Of the 22 candidates who had a mathematics degree or a degree (e.g. 4 year Hons.BEd with mathematics as a main subject, Engineering, Physics, Chemistry) involving a substantial amount of post 'A' level mathematics, 11 gained a distinction, 6 passed and 5 withdrew from the course. Predictably a much higher percentage (50% as compared with 14% of the total population) of these students gain a distinction.

8.11 The following are tables of the 3 variables ((i) 'A' level mathematics, (ii) BA/BSc not involving mathematics, (iii) number of 'A' levels) for each of which the value of χ^2 suggests a significant difference (i.e. <1% level) in the Diploma results of the subpopulations D, P, F/W and so these variables appear to be connected with the students' performance in the Diploma course.

A much higher percentage (23%) of those having 2 or more 'A' levels gain a distinction than (9%) of those having less than 2 'A' levels.

8.12 If we consider the relative results of women and men students:-

	Diploma Result					
	D	P	Fail	Not Completed	Withdrawn	Total
Women	115	403	15	16	213	762
	15%	53%	2%	2%	28%	100%
Men	58	285	26	12	120	501
	12%	57%	5%	2%	24%	100%
Total	173	688	41	28	333	1263
	14%	54%	3%	2%	26%	100%

The value of χ^2 (with 4 degrees of freedom) has a significance level of 0.42%; when the data is modified by treating the Not Completed results as missing data and combining the Fail and Withdrawn values, the value of χ^2 (with 2 degrees of freedom) is not significant.

8.13 It was impossible from the registration forms to distinguish effectively between the teachers who had studied mathematics at main level at a college of education and those who had studied mathematics at subsidiary level as the variation in the number of contact hours and the style of the initial training courses causes difficulty in interpreting the information. The data comparing those who studied mathematics at college and those who did not are:-

	Diploma Result			
Main or subsidiary level mathematics at college	D	P	F/W	Total
YES	38	115	54	207
percentage	18%	56%	26%	100%
NO	135	573	320	1028
percentage	13%	56%	31%	100%
Total	173	688	374	1235
	14%	56%	30%	100%

The value of χ^2 (with 2 degrees of freedom) has a significance level of 9.0% and so the results of the two groups of students show no important differences.

If it were possible to distinguish those teachers who had done a substantial quantity of higher level mathematics at college, then the Diploma results of that subpopulation of teachers might reveal important differences.

8.14 Further information can be gained about the results of students from the information derived from the large sample questionnaire.

N.B. Care must be taken in interpreting and using the data in sections 8.15-8.18 because of the unequal response rates of students in the various subpopulations and in particular of the low response rate of students who have withdrawn from the course. Some of the data obtained from the LSQ may be weighted towards the views of those teachers who have been successful and so an over-appreciative picture of the value of the Diploma may be given.

Diploma Result

	D	P	Fail	Not Completed	Withdrawn	Total
Responses to questionnaire	75 16%	285 61%	15 3%	3 1%	86 19%	464 100%
All students	163 14%	660 55%	45 4%	26 2%	302 25%	1196 100%

8.15 The data was again re-coded to have three values (Distinction, Pass, Fail/Withdraw) and the χ^2 test was used in contingency tables of "result" against other variables, i.e. this continues the testing of D, P. F/W against the new variables and so is a continuation of section 8.8.

(a) The calculated χ^2 values for the following variables were significant at the 1% level:-

Age of the teacher	- see table at 8.16(a)
'O' level mathematics	- " " " 8.16(b)
Provision for tutorials in the course	- " " " 8.16(c)
Use made by the teacher of his or her workcards	- " " " 8.16(d)

The helpfulness of the Mathematics, Mathematical Education, Special Study in primary school mathematics as rated by the teacher - " " " 8.17

(b) The calculated χ^2 value for the following variable was significant at a 5% level but not at a 1% level:-

Number of academic year groups in classes taught by the teacher - see table at 8.18

(c) The calculated χ^2 values for the following variables were not significant at a 5% level:-

Catchment area of the teacher's school

Whether or not the teacher's school is in a SPA

Number of years' teaching experience

Number of children in the school

Whether or not the teacher is the school's mathematics specialist or consultant

The teacher's rating of the helpfulness of the Mathematical Investigation- see table at 8.17(iv)

8.16 Tables of data of variables which appear to be connected with students' performance and which were found to have a χ^2 sum suggesting highly significant differences in the subpopulations D, P and F/W are:-

	Diploma Result			
Age of teacher	D	P	F/W	Total
Under 30	21	47	15	83
percentage	25%	57%	18%	100%
30-39	38	13	28	202
percentage	17%	68%	14%	100%
40-49	20	88	47	155
percentage	13%	56%	30%	100%
50 and over	3	25	17	45
percentage	7%	56%	37%	100%
Total	82	296	107	485
	17%	61%	22%	100%

It is interesting to note that the percentage of the population gaining a distinction seems to decrease, and that the percentage of the population failing or withdrawing from the course seems to

increase, with increasing age.

(b)

	Diploma Result			
'O' level mathematics	D	P	F/W	Total
YES	77	255	80	412
percentage	19%	62%	19%	100%
NO	5	41	26	72
percentage	7%	57%	36%	100%
Total	82	296	106	484
	17%	61%	22%	100%

Teachers who do not have 'O' level mathematics are less likely to gain a distinction in and are more likely to fail or withdraw from Diploma courses.

(c)

	Provision for tutorials was:-		
Result	adequate	inadequate	Total
D	48	30	78
percentage	62%	38%	100%
P	191	95	286
percentage	67%	33%	100%
F/W	32	52	84
	38%	62%	100%
Total	271	177	448
	60%	40%	100%

The data underlines the necessity for good tutorial help for students.

(d)

	Use of worksheets/cards produced by themselves				
Result	Always	Frequently	Occasionally	Never	Total
D	4	49	23	4	80
percentage	5%	61%	29%	5%	100%
P	24	115	121	28	288
percentage	8%	40%	42%	10%	100%
F/W	18	41	29	9	97
percentage	19%	42%	30%	9%	100%
Total	46	205	173	41	465
	10%	44%	37%	9%	100%

Teachers who do well in Diploma courses are more likely to make frequent flexible use of their own materials for mathematics in their classrooms.

8.17 Students were asked to indicate how each of the four components of the Diploma course had helped them (if at all) in their teaching of mathematics. Their responses were matched against D, P, F/W and, as before the χ^2 test was used. The calculated value of χ^2 was significant at a 1% level in tables (i), (ii) and (iii), but for table (iv) the χ^2 sum was not significant at a 5% level.

(i)

Mathematics

Result	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
D	26	26	14	9	75
percentage	35%	35%	19%	12%	100%
P	107	88	69	18	
percentage	38%	31%	25%	6%	100%
F/W	15	23	27	14	79
percentage	19%	29%	34%	18%	100%
Total	148	137	110	41	436
	34%	31%	25%	9%	100%

(ii)

Mathematical Education

Result	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
D	19	36	16	4	75
percentage	25%	48%	21%	15%	100%
P	74	137	60	9	280
percentage	26%	49%	21%	3%	100%
F/W	14	20	30	9	73
percentage	19%	27%	41%	12%	100%
Total	107	193	106	22	428
	25%	45%	25%	5%	100%

(iii)

Special Study

Result	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
D	34	29	4	4	71
percentage	48%	41%	6%	6%	100%
P	84	113	57	24	278
percentage	30%	41%	21%	9%	100%
F/W	9	14	17	15	55
percentage	16%	25%	31%	27%	100%
Total	127	156	78	43	404
	31%	39%	19%	11%	100%

(iv) By comparison with the three preceding tables, the helpfulness or otherwise of the Mathematical Investigation did not distinguish between the subpopulations D, P and F/W.

Mathematical Investigation

Result	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
D	17	23	20	14	74
percentage	23%	31%	27%	19%	100%
P	48	89	78	56	271
percentage	18%	33%	29%	21%	100%
F/W	3	19	25	17	64
percentage	5%	30%	39%	27%	100%
Total	68	131	123	87	409
	17%	32%	30%	21%	100%

Students' comments about the usefulness of the four components of the course are contained in sections 9.10-9.13.

8.18 The χ^2 sum for the following variable when it was matched with students' results was significant at a 5% level but not at a 1% level.

Do the classes you teach contain children of more than one academic year group?

Result	YES	NO	Total
D	25	55	80
percentage	31%	69%	100%
P	118	172	290
percentage	41%	59%	100%
F/W	47	45	92
percentage	51%	49%	100%
Total	190	272	462
	41%	59%	100%

Although slight differences are indicated in the Diploma results of those who teach mixed age groups and of those who teach classes of only one academic year group, it is not possible to draw a conclusion from this table with any certainty for some schools choose a policy of vertical grouping of children whilst others, because of small or falling numbers of children, have to adopt this as a method of organising the teaching.

Students who have withdrawn from the course

8.19 Students who are less well qualified generally (e.g. have fewer than 2 'A' levels - section 8.11) or who are less well qualified mathematically (e.g. who do not have 'A' level, see section 8.11, who do not have 'O' level mathematics, see section 8.16) are more likely to withdraw from Diploma courses. Older teachers are more likely to withdraw from the course than those aged under 30 (section 8.16). The type, size and catchment area of a teacher's school do not seem to be important factors.

Beyond this the aetiology of students' withdrawal from the Diploma course is complex. The sources used are reasons stated by tutors (CQ), information from the supplementary sheet to the large sample questionnaire (Appendix 1) and discussions with the three students in the small sample who have withdrawn from the course and with the student who had not completed the work for the course at the end of the research project and who subsequently withdrew.

Information derived from the large sample questionnaire must be treated with some caution for 19% of those answering the questionnaire had withdrawn from the course whereas in the corresponding population of all students 25% had withdrawn. The information was frequently incomplete.

In all correspondence and discussions with teachers who had withdrawn from the course or who might be considering it, great care was taken to emphasise that about a quarter of students do withdraw from the course, that it was especially important for the future planning of courses to find out information from these teachers and that their help would be most valuable. They were also reassured that the information would be reported anonymously.

8.20 Students were asked (LSQ) for how long they had attended the course before they withdrew:-

No. of months of attending the course	No. of teachers	%
less than 2	5	4%
2 - 4	14	12%
4 - 8	35	29%
8 - 16	47	39%
more than 16	18	15%
Total	119	100%

So of the population of teachers who withdrew

16% of teachers do so during the first term of the course,

29% during the second term,

39% during the third or fourth term and

15% during the remainder of the course.

No coherent patterns emerged when this data was examined separately for the populations of men and women students or when the data was matched against their ages or the age groups of children they taught.

8.21 Teachers who had withdrawn from Diploma courses were asked to indicate to what extent they found the course helpful to them as teachers.

Their responses were:

Value of the course	No. of students	%
a hindrance	0	0%
no help at all	14	12%
of limited use	56	50%
fairly helpful	30	27%
other (please specify)	13	12%
Total	113	100%

All the 13 "other" comments expressed the view that the course had been more than "fairly helpful".

8.22 Tutors were asked to state reasons why students withdrew from the course. The reasons were classified. The classification was used in the construction of the large sample questionnaire so it is possible to compare globally the reasons stated by the tutors and the students. The headings in the table are not quite well-defined, for example, if the root cause of a teacher's withdrawal from the course was the extra stress caused by the break-up of his or her marriage, then the stated reasons could fall into any of a number of categories.

Reasons for withdrawal of students as stated by tutors and by students

(i) for some students more than one reason was given;

(ii) direct comparison is not possible; the two samples of students are different.

	as stated by tutors (for approx. 360 students)	as stated by students (119 students)
Diploma course		
Maths too hard	46	29
Pressure of work or assessment associated with the course	40	29
Course inappropriate	28	48
Lack of adequate financial support	4	6
Travelling distance too great	13	13
	131	131
School		
Pressure of school work	25	40
Promotion	26	10
Left teaching	9	3
	60	53
Home or domestic		
Pregnancy	12	5
Own illness	29	17
Family illness	15	5
Other personal problems/ reasons	14	12
General family or domestic pressure	35	25
Changed schools/moved to another area	21	34
Outside commitments	5	14
	131	112
Not known by tutors	70	

Even though the samples of students are different, consistency may be found between the tutors' and students' views as expressed in the table.

The students normally gave two or three reasons why they withdrew from the course; the tutors normally stated only one reason why a particular student withdrew. The data in the table suggests that reasons associated with the Diploma course and those with home and family life are roughly equally influential and those connected with the pressures of school less so.

The polarity between the students not coping with the demands of the course (Mathematics too hard, pressure of work or assessment associated with the course) as favoured by the tutors and the course being inappropriate as favoured by the students may be accounted for, to some extent, by semantics or possibly a difference in viewpoint, but nevertheless the tutors report inappropriateness of the course for approximately 8% (28/360) of students who have withdrawn but about 40% (48/119) of the students themselves claim the course is inappropriate.

The teachers, understandably, are more aware of the pressures of their school work. On the other hand, tutors seem fairly aware of some of the illness affecting the teachers or their families.

8.23 For 74 of the 119 teachers who had withdrawn from the course, it was possible to compare their reasons for withdrawing with those stated by their tutors. Of these 74 comparisons 60 showed agreement or some measure of agreement and the remaining 14 showed no certain consistency.

Overall this does great credit to the integrity and honesty of students and the perceptiveness of tutors. The 14 cases of possible major discrepancy are quoted in the table overleaf in the hope that the high level of sensitivity of those running and administering the courses will increase.

The reasons for withdrawal as stated by student and tutor in the 14 instances in which there may be discrepancy (see section 8.23)

Student	Tutor
Course badly run. Staffing cuts. Visiting lecturers were often late and left early.	Promotion, changed schools.
Pressure of course work, school work and domestic pressure.	Lack of adequate financial support.
Maths too hard, course inappropriate.	Pressure of school work.
Husband died.	Pressure of course work, school work.
Maths too hard, course inappropriate.	Withdrew on the morning of the exam.
Could not cope with modern maths. Felt the advertising for the course was misleading.	Course inappropriate.
Daughter in serious road accident.	Not suited to course.
General family and domestic pressure.	Travelling distance too great.
Unemployed. Own (nervous) illness. Pressure of assessment associated with the course.	Mathematics too hard.
Personal problems/reasons. General family or domestic pressure.	Moved to another area.
Course inappropriate, general pressure at home.	Mathematics too hard. Pressure of work or assessment associated with the course.
Maths too hard. Course inappropriate.	Pressure of work or assessment associated with the course.
Pressure of course work, school work, home life and outside commitments.	Own illness.
Personal problems.	Maths too hard. Pressure of course work. Course inappropriate.

8.24 Students' reasons for withdrawing from the course were tabulated for the three subpopulations classified as Mr., Mrs., Miss.

Note: Some students gave more than one reason.

Reasons for withdrawal from the course	Students classifying themselves as Mr.	Mrs.	Miss	Total
Diploma course				
Maths too hard	11	16	2	29
Pressure of work/assessment associated with the course	14	13	2	29
Inappropriate	16	24	8	48
Lack of finance	3	3	0	6
Travelling distance too great	4	7	2	13
School				
Pressure of school work	19	16	5	40
Promotion	3	6	1	10
Changed schools	2	4	5	11
Left teaching	1	2	0	3
Home or domestic				
Pregnancy	0	5	0	5
Own illness	6	10	1	17
Family illness	0	5	0	5
Other personal problems	4	7	1	12
General family/domestic pressure	8	14	3	25
Moved to another area	0	3	3	6
Outside commitments	6	5	3	14
(for comparison:- Numbers of students (LSQ) who have withdrawn from the course)	44 37%	63 53%	12 10%	119 100%

Men feel the pressures of work associated both with the course and school more often than women, whereas married women have to cope with family illness and other domestic pressures.

8.25 A quantitative study of data gives only partial clues as to students' motivation for withdrawing from Diploma courses. The teachers frequently cite more than one reason for not pursuing the course. These reasons are such that they are likely to be the cause of stress and anxiety to the teacher. If several stressful reasons

are mentioned then their total effect is likely to be greater than the sum of each of the stresses.

8.26 The next four sections consist of shortened case studies of the three students, Susan, Alan and Sarah, in the small sample who have withdrawn from the course, and of the student, Hazel, who has not completed the course and subsequently withdrew.

8.27 Susan withdrew from the Diploma course after two terms. She is aged 25-29, has an arts degree and a primary PGCE but no 'O' level maths. She currently has a scale 1 post teaching 8-9 year olds in a primary school of 101-200 pupils. The school is situated on a council housing estate in a city. The number of pupils in the school is falling fairly rapidly. Two teachers have had to leave in the past year and the school is to merge with an adjacent school. Susan commented "I am thinking of volunteering for redeployment. It's such an unsettled atmosphere at the moment and you always imagine it is going to get worse".

No children's work in mathematics was seen on either visit.

The college at which she took the primary PGCE was one that was visited in connection with the research project and the tutors indicated that then she had difficulty with both the mathematics and the teaching practice parts of the course.

The responsibility for organising the mathematics in the school is taken by the deputy headmaster. The headmaster commented on Susan's contribution at staff meetings: "When we have meetings she has been plugging Dienes' Blocks and place value materials. We have had some lively discussions."

Susan showed me an essay she had done for the course about the use of relations in the primary school. It was well written and supported with apposite quotations from the work of Williams & Shuard, Dienes, Stern and from the Fletcher resource books, but there was no direct reference to work she had done with children.

She described her dissatisfaction with the course at length. "Many of the lectures are boring and too theoretical, which is all right for full time students but rather frustrating when giving up

valuable free time. The amount of benefit from the course is small compared to time and work required to keep up."

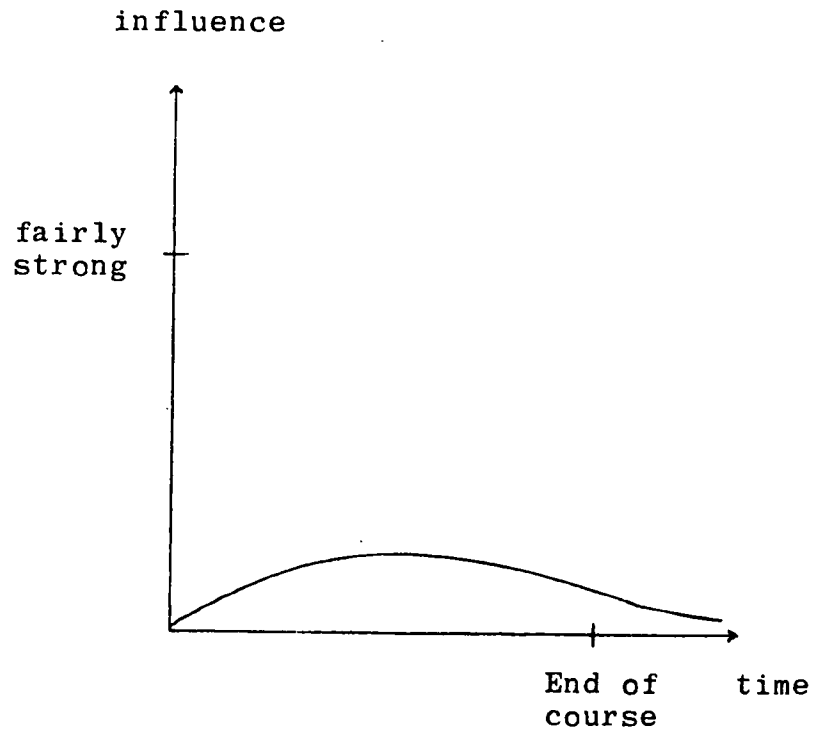
When asked if the course had helped at all, she commented: "It gave me ideas which I expanded on a bit. It made me feel quite confident in some of the things I was starting to do already. I'd been using Dienes' apparatus and I felt a lot more confident. The other people in the school don't really use it and I found that the other people on the Diploma course were a lot more progressive." When asked about how the course could be improved, she said: "It was quite a good idea really, but there was too much work for a full-time teacher. Some of the mathematical ideas for teaching were a bit poor but it might have been the way it was approached. I found it was a bit difficult. I was not used to sets or the rest of it."

She found the Mathematics Education "fairly OK":, the Mathematics lectures the worst and of those the ones about mathematical proof and mathematical modelling incomprehensible.

She reached a stage where she was doing so much maths in the evenings she found herself at school thinking "not maths again". In those circumstances it was surely a wise decision to withdraw from the course.

Susan drew the following graph in response to question 5 of the second year interview schedule (Appendix 3):-

Susan: Influence of the course



8.28 Alan withdrew from the course after two terms but continued, occasionally, to turn up for lectures. He is aged 55-59 and has been teaching for 9 years since he left the RAF. He has a scale 1 post in a school for children aged 5-12 and he is currently teaching 10-11 year olds. His teaching certificate had history and mathematics as main subjects; he has one 'A' level (Art) and 'O' level mathematics.

The children's work seen in his classroom was closely linked to the textbook used ('Basic Mathematics' by A.L. Griffiths) and very little help with difficulties or encouragement or praise was given.

The school is in the process of changing its mathematics policy and scheme. The headteacher commented on the work that was in progress and Alan's part in it:'

> "We have had two staff meetings to introduce Fletcher Maths, one in which the maths co-ordinator spoke to the staff about aims in mathematics and the various methods by which maths could be introduced in a classroom and then a follow-up meeting to that to discuss problems arising from the aims and objectives he set out. We are introducing Fletcher gradually through the school. It will take another two years to reach Alan's class. There have been meetings of staff who are on Fletcher Mathematics."
>
> "Within the staff meetings he has not played a terribly significant part. He has not initiated discussion."

Consequently the headteacher felt that the Diploma course had been no help to the school. He replied to the suggestion that Alan, being the oldest teacher on the staff, might have difficulty in talking to the younger teachers.

> "No, well. Alan is not a part of the staffroom as such. It's not a question of age. He takes his tea breaks sometimes in his own classroom and that sort of thing. I would not say he finds it difficult to talk to other members of staff. It's a very friendly staff, a very open staff."

Alan would advise a teacher contemplating the Diploma course to go ahead:-

> "I would say it's as good thing. It sorts you out a bit and I've learned a lot. I've straightened myself out. With maths we tend to see it from the adult's side rather than the child's side. I think we tend to expect children to

know too much. An adult will pick it up very quickly but sometimes a child will get muddled up."

Alan described his view of the role of the maths specialist in a primary school:-

> "The overall responsibility for the school maths. It's his business to know what's going on. If the teachers are not teaching correctly, explain to them in the nicest possible way 'perhaps you had better do it this way.....'. He is responsible for setting up the school curriculum as well. They have come to me from other classes and they haven't even known their tables. 9-10 year olds. Very often I have to set to with this lot and teach them some of the basic maths before we can even start getting on to the stuff we are supposed to do."

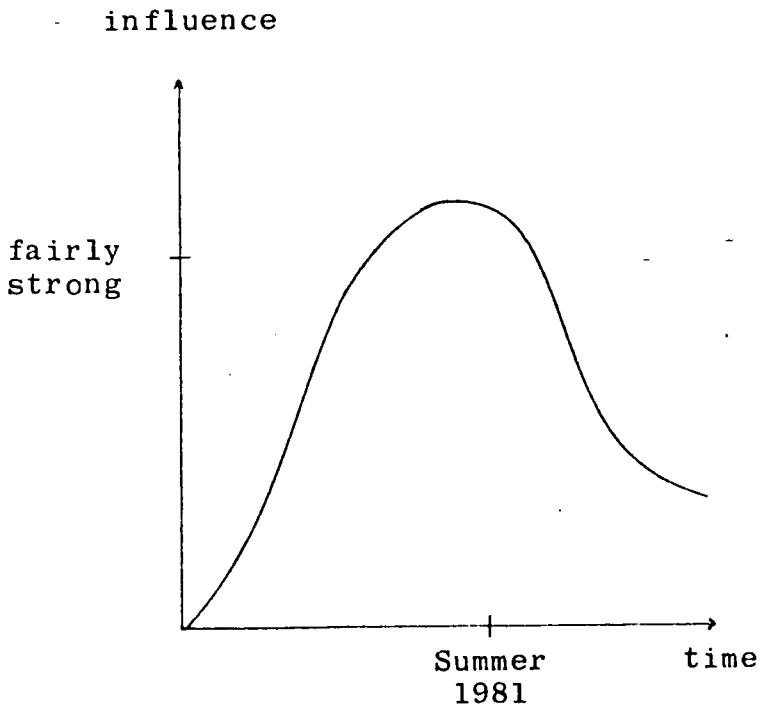
In spite of tutorial guidance, he produced a Special Study which was a sequence of activities and work for teaching fractions and did not explicitly mention children. His headmaster commented:-

> One topic on fractions he did, worried me in case it would take over an inordinate amount of time and distort the curriculum"

because Alan was proposing to teach fractions, and nothing but fractions, in mathematics to his children for the majority of a school year.

Alan has had difficulties at home - the death of his mother-in-law and "other personal problems, things". This accounts for the fall in the curve of the graph.

Alan: Influence of the course



The selection of teachers for the Diploma course was made by the director of in-service education at the centre and the mathematics tutors apparently were not involved (the policy has now been changed). Seventeen teachers were selected for the course Alan attended.

It does seem that the Diploma course has been worse than ineffectual from the point of view of the children that Alan teaches.

8.29 Sarah withdrew from the Diploma course after one year. She had separated from her husband (they have no children) and moved to another part of the county. She is aged 25-29 and is helping to organise the mathematics (scale 2 post) in a 5-11 school. She is currently teaching 6-7 year olds. She has no 'A' levels but took a main mathematics course at college.

The children's work seen was based on the Nuffield scheme and Sarah was sensitive to the difficulties experienced by some of the children and capable of extending the brighter children.

The headmaster praised her work in teaching and leading the mathematics in the school (a teacher who has a scale 2 appointment for organising the mathematics in the junior part of the school will probably take early retirement). He talked about the influence of the course:-

> "Well in Sarah's own classroom. Maths is her main interest. She was appointed to a scale post in maths when she came to the school and so her room has always looked good for maths. She's been asked for a lot of textbooks, a lot of additional materials, which she is using initially in her own classroom, and then she feeds it out to the whole infant department."

Sarah would encourage a prospective student to take the course:-

> "By all means. I've learned ever such a lot of maths and I think it's the sort of course that should be run in teacher training colleges."

but she did not enjoy writing essays:-

> "Horrible, I kept putting it off and putting it off. We had one tutorial about that and I feel we should have had more. I think that they are in touch with students and they forget just how rusty we are."

E.A. Albany (Ed) 'Nuffield Mathematics 5-11' - Longman

She has gained a lot from the one year of the Diploma course:-

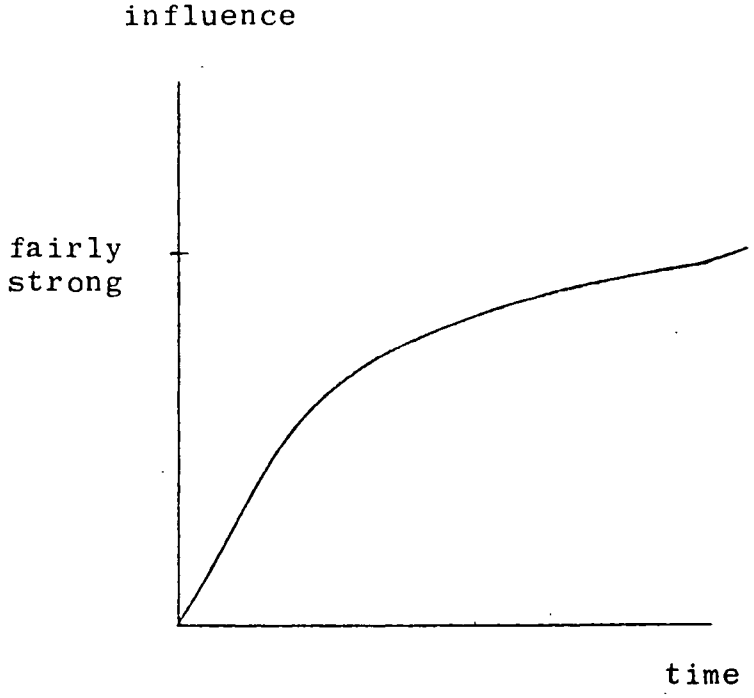
> "We did polyominoes and I came back and talked to them about that, you know. If you had a bright child you could stretch them doing interesting experiments using centicubes. We have had a talk from a headteacher in a first school about organisation and she gave us some helpful points which I felt was very good and I came back and talked to them about that and picked up ideas."

but she was critical of the poor lecturing for some of the Mathematical Education. The Diploma course she felt could be improved by incorporating some work with children and more detailed help with the organisation of mathematics.

> "you need to be able to help the staff without sounding a know-all."

Sarah seemed shy on the first visit; she had to be persuaded that a second visit would be valuable and then, although she seemed upset, she talked with some enthusiasm about her work in constructing schemes of work, devising assessment sheets, discussing with other teachers how to 'fill the gaps' in the Nuffield scheme and dealing with other teachers' difficulties in teaching mathematics.

Sarah: Influence of the course



Sarah described the influence of the course as "up and down". Some weeks were very good, some weeks were useless."

Sarah has now moved to within 15 miles of another centre which teaches the Diploma course and so, in theory, she would be able to resume her studies after a break of a year. She has decided against this. Perhaps a year is not long enough for her to recover sufficiently from the hurt and the separation to allow her to study for a substantial course in addition to all the work she does in school. On the other hand, a two year break in the middle of a Diploma course may be considered to be too long for educational reasons.

8.30 Hazel started the course in September 1979 but failed to complete the course. Her teenage son had a serious road accident in 1981. She was obviously shattered by the shock. Her son has now recovered and shows no sign of brain injury. On the second visit, in 1982, Hazel was happy and confident; it was like talking to a different person.

She still had a quantity of work to complete before the summer of 1982. She planned to write up the investigation (palindromic numbers), do an essay (mixed ability teaching) and write up the Special Study in the Easter holiday! See section 10.8 for details of her, and the other students', contribution to LEA in-service work.

8.31 It is difficult to summarise with confidence the motivation for these four teachers taking the course and their reasons for withdrawing from it.

Susan saw the need to strengthen her mathematics and to increase her chances of gaining promotion but she found that a mixture of the mathematics in the course being inappropriate and badly taught, stress at school caused by uncertainty about redeployment and poor relationships in the staffroom, and possibly other personal difficulties, caused her not to complete the course.

Alan's stated motivation for joining the course was for help with teaching mathematics. It is not clear why the college accepted him in the first place.

Sarah took the course for help with both teaching mathematics and organising the mathematics in her school. Her work for the course was good and both she and her school derived benefit from the course. The break-up of her marriage, the subsequent separation and moving to another part of the county is, and will continue to be for some time, a cause of distress. It is a pity she does not feel able to resume the course after a break of a year.

Hazel's motivation for taking the Diploma course was to gain help with her teaching of mathematics, her own mathematics and organising the mathematics in her school. The course has been valuable both for her personally and for her school. She is fortunate in attending a course that requires day-release from school. She would not have been able to cope with the extra pressures of an evening course alongside the shock and worry of a serious accident to her son.

CHAPTER 9

THE RESPONSE TO THE COURSE BY TEACHERS AND THEIR SCHOOLS

9.1 In 1981 the 41 teachers in the small sample were asked "Suppose a teacher came to you who was thinking of starting the course in September, what would you say to them?"

The response was immediate:-

Go ahead and do it...	25
Think carefully - the mathematics is difficult	6
Think carefully - consider how you will cope with the workload	7
Don't do it	3

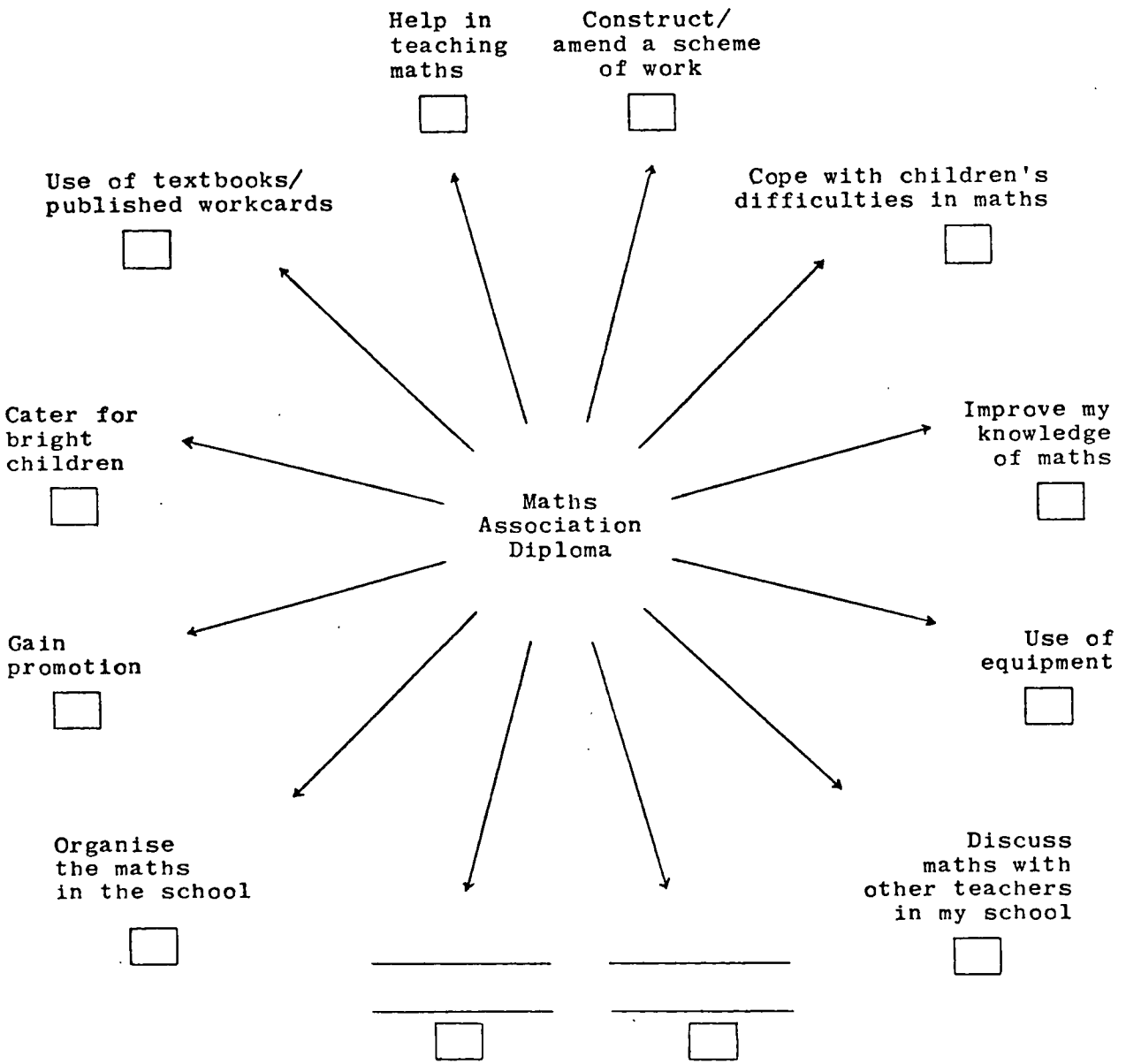
Details of the difficulties students experience with the mathematics can be found in sections 6.6-6.7 and the difficulties of coping with a substantial part-time course are described in sections 5.12-5.14.

The students' rating of the helpfulness of aspects of the course

9.2 The small sample students were given a copy of the diagram on the following page and asked to mark each of the boxes with one of the numbers from 1 to 4 as in the scale on the right hand side.

Their responses are summarised in the table:-

The helpfulness of aspects of the Diploma course



1. Very helpful.
2. Fairly helpful.
3. Of limited help.
4. No help at all.

	Very helpful	Fairly helpful	Of limited help	No help at all	No response
Personal					
Improve my knowledge of mathematics	26	10	4	1	
Gain promotion	7	5	11	14	4
Teaching mathematics					
Help in teaching mathematics	18	18	4	1	
Cope with children's difficulties in mathematics	7	23	10	1	
Cater for bright children	14	11	13	3	
Use of equipment	7	14	19	1	
Use of textbooks/ published workcards	9	13	14	5	
Organising the school mathematics					
Construct/amend a scheme of work	15	15	8	2	1
Organise the mathematics in the school	12	16	10	3	
Discuss mathematics with other teachers in my school	15	19	7	0	

There are several points in the table that require comment (sections 9.3-9.8).

9.3 It is encouraging that teachers feel their own knowledge of mathematics has improved. If this is associated with an increase of confidence in and of liking for the subject then the following criticism of primary mathematics teaching may not apply in their classrooms:-

> "However for the children who showed most marked mathematical ability the work was often too easy and it is a matter for concern that these children's abilities were not fully extended in their work in this subject."
> (HMSO (1978) Primary Education in England, a survey by HM Inspectors of Schools)

9.4 The figures obtained for help in gaining promotion reflect the frustration felt by conscientious and ambitious teachers at a time when opportunities for promotion are few.

The table in section 4.18 indicates that approximately 20% of Diploma students are gaining promotion or greater responsibility for mathematics in their schools. Teachers in the small sample who had gained promotion generally felt that the Diploma had been helpful; most of them had been asked non-searching questions about the course at their interviews.

9.5 A selection of the teachers' comments about the course being helpful (or otherwise) in considering how to cope with children's difficulties in mathematics is quoted:-

> "Lots of help. Diploma sessions on e.g. subtraction were useful and when I talked to other teachers on the staff (of my school) they asked the same sort of questions."
>
> "We did not deal with it on the course but my child study followed up children's difficulties."
>
> "Limited. We could have gone through fractions or decimals and looked at the basic mistakes."
>
> "I think I was coping before but it's given me more confidence."
>
> "I think the improvement in my own mathematics has given me more confidence and more idea of what to look for, when to be patient, when to push and when to change direction."
>
> "I don't think I saw enough material and enough of the structured help that slow learners need."

9.6 In the table in section 9.2 it was not obvious whether "use of equipment" and "use of textbooks/published workcards" should be classified as being more pertinent to teaching or organisation for mathematics. Certainly they are both among resources to be used by a teacher in his or her classroom. Although their use will presumably have been discussed on the teacher's initial training course, it is a worthwhile exercise during the Diploma course to examine and investigate, in the light of the teacher's classroom experience, the value and range of possible uses of the different types of resources available.

In addition part of the duties of a mathematics co-ordinator should be to "organise and be responsible for procuring,

within the funds made available, the necessary teaching resources for mathematics, maintain an up to date inventory and ensure members of staff are aware how to use the resources which are available." Some 38% of Diploma students are the mathematics co-ordinators for their schools (section 4.19) so discussion of priorities in buying equipment and of how to help their colleagues to use equipment well in mathematics lessons are valuable aspects of Diploma courses.

A typical selection of the comments students made about the helpfulness (or otherwise) of the Diploma course in discussing use of equipment are listed:-

> "Not very helpful. They did show us some film strips."
>
> "They had a wealth of equipment. I am just beginning to realise the importance of it. It's expensive but you can make things like Napier's rods."
>
> "The maths education was too theoretical and could not easily be used in school. He lost most people, including me."
>
> "It has encouraged me to use equipment and to be more experimental ... I would also use the OHP because things like geoboards and clock faces, they all show through on the OHP and are a far better teaching aid than each child having it on his desk to meddle with as it were."
>
> "I felt that it was light; we should have seen more commercially available equipment and made some of our own."
>
> "Poor apart from a lot of structural apparatus."

These comments can usefully be set in the context of the data in section 6.4(iv) which indicates that only about 20% of Diploma students thought that the time given to "priorities in buying equipment" was about right.

Perhaps tutors need to consider the relevance of the following statement of the Cockcroft Committee for their Diploma courses:

HMSO (1982) 'Mathematics Counts' Report of the Cockcroft Committee of Inquiry.

"Practical work is essential throughout the primary years if the mathematics curriculum is to be developed in the way we have advocated ...."

9.7 The Cockcroft Committee also expressed the view that part of the duties of a mathematics co-ordinator should be to "prepare a scheme of work for the school in consultation with the head teacher and the staff and, where possible, with schools from which the children come and to which they go."

In the light of this it is interesting to examine the views of Diploma students about the helpfulness (or otherwise) of the course in constructing or amending a scheme of work:-

"Not very helpful - only a brief discussion at the end of the course. I hoped to come away with ideas for a framework for the school maths."

"We did work on formulating a scheme for particular topics. I got some idea of how to go about it."

"We've probably only had one set of guidelines to look at but we have not got down to the basic part of it, so when it comes to the construction of a scheme, no."

"I would want to see it linked to material as well."

"We've had two or three discussions and the trouble is that you start arguing about one little detail."

"Yes I did some work which I'm not being allowed to implement."

"We did a good series of work on area and looked at the stages right through from 5 to 13."

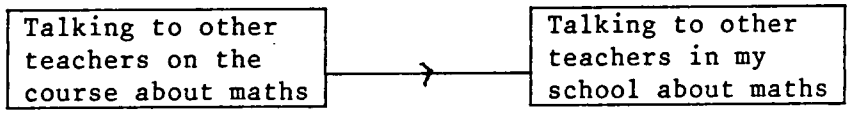
Again these comments can be set in the context of the data in section 6.4(iv) that only about 25% of the students thought that the time allocated to constructing a school mathematics scheme was about right.

9.8 In the diagram in section 9.2 there are two empty spaces. Students were asked if the diagram had covered the most important things or whether anything really stood out as being missed. The most frequent comment (6 teachers from the 41) was that talking to

other teachers on the course had been very helpful. This may have been triggered by the adjacent statement "discuss mathematics with other teachers in my school" which 34 out of the 41 teachers rated as very or fairly helpful but further discussion revealed many interesting comments such as:-

> "The Diploma has tremendous value in the discussions we had with other teachers. It's the general interchange. You don't feel guilty about talking about maths on the Maths Diploma. If you come into the staffroom and talk about maths - 'she's at it again'."

Many teachers saw the connection



as being a very important one for influencing positively the quality of mathematics in their schools.

The relative helpfulness of the four components of Diploma courses

9.9 Students were asked (LSQ) to indicate how each of the four components of the course had helped them in their teaching of mathematics. Only the replies of those students who started the course in 1978 or 1979 are recorded because the students who started the course in 1980 were generally only in the second term of the course and would have difficulty in assessing the helpfulnes of the course.

	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
Mathematics	216	137	110	41	504
	43%	27%	22%	8%	100%
Mathematical Education	105	194	105	22	426
	25%	46%	25%	5%	100%
Special Study	126	157	77	43	403
	31%	39%	19%	11%	100%
Mathematical Investigation	66	132	122	87	407
	16%	32%	30%	21%	100%

The students were asked to give further details of how they found the components helpful. The following four sections (9.10-9.13) discuss their replies.

9.10 Students' further comments on the usefulness of the Mathematics were roughly classified as:-

The Mathematics component gave	Frequency	
Increase in knowledge	97	25%
Increase in interest/confidence	23	6%
Increase in knowledge and interest/confidence	41	11%
No increase in confidence (e.g. "it made me understand what some of the slow learners in my class must feel")	33	9%
Insight into the structure and progression of mathematics (e.g. "it showed me where the maths I teach is leading")	64	17%
Useful integration with classroom experience	43	11%
No integration with classroom experience	50	13%
No help	21	5%
Other comments	13	3%
Total	385	100%

Most of the teachers in the small sample mentioned examples of work they had tried in their classrooms as a result of the course:- work on 3-d shape, symmetry, probability, sets. One or two teachers mentioned that they gave their children problem solving situations and investigations but this was not a general feature of the classrooms visited and the children's work seen. One teacher summarised this level of influence of the Mathematics component by:-

> "I've enjoyed it. I don't think in terms of my own classroom there has been much of a change apart from the odd new idea."

One teacher had been helped greatly by the Mathematics component:-

> "The maths fell into place and instead of feeling that I was no good at maths at all, I felt that I'd been subjected to bad teaching in the past. I've started to read books about maths. I'm taking 'Mathematics in Schools' now."

Two infant teachers had serious misgivings about the Mathematics component:-

"I did not enjoy it at all. It was maths at my own level. It was just so irrelevant."

"It's been too high powered to be any help. Far above what any infant teacher would need."

A teacher who is a headmaster in a small 5-11 school reinforced their views:-

"The first five minutes were on infant work and then on to junior work. To improve things you really need an infant specialist, someone who really knows about infants."

Would you want the intersection of infant specialism and maths specialism?

"Oh yes, yes indeed. My wife is an infant teacher. She went on the course hoping to improve the mathematics side and felt that it was lacking in help to teach in an infant school."

Help given by the Mathematics component

Type of School	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
Nursery, infant or first	21 25%	28 34%	19 23%	15 18%	83 100%
Junior or Middle	64 40%	45 28%	37 23%	14 9%	160 100%
Infant+junior or first+middle or special	49 31%	51 32%	46 29%	12 8%	158 100%
Secondary	10 37%	12 44%	5 19%	0 0%	27 100%
Total	144 34%	136 32%	107 25%	41 10%	428 100%

A smaller proportion of the teachers of children in the 5-9 age range found the Mathematics component very helpful than of the teachers of older children.

9.11 The teachers' comments on the helpfulness of the Mathematical Education component can be roughly analysed as:-

Mathematical Education component

	Frequency	
Relevant to the classroom	125	35%
Relevant to classroom + school organisation	33	9%
Not relevant	21	6%
Helpful	77	21%
Not helpful	73	20%
Other comments	32	9%
Total	361	100%

Teachers in the small sample were appreciative of relevant and useful assignments and of the value of the discussions with other teachers. They expressed a spectrum of opinion as indicated below:-

> "Very, very helpful indeed. We got lots of practical ideas which I've found I can use in the classroom. Maybe it will take me a year to assimilate all the information I've received and to present it in the classroom."
>
> "More influence on how I teach rather than what I teach - a much more practical approach - that sort of thing."
>
> "I would say that it was the least well covered part. Organisation in school or teaching maths we have not done in anything like the depths of the other parts."
>
> "It's been awful. Too vague, too theoretical."

Helpfulness of the Mathematical Education component

Type of School	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
Nursery, infant or first	26 32%	34 42%	16 20%	5 6%	81 100%
Junior or Middle	36 23%	73 46%	39 25%	9 6%	157 100%
Infant+junior or first+middle or special	36 23%	71 46%	42 27%	7 4%	156 100%
Secondary	5 19%	12 46%	8 31%	1 4%	26 100%
Total	103 25%	190 45%	105 25%	22 5%	420 100%

There is not the same substantial difference of view between infant (and first school) teachers and teachers of older children about this component as there was about the Mathematics component.

9.12 The comments made by students about the value of the Special Study can be summarised as follows:-

	Frequency	
Valuable - made aware of children's individual problems or difficulties	158	34%
Valuable	92	26%
Useless	33	9%
Very time-consuming	17	5%
Not clear what was expected (often critical of preparation and tutorial guidance)	15	4%
Other comments	37	11%
Total	352	100%

Teachers in the small sample made many appreciative comments which reflected the overall picture, e.g.

"It made me think out what I was doing."

Some mentioned that there may be difficulties in organising this work in school:-

> "The only way to observe the children in anything like the depth required is to use a tape recorder in a quiet room. I don't find taping in a classroom is at all feasible. Fortunately having a student (on teaching practice) has freed me. Our deputy head has a student which again freed me for a couple of half hours. I know some people on the course are getting no time. They are in difficulty over it."

Helpfulness of the Special Study

	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
Nursery, infant or first	32 42%	26 34%	10 13%	9 11%	76 100%
Junior or Middle	39 26%	65 44%	29 19%	16 11%	149 100%
Infant+junior or first+middle or special	47 32%	55 37%	32 21%	15 10%	149 100%
Secondary	5 22%	9 39%	6 26%	3 10%	23 100%
Total	123 31%	155 39%	77 19%	42 11%	397 100%

It is interesting to note that the proportion of teachers who rated the Special Study as "very helpful" decreases with the increasing age of the group of children taught.

9.13 Teachers' comments about the usefulness of the Mathematical Investigation have been summarised as:-

	Frequency	
Valuable and enjoyable personally (but no transfer into the classroom	133	38%
Valuable and enjoyable + transfer to classroom	102	29%
Too difficult	18	5%
Not clear what was expected (often criticism of preparation and tutorial guidance)	4	1%
Useless or a waste of time	65	18%
Other comments	31	9%
Total	353	100%

The small sample of teachers made varied and interesting comments on this aspect of the course:-

> "I spent an awful lot of time getting nowhere but I enjoyed it. If you don't like doing that sort of thing, then you can't see that playing about with numbers is fun and you won't be able to teach maths in a way that children will consider to be fun."
>
> "I'm using investigative work with the fourth year top set."
>
> "It's difficult to do open-ended work with our school organisation."
>
> "It's just a hard slog and it isn't going to make me a better teacher."

Of particular interest is the conversation with the one teacher in the small sample who is a mathematics graduate about her use of investigations and some of the problems of getting teachers to adopt open-ended work:-

> "I use them all the time. I used them last year with a set of brighter fourth years, and the whole of the half year's work was based on investigations. Now they had never met them before, they did not do them to the depth I wanted, they were so used to ticks and crosses. When they had got

a minor solution they wanted to stop and start with the next thing. They did not seem free to go off on a chain of their own even though they knew I would accept that. They found that hard, which is inevitable, but they enjoyed it."

How much confidence do you think a teacher needs in their own personal ability to do mathematics before they are prepared to use investigations with children?

"A lot more than they have got. Some of them have sufficient problems dealing with ordinary mainstream curriculum work and would not dare step out of it. I think that there is the fear that with investigations there are no answers and I think teachers who have not quite got the confidence need the answers. I would not be as prepared to step out of line in another subject, but I would be more prepared to tackle open-ended work in English than a non-mathematician would be prepared to tackle it in maths. It's very easy to spot able maths children who are brighter than you. It must be disconcerting to find a 10 or 11 year old... I suppose it depends what you are like as a teacher doesn't it?"

Helpfulness of the Mathematical Investigation

Type of school	Very helpful	Fairly helpful	Marginally helpful	Not helpful	Total
Nursery, infant or first	11 14%	20 25%	24 30%	25 31%	80 100%
Junior or Middle	36 24%	49 32%	35 23%	31 21%	151 100%
Infant+junior or first+middle or special	14 10%	54 37%	52 36%	25 17%	25 100%
Secondary	4 16%	6 24%	9 36%	6 24%	25 100%
Total	65 16%	129 32%	120 30%	87 22%	401 100%

Comments about the primary PGCE

9.14 The Cockcroft Committee commented on the problems of the primary PGCE as a preparation for teaching mathematics to young children. A short time is available, many students may not have studied mathematics for at least five years and many students may have a sense of inadequacy in mathematics.

All of the five teachers in the small sample who entered the profession by this route spontaneously mentioned the inadequacy of their training.

The mathematics honours graduate who had a primary PGCE had done a degree which did not involve group theory and a post-graduate education course which provided method courses for all subjects in the primary school curriculum except the subject of the student's degree.

Another student (Dave, see section 9.25) commented:-

> "I did a one year PGCE. Most of that (mathematical education) was left as incidental. It was simply a practical, pragmatic training for teaching. Not perhaps the fault of the course but more because I was concentrating on the actual teaching."

The view of another graduate student at the end of her Diploma course was that the combined influence of the primary PGCE and the Dipoloma course formed a useful minimum preparation for anyone wishing to teach mathematics in a primary school:-

> "I can't help feeling that what I have now is not much more than a minimum, really, for anyone hoping to teach mathematics reasonably well. It's (the course) given me an awful lot but it does not seem too much."

This small quantity of evidence does seem to support the Cockcroft recommendation "In our view the long-term solution lies in lengthening the PGCE course for primary teachers' and it does seem to point to a need, in the short term, for in-service education of teachers.

The view of headteachers

9.15 In 6 of the 41 schools visited the Diploma student was the headteacher. A selection of views from the headteachers of the 35 students who were not headteachers in the small sample on how helpful they felt the Diploma course had been to their schools follows:-

Little or no help

> "It hasn't been particularly, it does not seem to have stood him in particularly good stead."

"It's more appropriate for a 'liberal' school than a 'formal' one."

"No help."

"Not really."

Some help with the students' teaching but little throughout the school

"It's not had a great impact outside of his classroom."

"Not a lot except that it has given her more confidence."

"It's been useful without doubt. It has given her new ways of looking at maths."

"It has added to her conception of maths."

Help with the mathematics throughout the school

"She has a greater measure, if that's possible, of enthusiasm for and knowledge of maths. At meetings of other members of staff the enthusiasm has bubbled out of her."

"It has introduced into the school innovations in the form of equipment and approaches."

"He has shared his new ideas with the staff."

"If you look at it in the long term it's a learning process on his part, and on our part we have to learn how best we can use him."

"I find it a tremendous asset to have someone in the school who knows about recent developments and different approaches."

"I feel she has come out a more confident teacher. The extra qualification I think has helped her in dealing with other members of staff."

"He has always done a lot and been interested in maths. I think it's given the maths more impetus."

"It's reflected in her enthusiasm. She is devising schemes or work, assessment sheets."

"She succeeded and success brings confidence. She certainly is able to draw out other people's ideas and to present hers."

"During the course the two teachers gave a lot of support to each other. They also support each other in the way they look at the curriculum, in the alterations they can see as possible!" (Two teachers in the school were Diploma students.)

Agnosticism

"It's going to be difficult for me to sort out what he would have done in any case and would have done specifically because he's been on the Diploma course."

"I did not know her before she did the course so I've no real idea of what effect it had on her. There is no doubt that she has had a big effect on the maths in the school."

"I'm not certain what can be ascribed to the Diploma course."

Of the six students who were headteachers, two made comments that the course had clarified their ideas about the work and purpose of a mathematics co-ordinator:-

Help in appointing a mathematics co-ordinator

"The two serious contenders for the job were both doing the Diploma course." (The teacher who was appointed was in the small sample.)

"Yes, because I knew what I wanted. It was easy to discern those who thought that being the maths expert was just knowing your tables and being good at it." (The headteacher was a member of the small sample).

Judging from a personal viewpoint, in over 80% of the schools visited the headteacher was giving excellent support and encouragement to the teacher who was the Diploma student.

9.16 Students were asked (LSQ) how effective they thought the Mathematical Education component of the course was in helping teachers to organise and lead the mathematics in a school. Their replies are summarised in the table below:-

	Frequency	
Highly effective	108	17%
Fairly effective	293	47%
Of limited effect	191	30%
No effect	34	5%
A hindrance	2	<1%
Total	628	100%

9.17 During the second visit to the schools of teachers in the small sample it was important to look for changes in the teaching and organisation of mathematics in the school.

When the teachers were asked what changes they had made in the teaching (or organisation) of mathematics, typically they commenced by saying "nothing much" or "basically I'm still teaching the same way", but when they were asked to talk about the work they had been doing the picture many teachers gave was somewhat different. The following list of comments are those for which it was possible to obtain supporting evidence from the teacher's classroom or spontaneous confirming comments from the headteacher or other members of staff.

Substantiated developments in the mathematics in the schools of teachers in the small sample

Little or no development

Nothing much (4)

Nothing directly attributable to the course.

Gained promotion to another school.

The teachers "are not really interested in maths at the moment; they are concerned about their jobs. It's terrible isn't it?"

The headmaster had to intervene when the teacher, who had misinterpreted the Special Study guidelines, proceeded to teach the children in his class nothing but fractions in mathematics for a whole year (see section 8.28).

Some substantiated development

More investigative work used in my classroom.

More use of charts and hardware.

Calculators are starting to be used.

Calculators introduced into year 4.

"The course has influenced his teaching. Lots of little things."

Supplementary material written for SMP 7-13.[1] More staff discussion.

"I have gained in confidence; anyone on the staff can come to me and ask a question and if I don't know immediately then I know sources to find out."

"The influence of the course continues, it still gives me the basis for explaining things."

"Nothing directly attributable to the course. SPMG[2] has been introduced in place of Beta."[3]

"Some work on symmetry. I also had the confidence to let the children talk to each other about their maths."

"Obviously whatever I do I think a little bit more carefully about it."

"Two ex-Diploma students were appointed as part (half) time teachers in an 11-16 school because no other mathematics specialist was available (see section 9.23).

"The other teachers are starting to come to ask for advice."

"We've had discussions with the other staff about Dienes' apparatus and place value."

A maths problem board is prominently displayed.

1 'School Mathematics Project 7-13' - Cambridge University Press
2 Scottish Primary Mathematics Group 'Primary Mathematics - A development through activity' - Heinemann
3 T.R. Goddard etc. 'Beta Mathematics' - Schofield & Simms

"I've appointed a maths co-ordinator who did the Diploma course." (a fellow student on the course that the headteacher attended.)

"We've been thinking about the books and the equipment in school and the place of practical work."

"He has drawn up a list of apparatus and equipment. Not only does he know of suitable apparatus but of how it should be applied."

"A lot of help has been given to teachers informally."

"A core scheme has been devised."

"It (the course) has been helpful in coping with a very bright 11 year old."

"We've appointed the Diploma student full-time."

9.18 The discussions with Diploma students and their headteachers were marked by a degree of openness, friendliness and sincerity that was refreshing. They were willing to show schemes of work, to discuss both achievements and problems in teaching of mathematics in their schools and to be honest about the difficulties they faced in encouraging some of the teachers on the staff to accept and understand the need for new ideas. There was a high level of consistency between the views of headteachers and the teachers.

9.19 Nevertheless there remain insuperable difficulties about assigning causality between substantiated developments in a student's school and the Diploma course. In about half of the 41 schools visited the teachers and the headteachers reported that the Diploma course had been influential in their mathematics. In only 1 of these schools was it felt by the research fellow that there had been a marked and unmistakable change in the work of the Diploma student that was ascribed to the Diploma course by the teacher and his headmistress and that could not reasonably have occurred spontaneously or be caused by other influences. In another 20 schools the Diploma course seemed to be among the possible causes of the development of mathematical teaching and organisation in the school but there would be difficulties in demonstrating the causality

beyond reasonable doubt. Considering the remaining 20 teachers the effectiveness of the course was impaired by the nature of the relationships in the school (4), or difficulties with the course (6), or the teacher's lack of confidence in teaching mathematics (7), or the teacher not being in a situation to implement much of value from the course (2 supply teachers and 1 teacher from a guidance unit for 14-16 year olds.

Observed influence from the Diploma course on the 41 teachers (and their schools) in the small sample

	Frequency	
Perceptible change caused by the Diploma course	1	2%
Change possibly caused by the Diploma course	20	49%
Possible change impaired by relationships in the school	4	10%
Possible change impaired by difficulties within the course	6	15%
Possible change impaired by the lack of confidence of the teacher	7	17%
Little or no change possible	3	7%

9.20 Case studies and other illustrative material from small sample students are included in the remainder of the chapter.

Michael (section 9.21) illustrates how a teacher who gained a distinction under the old-style regulations seems unable, partly because of his own diffidence and partly because of the relationships in the school, to influence the mathematics teaching in a positive sense.

In the previous chapter (section 8.27) Susan, who had difficulties at school and a weak mathematics background, showed how unhelpful she found the course.

Margaret (section 9.22) shows how at present the Diploma course may, at best, influence her own teaching only. In the likely event of her gaining promotion and becoming responsible for the mathematics in a middle school, the course may become much more influential.

In 1981 Jane was a supply teacher having a teaching certificate with main subject PE. When the second visit was made in 1982 she had been appointed as a part-time mathematics teacher in a

comprehensive school. Part of the interview with the head of the mathematics department is recorded in section 9.23.

Both Sarah (8.29) and Hazel (8.30 and 10.8) show that, despite not finishing the course for personal and family reasons, developments in their own teaching and in the mathematics throughout their schools have continued. Each of their headmasters praised and acknowledged the value of the course. Nevertheless it is impossible with certainty to say that without the Diploma course the developments would not have happened.

Fiona (section 9.24) has clearly increased in confidence. This is probably due to her promotion, her involvement with the Schools Council project and the Diploma course. Again it seems impossible to isolate the influence of the Diploma course and assess just how valuable it has been to her.

Dave (section 9.25) however, from his comments and the work done during the course and in his school, presents a picture in which it is possible to ascribe with confidence to the Diploma course credit for being a source of the ideas and enthusiasm which have enabled the developments in his teaching to take place.

The graphs included in the accounts are the students' responses to question 5 of the second year interview schedule (Appendix 3).

9.21 Michael gained a distinction in the Diploma course under the old style regulations. He gained grade A for the Mathematics and the Mathematical Investigation and grade C for the Mathematical Education and the Special Study.

He is aged 25-29, has 'O' level maths, one 'A' level and a teachers' certificate with French as the main subject. He teaches fourth year junior children in a 5-11 school. Before the Diploma course he held a scale 2 post for environmental studies; he now has a scale 3 post for mathematics.

The children in his class were observed in the visit made to his school in 1981 working "at their own pace" through SMP cards.[1] There was a long queue of children round his desk and several children were having substantial difficulty with the work. Some of the children's mathematics books were seen in the visit in 1982. All the work was taken from SMP cards and it had been marked correct or incorrect without comment. A boy who obviously experienced difficulty with mathematics had pages of work on division marked incorrect; earlier in his book there were pages of incorrect subtraction. There was no sign of work designed to help with the difficulties in subtraction before subtraction was used implicitly in the work on division.

Michael's Child Study was seen. It had been graded C. There was no direct conversation with children recorded nor was there any evidence that he had listened to children doing and thinking about mathematics. The moderator at the centre is a member of a university mathematics department and has little direct personal experience of teaching in primary schools.

A new headmaster was appointed to Michael's school in September 1981. There are now plans to introduce 'Peak Mathematics'.[2] Michael views this as a useful development because "There has been no proper structure in the infant mathematics for the five years that I have been here. I think for the first time we might have a set scheme down in the infant school. There may be a few objections but I think it will be better for us in the long run as a school."

The headmaster commented on the mathematics in the school:-

> "I am going to change the approach to mathematics in the school, not tailoring it strictly to an SMP type approach but more emphasis placed on group work and more practical work.

1 School Mathematics Project 'SMP 7-13' Cambridge University Press

2 A.Brighouse, D.Godber, P.Patilla 'Peak Mathematics' Nelson.

> I think mathematics is taught at an infant level in a superb fashion, more practically. My head of infants here I have confidence in and I am much happier, mathematically, about down there than with the elevens. It was a very big school and a lot of the teaching methods arose because everyone was left to their own devices."

He expanded these thoughts at length but talked about organisation for mathematics in isolation from the mathematics content of the curriculum and from the difficulties children experience with mathematics.

He talked about the part Michael was playing in the mathematics throughout the school:-

> "I have confirmed that he has responsibility for mathematics throughout the school. I must be honest. He has not got an overall picture of what is required. I think he and I will have to work together to put down guidelines for the teachers because I think everyone works best if they have got some backup material giving confidence. The teacher tends to go mechanically through the scheme because he or she does not know any better.
>
> The trouble with Michael is that he has not a lot of confidence - he is shy and retiring - to think that he has a scale 3 post is quite alarming."

Michael talked about aspects of the value of the course in teaching mathematics:-

> "It made me think a bit more about what I was doing, how I was teaching maths, to find a nice way of doing it."

in constructing or amending a scheme of work:-

> "I think this maths course will be useful because I will know where to go for my resources and ideas. Obviously this new scheme that is coming in, I shall have to work with that. So I will be amending a scheme of work from September."

in organising the mathematics in the school:-

> "We are dealing with a primary school here. I would have liked to have studied a bit more infant mathematics. My experience is from first year junior up. I don't feel particularly confident spouting about infant maths."

in looking at available textbooks or published material:-

> "We only touched the surface of that. We only touched the surface of schemes."

in considering the usefulness of various materials and equipment for mathematics:-

"They did not really do a lot on that."

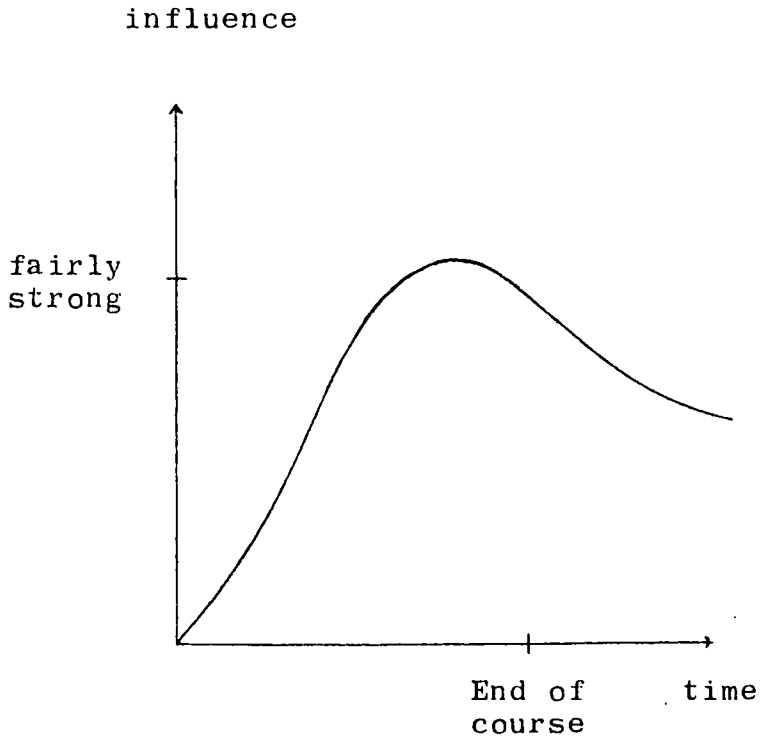
and in discussion with other teachers on the course:-

"I think the valuable thing was for a couple of hours every Tuesday night to be able to sit down with other teachers, from infant right up to top junior level. You really talked amongst yourselves about what you were doing, how you did things."

He explained his graph of the influence of the course:-

"I was influenced fairly strongly at the time of the course. The course still influences me. I refer back to things we have done."

Michael: Influence of the course



9.22 Margaret passed the course with distinction. She is aged 30-34, has 'O' level maths, 2 'A' levels and an honours BEd in geography. She has a scale 2 post "for organising the mathematics exams and all the paperwork that goes with it" in a 9-13 middle school with 760 pupils. The headmaster described the catchment area as quite varied. The deputy head is a mathematics specialist. The headmaster said that he "takes a keen interest in maths": Margaret said that he

"tends to interfere a lot". The senior mistress has a Cambridge mathematics degree, the head of mathematics is a specialist and the head of PE teaches mathematics. There was a well documented scheme based on SMP[1] lettered books, with supplementary material from SMG[2] and 'Basic Skills in Maths'.[3]

The headmaster talked about the influence of the course in the school:-

> "Not a lot except that it has given Margaret more confidence. That has served two purposes: it has improved her knowledge but she has also been quoting the fact that she has been told these things ... We have not had a lot of feedback but certainly as far as she is concerned it has done her a lot of good and that must be reflected in her teaching."

Margaret gave the following advice to a prospective student:-

> "I'd tell them to do it. I started it because I have not got any formal maths qualifications."

She commented about the course:-

> "I sometimes wish the education had a bit more body to it. It's been a bit wishy-washy at times, a bit indefinite. The education exams worry me. I really don't know what they will be like."
>
> "It's useful, the contact with other people on the course as much as anything. I've learned a lot about what goes on in other people's schools."

She was asked whether the mathematics content had helped her to teach mathematics:-

> "Not really; I've tried a few investigations and adapted a few topics - the stuff on binary systems and permutations."

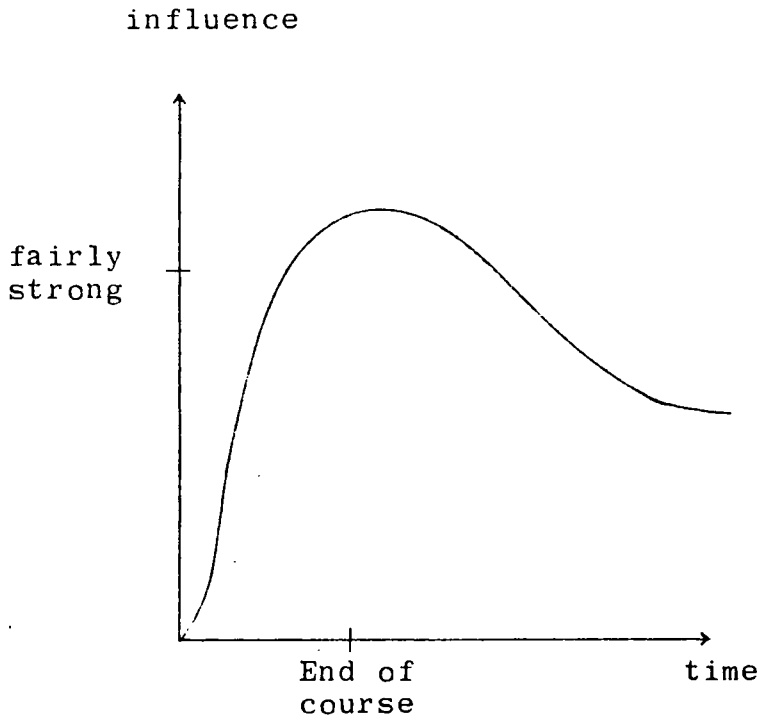
1 'School Mathematics Project' Cambridge University Press.
2 Scottish Mathematics Group 'Modern Mathematics for Schools' Blackie/Chambers
3 R.W. Fox 'Basic Skills in Mathematics' E. Arnold

She talked about the "bright" children in the school, explaining:-

> "The bright kids are the ones who are quick to see patterns and who can explain it to you, the ones who can draw their own conclusions. They do well in exams but they don't necessarily come top."

Margaret described the influence of the course on her by the graph, but the influence on the mathematics in the school is small.

Margaret: Influence of the course



9.23 Jane is aged 35-39, has 'O' level mathematics, no 'A' levels and a teaching certificate with main subject in PE. In 1982 she was a supply teacher doing only occasional work. In September 1981 she and another student on the Diploma course were each appointed as half-time teachers to an 11-16 comprehensive school to replace a teacher who had maternity leave for a year. The school has approximately 650 pupils, 3 teachers who teach mathematics for three-quarters or more of a full timetable and a further 8 or 9 teachers who teach mathematics for part of the time (one of whom is a first year Diploma student).

The head of mathematics in the school, John, described how he had phoned up the local education authority office and was told

that there were plenty of history teachers available but no mathematics teacher. He described the two Diploma students' contribution: "It's been a life saver".

> Can you tell me how you see a Diploma student fitting into the school mathematics teaching?

"Hopefully one would like to use these people in the lower school because of the specific bias of the training. Like every other school we find it difficult to staff examination courses, although we are quite lucky here - a lot of highly qualified teachers. I could think of these people doing a CSE course, though I do know the mathematical content of the course is not particularly heavy. I would not think of them as 'O' level teachers. I think that would be unfair to all concerned."

> Can you tell me how useful you feel the course has been to you in the school?

"It's early days yet. It's eased our supply problem of teachers trained in mathematics of any kind and this is good. It's also injected new enthusiasm into the school. Whether this particular Diploma is totally relevant to the secondary situation remains to be seen but so far it has helped us to place teachers in front of first and second year classes who are well on their way to being qualified to do such a thing, which is something we have not always achieved in the past."

> So it's making a bad situation slightly better?

"More than slightly better. One of the teachers on the course has tried out some of the things he has learned on the course and classes in the school are being used for projects. Anything that stimulates the mathematics environment of the school is a good thing."

> Are the links with the classroom made strongly enough?

"This is difficult because the course is designed for the age range 5-13. The number of links that can be made with the ages 11-13 in our case obviously must be fewer. I think it will help with remedial teaching. Like every school we have children who cannot do basic things so the kind of training that infant teachers should receive about how to teach the very basics of arithmetic and mathematics should come in very useful."

Jane was hesitant to talk about her teaching:-

"I've got a fourth year, half of them will take CSE, and I've got a second year who are the class above remedial."

You used to teach PE in a secondary school, so you are used to the traumas of ....

"Yes, but I would not say I was used to it any more. That was ten years ago. Things have changed."

Got worse?

"Yes, discipline-wise."

I suppose discipline and behaviour of the kids must be the biggest problem that hits anyone who teaches in a secondary school?

"Yes it is, and knowing what to do within the system."

Now, what sort of maths are you teaching?

"The fourth years are following a book 'Simple Modern Maths' by Boyd & Court. It can get pretty boring because there are a lot of examples. I try to vary it a bit. With the second year they are more on topics which you can take from any book so you don't follow any particular book. At the moment they are on revision but I started off on fractions which they had not got at all."

Fractions is difficult, isn't it?

"Very difficult for most of them, yes. A few of them have found out what to do but they don't know what they are doing anyhow and the rest have not found out and still don't know what they are doing."

Oh Jane! But you are winning, are you?

"On some things, yes. I did number bases the other day. They did not know why they counted in tens - fingers - so we were getting through on that; it went quite successfully."

Obviously John and Jane are doing their best in difficult circumstances to provide an adequate mathematical education for the children in the school, but nevertheless serious concern remains about the quality of the education given to the children.

9.24 Fiona is aged 25-29, has 'O' level mathematics, 2 'A' levels and a teaching certificate with main subject art. She teaches in a 5-7 infant school and has previously attended a 10-week (3 hours per week) course on infant mathematics at the local mathematics

centre. She has been promoted to a scale 3 post within the school with responsibility for co-ordinating the mathematics and science and has done considerable work in changing the mathematics scheme and assessment sheet, selecting new equipment, holding year group meetings and discussions (especially with a new teacher) and organising mathematical activities for parents to do with their children at home.

Her headmistress was appreciative of the quality of Fiona's work in the school and the increase in confidence which she is showing but was reluctant to say that it was the result of the Diploma course:-

> "It is difficult to estimate how much of it is due to the Diploma. My instinctive feeling is that it is her doing the Diploma rather than the Diploma itself. The confidence she got from the studying and the reading."

> She has increased in confidence? How does that show?

> "Her ability to lead group discussion, her wanting to lead group discussion, her ability to prepare points for discussion and to keep a discussion in line. She has changed such a lot, it is really noticeable. Whether it is the increased responsibility, but certainly having done the Diploma she does feel confident to say 'such and such a thing is so', or 'that is worth considering'. She can help teachers with questions or understanding. But whether something else would have done the same thing I don't know. She was obviously ready to do something."

> Fiona gave her view of the course implicitly in the advice she would offer to a prospective student:-

> "I would say that they must be prepared to do a lot of work and not expect the course to be totally aligned to school. They are not going to be able to sit at the course one evening and be told that next week you will be able to do this work in school. It's not that sort of course. It's an awful lot of theory and mathematics at their own level."

Nevertheless her assignment work for the course contained sections which demonstrated her considerable ability as a teacher. She has skilfully incorporated into an essay on 'The meaning and place of understanding in children's learning of mathematics in the infant school' a section on 'Understanding and the language barrier'"-

> "Primarily the children are faced with language that they are unfamiliar with e.g. partitioning the set. They also

have the problem of hearing mathematical words and sentences that have a different meaning from everyday language, e.g. The child may hear mother telling an older brother at home to 'do his sums', but in school the child is asked to 'find the sum of' 6 and 3.

Children also hear words that are similar to other words which confuses the content of the question. Two particular cases arose this term in school:-

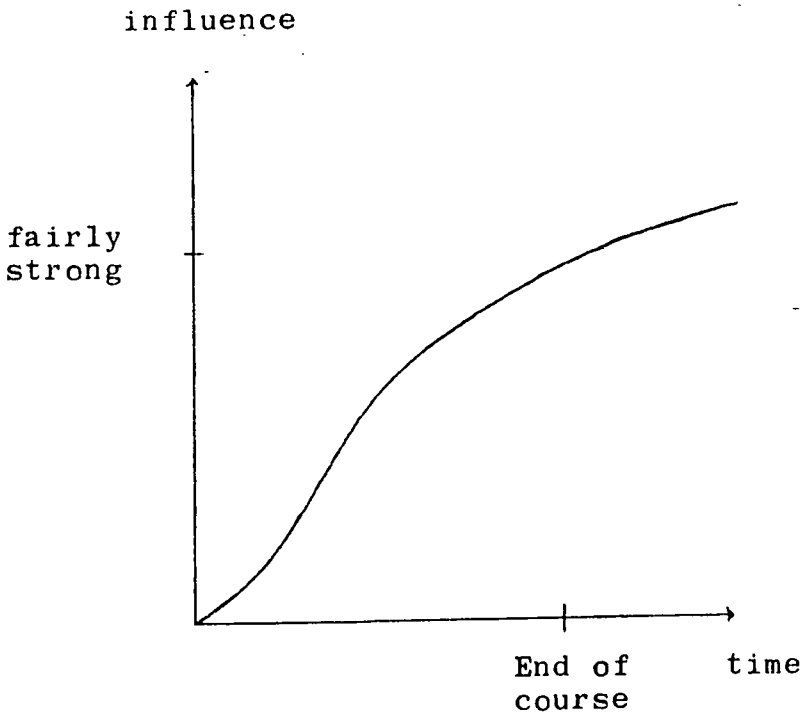
(i) Karen came to me with a sentence in her book reading 'The difference between 5 and 2 → 7'. When I asked her what she had written she said: 'the difference between 5 add 2 → 7'. What a confusion the careless reading of this sentence must have caused! I pointed out the incorrect reading and then she showed me how to match the sets to find the difference. It was going to take several examples to reinforce the correct in her mis-reading.

(ii) Mark was confused with the comparison with a pair of objects. He was saying 'The skipping rope is longer and the metre stick'. So in fact he was listing the objects, but stating that the skipping rope was longer, or even comparing one object to many. I explained that when we are comparing a pair of objects we say that the skipping rope is longer than the metre stick. Several examples were needed for the new language to become meaningful. Mark then continued to compare 2 objects of mass, height and size, with ease."

She and the deputy headteacher are now involved with the Schools Council project 'Understanding in Learning' and Fiona has chosen as the topics to investigate comparison and order. Her Special Study for the Diploma was a study of children's work in making comparisons.

Fiona drew the following graph of the influence of the course and commented "The continued increase is partly because of the research work and my post as well. It's come together".

Fiona: Influence of the course



9.25 Dave is aged 25-29, has an arts degree, a primary PGCE and 'O' level mathematics. He has a scale 1 post teaching 9-10 year olds in a primary school with 101-200 children. The school is situated in the type of village that would be classified as rural under an inner city/other urban/rural trichotomy but that may be classified as industrial since a pit or a mill is the major employer.

He has developed work with the children in his class that is taken from a variety of sources, including puzzles, practical work and work from SPMG. Last year the work was dominated by the published scheme. He is now giving the children far more praise and encouragement.

Scottish Primary Mathematics Group 'Primary Mathematics - A development through activity' - Heinemann

The teacher of the 'top' class has a scale post for mathematics and science. The headteacher commented on Dave's increase in confidence: "He comes back from the course and shares his ideas with the staff. He's been very good. I think he's enjoying it."

Dave showed me an assignment he had written entitled 'Compare two contemporary mathematics schemes for work at some developmental stage of primary school work'. He had made a comparison of SPMG[1], which was used in his school, with SMP[2] and had achieved a good balance of the comparison of the texts, the language and development of concepts needed by the children and the organisational problems associated with each scheme.

Dave's comments about the course are recorded below:-

The Mathematics component:-

> "Well, naturally I'm not going to pretend that I find it all easy. If I did I would not be on the course. Some of it, yes, it is hard but I went on the course because I felt my mathematics background is limited."

The effect on his teaching:

> "I still believe in the class lesson in its place, but I was using it too much and expecting too much from it. I've become more flexible using groups at both ends, with the bright children and with the less able. I'm involving shape a lot more because of the ideas from the course, which last year when I got them were a bit too late to put into action. This year I'm actually using them. A lot of the number aspects are the same as last year but there has been broadening and deepening. I'm using more practical apparatus."

The effect on the mathematics in the school:

> "For example at dinner time today a colleague came in and asked me how would I get round the problem of a child saying, when they were trying to find out how many half pence there were in $3\frac{1}{2}$p., six and a half. We discussed ways of doing it using plastic money."

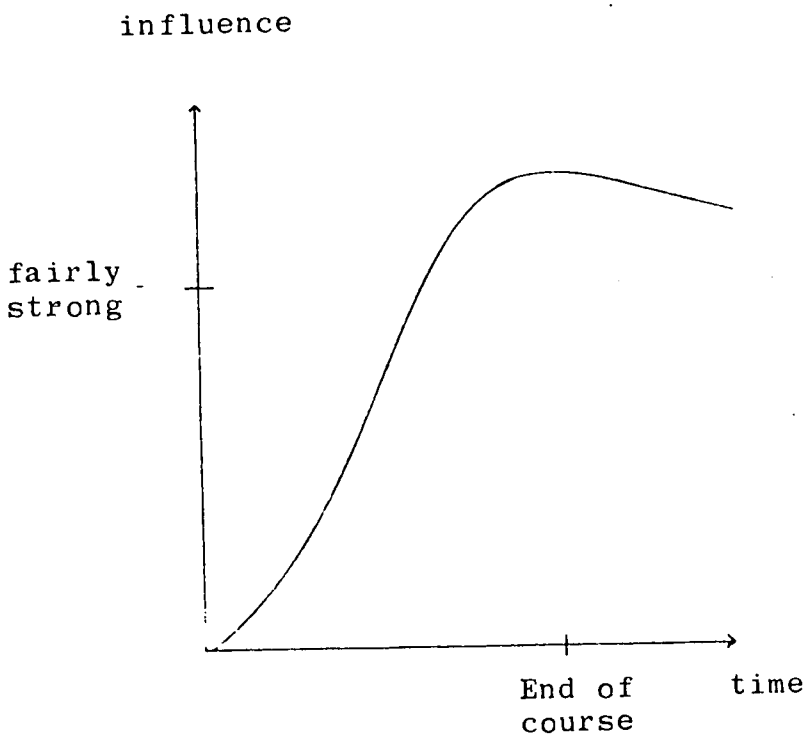
1 Scottish Primary Mathematics Group 'Primary Mathematics - A development through activity' Heinemann

2 School Mathematics Project 'SMP 7-13' Cambridge University Press

"We had some money to spend from the Parent Teacher Association and I mentioned some multibase arithmetic blocks, Dienes. I thought that these might come in useful especially lower down the school. I was prepared to discuss their use in the staff-room - there is no point in just me using them - the head said to me "Wait a minute, I've seen something like that" and we went into the top class teacher's room and came out with three piles. We had got the whole kit."

Dave drew a sketch graph:

Dave: Influence of the course



and commented:-

"It started fairly slowly but after Christmas of last year it started to have an influence. When I look at a scheme now I'm looking for content and development - all ideas I've got from the course. The influence of the course is more than

just 'fairly strong'. As to whether it would carry on, I think naturally there would be some falling away, but the things it has taught me are valuable and would continue to be valuable for the rest of my teaching career."

CHAPTER 10

THE DIPLOMA COURSE AND THE PROFESSIONAL DEVELOPMENT OF TEACHERS

10.1 The James Report[1] spoke of the need for teachers to "extend their personal education, develop their professional competence and improve their understanding of educational principles and techniques." It proposed that "all teachers should be entitled to release with pay for in-service education and training on a scale not less than the equivalent of one term in every seven years and, as soon as possible, on a scale of one term in five years" which would require an estimated 3% of the teaching force being absent from schools at any one time.

The then Secretary of State for Education and Science presented to Parliament the White Paper 'Education: A Framework for Expansion'[2] paragraph 61 of which states:-

> "The Government propose to give effect to the Committee's recommendation, in the firm belief that expenditure to achieve an expansion of in-service training of this order is a necessary investment in the future quality of the teaching force. The recommendation will need to be implemented over a period as increases in the teaching force permit larger numbers of teachers to be released. The raising of the school leaving age will put staffing standards under temporary strain, but the Government's aim is that a substantial expansion of in-service training should begin in the school year 1974-75 and should thereafter continue progressively so as to reach the target of 3 per cent release by 1981."

1 HMSO (1972) 'Teacher Education and Training' the James Report
2 HMSO (1972) 'Education: A Framework for Expansion'

These proposals have not been implemented although the need persists and although there is a surplus of trained and qualified primary school teachers (though not of mathematics teachers. Expenditure is still necessary and the model of the Diploma course requiring day or half-day release from school is remarkably effective and cheap.

10.2 The Cockcroft Committee have pointed to the special needs of mathematics in in-service support for teachers and their belief that "there are a number of reasons which justify support for teachers of mathematics on a scale which may not, on financial grounds, be possible for teachers of all subjects at the prsent time." In addition to their justification of this statement in paragraph 718, for primary school teachers, the majority of whom are not mathematics specialists, the justification must include explicit mention of the necessity of building up confidence and mathematical knowledge.

10.3 In section 4.7 the work of Diploma students in developing their professional interest in mathematical education is reported. Most (80%) belonged to no local or national mathematics teachers' group or organisation. About half (49%) had attended no other in-service course (even a short course run by their LEA) related to mathematics. Slightly less than half (46%) had found no books that were particularly useful for the Diploma course (books that, conceivably, could have been valuable for continued reference after the end of the course).

One of the teachers in the small sample is chairman of her local branch of the Association of Teachers of Mathematics. She was asked if the local branch had gained any new members from the group of Diploma students and she replied "I don't think we have. We handed out ATM literature at Diploma meetings and people have come for single meetings."

HMSO (1982) 'Mathematics Counts' - the Cockcroft Report

This is the picture of the professional development of those primary school teachers who are motivated to take a substantial course, largely in their own time, in mathematical education. The corresponding picture for the overall population of primary school teachers must give serious cause for concern.

Diploma students and the national mathematics teachers' organisations

10.4 There are now a considerable number of teachers who have gained the Diploma in Mathematical Education of the Mathematical Association and it is interesting to ask if the Association continues to provide any help for such teachers.

Certainly at national level the Association, by means of its journals 'Mathematics in School' and 'Mathematics round the Country' provides material for primary school teachers. In recent years, one day at the national conference has had a primary school bias (in 1982 a lecture 'Developing Mathematical Thinking in the Primary and Middle Years' followed by a choice of working sessions).

But what of the picture at local branch level? How many branch meetings could a typical Diploma student (who has 'O' level mathematics but not 'A' level mathematics and teaches in a junior school) enjoy and find useful and relevant to his or her teaching? The secretary of the Branches Committee supplied recent programmes for twenty one branches. Thirteen of these appeared (insofar as it is possible to judge from a list of titles and names of speakers alone) to have one or even two meetings out of a typical programme of five or six meetings that would be of possible interest to the former student. Members at one branch claimed that most of its meetings would be of interest to middle school teachers.

Similarly the Association of Teachers of Mathematics continues to provide, through the journal 'Mathematics Teaching', the various informal publications, the meetings of local branches and the annual national conference, a valuable forum for the sharing and development of ideas and mathematical activity.

It is a feature of the Diploma course that members of each of the 'rival' organisations have co-operated so well and that the course reflects some of the thinking of both organisations. In fact, more tutors attended the Association of Teachers of Mathematics conference in 1982 than the Mathematical Association conference.

Talking to other teachers about mathematics

10.5 Diploma students have stated (LSQ) that talking to other teachers on the course and finding out about the mathematics in other schools was useful and helpful.

	Agree	Undecided	Disagree	Total
Talking to other teachers on the course was useful and helpful	669 93%	32 4%	19 3%	720 100%

	Agree	Undecided	Disagree	"We didn't"	Total
It was useful to hear about mathematics in other schools	661 92%	36 5%	9 1%	12 2%	718 100%

10.6 Teachers in the small sample were asked in 1982 if they had kept in touch with any of the people on the course (or if they had started the course in September 1980 if they thought they would keep in touch). Some of the teachers gave more than one response.

Spouse is/has been a Diploma student	3
A friend is/has been a Diploma student	10
Another teacher in the school is/has been a Diploma student	4
Ex-Diploma students seen in connection with mathematics teachers' group or other mathematical in-service work	5
Ex-Diploma students seen occasionally at various teachers' meetings	9
Not really	17
Don't know	1
Total number of replies	49

Of the 41 students, 18 seem to have lost contact (and the opportunity to talk about mathematics teaching) with other teachers who were doing the course.

Contact seems difficult to maintain in a rural area where travelling distances may be great:-

"It's difficult. We are very spread out."

A teacher who had been promoted to a headship commented:

"Yes, but not since I've taken on this job. I've had so much to do.

Teachers who belong to local teachers' groups for mathematics seem to meet other ex-Diploma students regularly. Other teachers renew their acqaintance or friendship with teachers who were fellow students in different circumstances:-

"I go to Elland Road with another teacher who also did the Diploma."

Continuation groups

10.7 A small group of teachers from one centre who found this aspect of the course valuable are continuing to meet with the encouragement of the local mathematics adviser. A visit was made to one of their meetings. It was held in a teachers' centre. It started at 5.00p.m. and finished at approximately 7.00p.m. Nine teachers were present. One left after an hour to go to a parents' meeting at school.

The meeting consisted of four of the teachers talking about shape and how they teach it. They had brought along plenty of examples of good quality children's work and were prepared to talk about it and the children's thinking in some detail. There was a sensitive awareness both of children's difficulties and also of the need to challenge the more able child.

The atmosphere was relaxed, informal and friendly. Even the more reserved and diffident teachers were prepared to contribute to the discussion and were prepared to move around the room to use examples from the children's work or to demonstrate points on the board.

The group holds meetings about once a fortnight. They have discussed their Investigations and Special Studies and have had guest speakers:- the mathematics adviser, a mathematics teacher from

a local secondary school talking about structure in algebra ("he actually gave us interesting work to do") and a speaker from the Open University talking about 'Maths across the curriculum'.

Members of the group are being asked to be members of LEA working parties and to contribute to LEA in-service courses for teachers. One teacher is a member of a local mathematics teachers committee and was asking for contributions from the group towards some informal publications. The continuation group produces a newsletter which it circulates to members.

After the meeting the teachers were asked about the value of the group:-

How valuable did you find the meeting?

"It helps us to exchange ideas. When one is a maths specialist in a school, staff tend to rely on you. Although the specialist may wish to exchange ideas, others on the staff can be less willing."

"I find it both interesting and valuable to see what other work in the same area is going on. Ideas and suggestions of great value."

"I saw how other teachers in a similar situation to my own handled and developed shape. Though the goal was the same, the approaches were different. I will use some of the ideas."

"It's "useful to see how a first school tackles shape - 'de-isolates' one's own middle school teaching."

"I teach in a middle school and it was most interesting to discover what was being taught in first schools. Some of the things presented were new ideas to me. I will incorporate them into the remedial maths in my own school."

Which meetings of the continuation group have you found particularly useful and helpful?

"Discussions relating to teaching in school with teachers presenting children's work."

"Where teachers have presented work of children of different ages and abilities."

".... because we have both middle and first school representatives, most meetings are useful."

"Those directly concerned with school have been most useful but higher level maths topics have been interesting."

"All of them - especially bringing work by children."

What advice would you give to a group of teachers who were thinking of starting a continuation group in another part of the country?

"Do it. See your maths adviser, foster the friendships and mutual interests forged."

"Start as soon as possible after the course ends. Make arrangements before exams. Everyone hurries away after these. Arrange suitable premises."

"Formulate your syllabus one term in advance. Try to include a guest speaker at least once a term to ensure new ideas."

"Go ahead and do it; it keeps feeding new ideas."

"A solid agenda running perhaps a term ahead. This gives structure and helps sustain interest and enthusiasm."

"You must be prepared to go to the meetings and you make them work, saying what you want."

It is very encouraging to find a group of teachers who have gained sufficient confidence and who have enough initiative to organise a programme of meetings. They have recruited smaller numbers of teachers from subsequent courses that have been run at the centre and it is hoped that membership of the group will grow. Perhaps it would be valuable if members of the group could bring along other teachers from their schools to selected meetings so that on these occasions the group becomes a meeting of ten or so schools rather than of ten or so teachers.

Follow-up work for the LEA

10.8 One of the teachers in the small sample, Hazel, (see section 8.30) and fellow members of her (day-release) course have been involved in in-service education for teachers under the guidance of the LEA mathematics inspectors. They have been helping teachers to see the range and development of mathematics in the context of the LEA guidelines or framework.

Hazel explained what they had been doing:-

"We got together, the 18 that were left at the end of the course, with the two inspectors. They explained what they wanted us to do. They felt that teachers would take more notice of us as working teachers. It would not be too high flown or theoretical. We had these meetings in the Autumn term to work through the framework. We each took an aspect. I was working in the group doing shape through symmetry and we just showed the development of that through using the framework also on the organisation of maths. Other groups are doing area, graphical representation and three aspects of number using a number line, working with fractions and so on. I went with another colleague to the opening day. The inspectors did the morning and we took the afternoon session. We just showed them the developing progression through symmetry into the transformation geometry in secondary school, starting off with art work and ink blots and suchlike. We've all gone along each time to support the others. It encourages the teachers to look at maths in a different way."

How many meetings have you had?

"One day followed by six evenings and then a final day. We won't be involved in that, just the inspectors. That's just a rounding off day on the organisation of maths in the school."

And how do you feel it's gone down?

"Very well. The group has been very responsive. They have enjoyed it, hearing all these different suggestions. In your own school you can get very parochial. You don't look outwards. This is intended to make people think."

How many teachers have come along?

"Twenty one or twenty two I think."

Have they volunteered to come?

"Yes, but I think the inspector wrote the letter in such a way that it was an invitation they could not refuse or their head could not refuse. There have been courses at 3 teachers' centres in the county. The intention has been that there will be one teacher from every middle school at one of these courses."

It is encouraging to find an LEA which is prepared to give day release to teachers doing the course and which subsequently uses effectively the expertise and enthusiasm of the ex-Diploma students.

Diploma students' plans for further study

10.9 Teachers in the small sample were asked in the Spring term of 1982 if they had any thought of or plans for any further study. Their replies are classified by the year in which they started the course 1978, 1979 or 1980.

1978 (10 teachers)

No definite plans (7 teachers)

No. (2)

Not at the moment.

Not until I find my feet here (appointed to headship).

I could not take anything on at the moment (appointed to headship)

I never stop (but did not mention anything specific).

I would like to do research but I have not got a first degree.

Plans being executed (3 teachers)

Obtained Open University degree (mathematics, history of mathematics, statistics, computing).

Diploma in reading.

A 2-year part-time science course.

1979 (21 teachers)

No definite plans (9 teachers)

No. (2)

A year's rest then possibly an environmental studies course.

Family commitments too great at the moment.

Looked at the courses advertised at the teachers' centre.

Another course would have to involve secondment from school. (2)

Gave up a postal course in 'A' level mathematics.

When I'm settled in my new job....

Definite plans 6 teachers)

Information received about computing course - 2 hours per week for 1 term.

Diploma in Advanced Studies in Education (DASE) (2)

Associateship of the College of Preceptors.

Open University course.

MEd course (but received news that morning that Diploma course did not carry exemption from Part 1 of the MEd).

Plans being executed (6 teachers)

In-service BEd. (2)

DASE.

Computer assisted learning course.

Open University EM 235 'Developing Mathematical Thinking'.

Involved in Schools Council project 'Understanding in Learning' - it takes up as much time as the Diploma."

1980 (10 teachers, interviewed in the fifth term of the course)

No plans (4 teachers)

Don't feel like it at the moment.

Not a long course.

Thoughts or plans (6 teachers)

Open University foundation course in mathematics.

A modern 'O' level followed by 'A' level mathematics.

Probably in reading or remedial education.

The prospect of doing a further degree appeals to me.

A course on computers and suchlike if I ever get over this!

DASE - ask me again when I've done my child study!

It is difficult to summarise the thoughts, plans and actions of the students, but it does seem from this small sample that about 30% proceed with some form of further study.

10.10 Although no systematic collection of such information was made, students in the small sample gave a picture of the diversity of regulations which govern the status of the Diploma course in connection with degree and other courses:-

"No exemption from part of an in-service BEd course was possible to Diploma holders."

"I got the impression that the Diploma would be a qualification for entry to an MA in curriculum studies." (a non-graduate)

"I applied to the university for an MEd. They had not heard of the Mathematical Association Diploma." (a BEd graduate).

"A letter from the university arrived this morning saying that the Diploma was not sufficient for exemption from Part 1 of their MEd course."

"A distinction in the Diploma course is an entry qualification for the MEd course."

In 1982 the Higher Degrees Sub-committee of the University of London Faculty of Education agreed that the requirement of at least a second class honours degree be waived as an entry requirement for the degrees of MA and MEd in mathematical education for Diploma students who have gained a distinction. They considered that the Diploma course was "relevant and ought to be encouraged" and so Diploma students who have gained a distinction have the opportunity to be considered for entry to these higher degrees at Chelsea College.

The Diploma course and in-service education in other areas of the curriculum

10.11 Many of the conclusions and recommendations of the research project are of interest and relevance to those providing and organising other in-service courses. The helpfulness of day and half-day release from school and the importance of ensuring that the course is relevant (in a broad sense) to the needs of teachers, their children and their schools must be relevant to provision for the continuing education of teachers in every type of school and every part of the curriculum. Good financial support for students and the importance of encouragement from the headteacher and other members of the staff for material from the course to be used in school must likewise have universal application.

The value of the Child Study in causing teachers to listen to and observe their children would be equally great for other areas of study.

However the concern of some Diploma students about their perceived difficulties in the Mathematics component may only be appropriate to note for in-service provision in those areas of the curriculum which cause teachers some anxiety.

Good tutorial provision would be essential for any similar course.

10.12 Diploma Board members (BQ) were asked what advice they would give an organisation which was setting up a comparable Diploma in another area of the primary school curriculum. The following points were made:

> "Find a good Chairman and a small enthusiastic team to design the scheme and do it on a pilot basis first."
>
> "Be very very clear about the aims of the course (e.g. retraining for those who know nothing about your subject, or creating an elite among those who do?) and be willing to close down courses in institutions which ignore the stated aims in order to keep up student numbers or to hide deficiencies among their staff."
>
> "Take a close look at what teachers say they want. I have a suspicion that the quality of maths teachers - and the mathematical quality of primary teachers - is well below that of other subjects."
>
> "A Diploma course may not be so necessary in (say) English since teachers are better qualified in English and there's much more material around (e.g.) on teaching reading etc."
>
> "Take care to stand back and evaluate and don't let administration take over."
>
> "Develop administrative procedures fully first rather than setting off on an ad hoc basis."
>
> "One is tempted to say that since the Mathematical Association has inaugurated the whole business then other organisations will find it easier to follow in our footsteps, but of course they would be far better off working independently and coming to their own solutions for their own problems rather than being influenced by ours."
>
> "To expect teachers to have too great an expectation of the course and too low an opinion of their own abilities."

10.13 Interest in the model for the Diploma course developed by the Mathematical Association has been shown by other organisations of teachers of other subjects in the school curriculum.

The Association for Science Education wrote in April 1982 that they are:-

> "now entering the field of validation of in-service training courses. The full Validation Board has only recently been set up and it has had an exploratory meeting with some colleges who have already expressed an interest in our validation scheme."

They have corresponded with the secretary of the Diploma Board and have acknowledged the helpfulness of the booklet 'The Mathematical Association Diploma - a general guide' and of the regulations for the Diploma in formulating a diploma course appropriate for teachers of science.

The Historical Association have approved a few centres to start teaching courses in September 1982 leading to the Advanced Certificate in the teaching of History. These courses will "involve at least 100 hours' teaching contact time, followed by a six months' tutored project, usually spread over eighteen months part time study."

This Association has appointed an Advanced Certificate Board with local contact members for centres. The course is not designed specifically for primary and middle school teachers; "it is intended to be sufficiently flexible to allow institutions to make suitable provisions in the light of locally defined needs. They have received interest in the Advanced Certificate from Scotland, which they did not expect; they expected interest from Wales but "not a glimmer of interest has come up." The course is normally to be assessed by two pieces of course work, a 'linking study' consolidating the work of the course and focussing upon the learner and a 'post-course project' developing a scheme for the candidate's own school.

This is the first time the Historical Association has been involved in validating an in-service course for teachers. They looked at two other organisations in developing the Advanced Certificate; one of these was the Mathematical Association and "that was very much to the fore of our minds".

The Diploma course and other mathematics in-service education

10.14 The information collected during the research project points to certain subpopulations of teachers and their needs for continuing education either in their own mathematics or their teaching of mathematics to children.

(a) Every one of the six teachers in the small sample who were graduates and who had trained by means of a PGCE course for primary teachers mentioned that there had been insufficient time to devote to mathematics in the PGCE course. The evidence of just a small number of teachers would support the view of the Cockcroft Committee that "the long term solution lies in lengthening the PGCE course for primary teachers". However, in the short term their lack of initial training indicates a need for in-service education.

(b) The Diploma course (and presumably other long in-service courses in mathematics) attracts primary school teachers who are likely to be better qualified in mathematics than the average primary school teacher. Almost all of the 99% of primary school teachers who have not attended a Diploma course will be responsible for teaching mathematics to their class of children; the mathematical development (or lack of it) of their pupils will be largely their responsibility for the year. The mathematical knowledge of the teacher and his or her degree of confidence in and enthusiasm for the subject will be transmitted to the children.

One of the major problems of in-service education in mathematics is how to reach such teachers. The present system is that teachers voluntarily undertake in-service education; there are, for example, no clauses in their contracts to provide for systematic updating of their knowledge and expertise. This means that almost all primary pupils are likely to be taught mathematics by

teachers who may be poor advertisements for its continued learning.

There is an additional problem. The mathematical content of Diploma courses, although it certainly is not excessive, may prove daunting to some primary school teachers.

(c) The needs of mathematics teachers of children in the age range 5-7 (such teachers may also have responsibility for organising the mathematics in a 5-11 school) will only be met on courses designed and taught by those with good knowledge of mathematics and with experience of teaching young children.

(d) The Mathematical Association in co-operation with the National Association for Remedial Education has developed, using a similar model to the Diploma in Mathematical Education, a diploma for teachers of low attainers in mathematics. The first courses started in 1981 and 1982 at Bishop Grosseteste College, Lincoln and at the West Sussex Institute of Higher Education.

CHAPTER 11

RECOMMENDATIONS AND CONCLUSIONS

11.1 Chapter 11 is designed to be read, not in isolation, but in conjunction with the rest of the report (the numbers in the margin refer to appropriate sections).

11.2 The Mathematical Association Diploma course has provided and continues to provide mathematical in-service

(2.21) education for a large number of primary school teachers. So, potentially, it may have a significant influence on the quality of the teaching and organisation of mathematics in primary schools.

11.3 The course, when it is well organised and taught and when conditions in the teachers' schools allow, can be

(Chapter 9) effective in influencing for good the teaching of mathematics and the organisation for mathematics in schools.

11.4 In order that the course should be more effective we wish to make recommendations from the Research Project to the following groups of people:-

- tutors (sections 11.5-11.9, 11.11, 11.15)
- moderators (sections 11.8, 11.11, 11.12)
- members of the Diploma Board (sections 11.5-11.7, 11.9-11.12)
- other subject teaching organisations (sections 11.13, 11.14)
- those responsible in LEAs for funding courses (sections 11.15-11.17)
- those responsible in central government for funding courses (sections 11.15, 11.18)

11.5

We note

(6.27) that 40% of students thought that the provision for tutorials was inadequate;

and recommend

(i) That the Diploma Board considers suggesting to colleges an estimated number of hours of tutorial time (e.g. 70 hours) that may be required for an average course;

(ii) that tutors (in institutions where such

(6.28) arrangements apply) press for tutorial work to be included as part of their timetabled workload.

11.6

We note

(6.4-6.5) the comments of some students about the lack of relevance to the course;

and recommend

(i) that despite the many difficulties it is essential

(6.2-6.3) that tutors continually renew their teaching experience in infant and junior schools;

(ii) that a moderator who is appointed should normally have experience of mathematical education in primary schools as well as qualifications in mathematics.

11.7

We note

(6.6-6.7, 9.10) the students' comments and views about the Mathematics component of the course;

conclude

that in general the level of difficulty of the mathematics is about right for the needs of the

teachers though the focus of the course may often be centred on the mathematics for 9-13 year old children rather than on the complete 5-13 range;

and recommend

that suitable teachers in infant or first schools who have a strong mathematics background be encouraged to contribute to the teaching, moderation and organisation of Diploma courses.

11.8

We note

(i) that many of the Diploma students have responsibility for mathematics in their schools; (4.17-4.19)

(ii) that many students felt that no sufficient emphasis was given to aspects of organising the mathematics throughout a school; (6.4(iv))

and suggest

that College Boards re-examine the balance and content of their courses to make them as helpful as possible to teachers who are, or hope to become, mathematics co-ordinators.

11.9

We note

(i) that 67% of students reported that they had enjoyed doing the investigation; (9.13)

(ii) that the Mathematical Investigation was perceived by many students as being the least helpful component of the course to them in their teaching;

and recommend

(i) that the Investigation be retained in the Diploma course since it has value in showing that mathematics is more than a received body of knowledge and it shows some students that mathematics can be enjoyable;

(ii) that tutors continue to recognise the difficulties
(6.31) that many students have in doing the Investigation and in introducing investigations to their pupils.

11.10
We note
(7.12) that students at a minority of centres have reported that their assignments and essays are not being returned, or that work is being returned without grades or comment;
and recommend
that the Diploma Board considers re-drafting the relevant regulations so as to remove any possible misunderstanding of their intentions by tutors.

11.11
We note
(7.3-7.9) the stress, reported by students, that is caused by assessment and particularly by examinations;
and recommend
that tutors, moderators and members of the Diploma Board consider and adopt appropriate methods to reduce their anxiety.

11.12
We note
(i) that moderators have an important role to play in
(7.13-7.20) ensuring that Diploma courses are of comparable standards;
(ii) that about a quarter of moderators' reports for
(7.22) courses that finished before September 1981 had not been submitted to the Diploma Board;
(iii) that the network of moderators is only partially
(7.14) connected;
(iv) the value of the moderators' meetings and regional

(2.26) meetings in providing opportunities for an exchange of views about the course;

and recommend

(i) that moderators' reports are made available to the Diploma Board within, say, three months of the end of courses;

(ii) that every effort continues to be made to achieve greater communication between courses, including appointing suitable tutors currently teaching on Diploma courses as moderators for centres other than their own.

11.13

We note

(i) that the model of the Mathematical Association

(10.13) Diploma course has been used by the Historical Association and the Association for Science Education in their discussions about developing in-service courses fore teachers in their own subject areas;

and commend

this model of in-service education to other subject teaching organisations for their consideration.

11.14

We note

the value of the Special Study of children learning

(6.32, 9.12) mathematics as perceived by students and tutors on the Diploma course;

and suggest

the inclusion of an equivalent study in courses set up by other teaching organisations.

11.15

We note

(i) the value of obtaining a good geographical distribution of Diploma courses; (2.22-23)

(ii) the extra difficulties faced by tutors and by local authorities in running Diploma courses at outposts; (5.22-23)

(iii) the recommendation of the Cockcroft Committee of Inquiry "We believe that energetic efforts should be made to explore ways in which diploma courses can be made available in areas which are remote from training institutions";

and recommend

(i) that some way should be found of providing support for Diploma courses run at teachers' centres and other suitable venues away from colleges;

(ii) that tutors and local authority advisers explore the possibilities of offering the model of the Diploma course involving one term full-time release and further part-time study to enable teachers who live in areas which are remote from Diploma centres to study for the Diploma.

11.16

We note

(i) the benefits associated with day release and half-day release courses; (5.7-5.9)

(ii) the substantial pressure of coping with the workload of the Diploma course in addition to their school, home and family commitments that is reported by teachers attending evening courses; (5.13-5.15)

(iii) that fewer married women teachers than would be expected from the population of primary school teachers are taking the Diploma course; (4.2)

(iv) that day release or half day release courses,

though necessarily more expensive than an evening course because of the cost of providing supply

(5.8, 10.8) teachers in schools, represent a worthwhile investment in local mathematical education, particularly if ex-Diploma students can be used to contribute to the in-service education of teachers in their schools and in the local authority;

conclude

that in the current financial climate the part-time release mode does offer substantial benefits;

and recommend

that LEAs and schools recognise the advantages of this investment in the mathematical education of their children and the organisation of mathematics in their schools and do all they can to facilitate and finance the release of teachers.

11.17

We note

(i) that Local Education Authorities may claim under

(5.17) the 'pooling' arrangements the full amount of course fees and travelling expenses for Diploma students who are serving teachers;

(ii) that both mathematics advisers and students have

(5.18-5.19) reported that many local authorities allow teachers in their full-time employment to claim only part or none of their fees and travelling expenses for the course;

and recommend

that LEAs reimburse teachers with the full amount of their expenses and fees.

11.18

We note

(i) that Diploma courses generally involve tutors in

(2.9, 11.5) three hours' teaching contact time and approximately one hour tutorial contact time per week, which amounts to about a quarter of a timetabled teaching load;

(ii) that since January 1982 evening Diploma courses are among the Advanced Further Education courses that are subject to an average conversion factor of 0.15 when numbers of full-time equivalent students are calculated;

(iii) that evidence collected during the later part of the research (5.26) suggests that the method by which colleges are funded gives insufficient recognition of the workload imposed by courses of this nature and, as a consequence, it seems possible that the future of some courses is in jeopardy;

and recommend

that urgent consideration be given to the impact of the methods of funding.

11.19 The success of the Diploma course is due to the efforts of many groups of people:-

(i) the members of the Mathematical Association who saw the need for substantial in-service education in the field of mathematical education for primary teachers and who designed the course to meet that need;

(ii) members of the Diploma Board and other members of the Association who continue to supply and maintain the framework within which Diploma courses are taught;

(iii) the tutors and the moderators who are responsible for ensuring that the course is as valuable as possible for their group of students; and

(iv) the teachers who are sufficiently conscientious and enthusiastic to devote a considerable amount of their leisure time over two years to the course.

However 99% of primary school teachers have not taken the Diploma course. Some of these teachers may be reached by ensuring a better geographical distribution of courses and others may be so lacking in confidence that they find the mathematical content of the course daunting. The Diploma students' previous low level of professional interest in mathematical education may reasonably be assumed to be typical of or better than that of the population of all primary teachers.

The problem remains. How do we ensure that all primary school children enjoy the sort of teaching that will enable them to develop into confident and creative users of mathematics?

CHAPTER 12

CONCLUSION AND RECOMMENDATIONS FOR FURTHER IN-SERVICE EDUCATION AND RESEARCH

12.1 Before coming to any conclusions about the contribution of the Mathematical Association's Diploma in Mathematical Education as an instrument for in-service education for primary school teachers, it is necessary to enquire to what extent the D.E.S. research project achieved its aims.

12.2 The monitoring of the progress of the Diploma was largely successful; access to the records held by the Mathematical Association was freely given and the staff at the Association Headquarters in Leicester were always helpful in dealing with queries. The response rates for the large sample questionnaire (73%), the two questionnaires to colleges (92% and 84%), the questionnaire to moderators (80%) and the questionnaire to mathematics advisers (80%) together with the helpfulness of Diploma Board members and the supply of documents by Douglas Quadling relating to the early development of the Diploma enabled a detailed and accurate picture of the organisation for the Diploma, individual courses, their assessment and moderation, and the teachers and their schools. In HMSO (1970), Townsend had similar success (response rate 73.5%) with a large sample (approx. 9322) postal questionnaire to teachers in connection with the D.E.S. in-service education research project in 1967.

By contrast, Pinner & Shuard report that the British Petroleum funded enquiry into in-service education from 1979-82 achieved response rates of 44% for a questionnaire to colleges and about 12% for a questionnaire to L.E.A. advisers. Their survey contains many useful, descriptive case studies of various forms of in-service courses.

HMSO 'Statistics of Education Special Serices 2. Survey of In-Service Training for Teachers 1967' 1970

Sr. M.T. Pinner & H.B., Shuard 'In-Service Education in Primary Mathematics' Open University Press Milton Keynes 1985 p.23, p.15

An unproven hypothesis is that the label 'D.E.S.' attached to a research project is helpful to give the work status in the eyes of students, tutors and other interested parties. It might be worthwhile to investigate this and if substance is found in it, for e.g. commercially sponsored research to get some official or semi-official seal of approval.

It is important, by careful pilot work, to improve the precision and to reduce the bulk of questions asked in a questionnaire or interview. Thanks are due to the many people, particularly in the Durham area, who helped with this aspect of the research.

12.3 The data acquired from such sources in the research project was far from being merely numerical; on all questionnaires there was the invitation to make open comments. Most people accepted the invitation and their comments were nearly always perceptive and helpful. There was the advantage in using the data to set the students' views and comments in the context of their qualifications, schools and home circumstances.

12.4 Cave (1968) reported a pilot study with teachers in Surrey and Kingston upon Thames and in (1969) as further study in Durham, Norfolk, and Glamorgan. These were reported in Taylor (1978). 80% of the Surrey and Kingston teachers indicated at least one factor that would make their attendance at in-service courses difficult; obligations to home and family was mentioned most frequently, followed by responsibilities to colleagues/pupils, staffing problems and difficulties of obtaining replacements and the need to reside away from home or undertake excessive travel.

B. Cave 'In-Service Training of Teachers; A pilot study in the County of Surrey and the Royal Borough of Kingston-upon-Thames' (NFER mimeo)

B. Cave 'In-Service Training; A study of teachers' views and preferences' (Occasional publication No. 22, NFER, Slough) p.63

W. Taylor 'Research and Reform in Teacher Education' NFER, Slough 1978, p.177-8

Cave (1969) again found that the teachers preferences for arrangements were quite definite; they would like the bulk of in-service training to take place close to their own home or school, preferably during school hours, but failing that at a convenient starting time after school, for a half day or full day at weekends or for up to one week during vacations.

12.5 Taylor (1978) reports a survey published by ILEA in 1974 of all courses of six weeks or longer that had been undertaken by teachers in that authority. Among the findings was that 'an anti-college of education bias was also evident', apparently on two counts: (a) lecturers treating serving teachers as 'students', i.e. "talking down to them" and (b) because of the lecturer's academic theorizing, i.e. non-practical approach to the 'everyday' problems which teachers face in the classrooms. Sections 6.1-3 of the Diploma research gives information about the background of tutors. The range of comments in Chapter 9 certainly does contain some of this flavour, but also that some teachers do not easily see beyond the superficial, immediate reaction to sessions. The motivation for the observation of the taught sessions in 1982 mentioned in (3.12) was in part the comments of 20% of the teachers in Section 5 of the large sample questionnaire (Appendix) who suggested that the course should be more relevant to their classroom work.

12.6 The strength of the response to the Diploma research project made it possible to have a considerable amount of background information about the teachers and the courses that they attended, to put their comments in context and so from in depth study of teachers from different parts of the population, gain an overall view of the course.

W. Taylor 'Research and Reform in Teacher Education' NFER, Slough 1978, p 180

12.7 Nevertheless Sections 9.18-19 indicate some of the doubts experienced in assessing the effectiveness of the Diploma with any substantial degree of certainty. It was felt that it was important, even allowing for the report having a possible influence on D.E.S. policy, to be necessarily cautious and to maintain integrity when attempting to assign causality for changes reported by both the student and the headteacher in the school.

12.8 Since the end of the research project the results of all the students in the small sample have become known.

	Small Sample	Whole population (Section 8.3)
Distinction	13 (32%)	173 (14%)
Pass	21 (51%)	688 (54%)
Withdraw etc.	7 (17%)	402 (31%)
Total	41	1263

The calculated value of χ^2 is significant at the 0.1% level. The results of teachers in the small sample are significantly better than those of the remaining Diploma students.

A further calculation comparing the results of the Diploma holders in the small sample with those in the whole population, (i.e. excluding in each case the students who had withdrawn, not completed the course or failed) showed that at a 1% significance level on a χ^2 test the small sample students achieved a higher proportion of distinctions.

Section 3.10 describes the selection of the small sample of students. Within each stratum the selection of students was random. It seems that being involved in a major research project may have encouraged students to focus their attention more on the course and the teaching and organisation for mathematics in their schools. The research project certainly would have meant that the course and its possible benefits to the school was drawn to the headteachers' attention more than might have otherwise happened.

A possible enquiry would be to compare the responses of a group of students attending a mathematics course with those of a

matched control group (possibly who were attending a course that would be judged to have minimal effect (positive or negative) on their teaching of mathematics).

Bishop and Nickson (1983) suggest that various studies give some indication that a way in which professional development of teachers of mathematics may be extended is by the teachers' participation in research and that with a shift in emphasis from qualitative to descriptive methods may allow 'the development of the means of enabling appropriate dialogue to take place, thus helping to bridge the gap between teacher and researcher.'

There may be a difference between curriculum development research and research into teachers' dealings with children, with colleagues on the staff or with tutors on an in-service course. Certainly one of the aims of the interviews in the Diploma research project was to use basic listening skills to enable the teacher or headteacher to make a very large contribution to the conversation. The interviews, from reading the transcripts made in 1981, were dominated by student or headteacher talk and were in no sense a dialogue.

12.9 A further variable which may have affected the ability of the research to assess the effectiveness of the Diploma course was the Research Fellow's attitude, which was declared when applying for the post, that she enjoyed teaching the Diploma course. It implied that for example, the tiredness of the teachers in the evening was known and this helped to identify some of the important areas of the research. That a substantial minority of teachers should have perceived the course as lacking in some measure relevance to their classroom and school came as a surprise and the research design was modified in 1982 to include visits to taught sessions of the course.

Possible bias from the attitudes of the Research Fellow implied that these sessions should be evaluated by a synthesis of views from students, the tutor and the observer.

A.J. Bishop & M. Nickson 'Research on the Social Context of Mathematics Education' NFER Nelson, Slough 1983.

12.10 The diagram in Section 3.4 indicates that the thinnest part of the work of the research project might have been in some cases the investigation of the work of the student in school and the perceived influence on it of the Diploma course. Section 3.11 describes some of the strategies that were used to enhance the quality of the information obtained. The ideal would be a form of unobtrusive monitoring of information about the teaching of the student, the quality and range of the children's work, the contribution of the student to working with fellow teachers in the school in developing the mathematics before, during and after the course. The resulting data (a large quantity) would be difficult to analyse and it would be difficult to arrive with reasonable certainty at an independent (as opposed to a reported) judgement as to the effectiveness of the course.

12.11 Other studies have tackled the problem of assessing the effectiveness of a course in different ways. The research literature is difficult to survey in the context of the Mathematical Association Diploma. It may be that in-service education in an area of the curriculum where teachers express a lack of confidence, where an official report HMSO (1979) observed in its conclusion 'It remains true that the ground to be covered is substantial' is not well served by research that does not include substantial investigation of the content and process of teaching and learning relevant topics.

It may possibly be very difficult to generalise across all subject areas without leaving out much that is of interest to providers of in-service courses in, for example, mathematics and science.

HMSO 'Mathematics 5-11' p.79

12.12 Goode & Hatt (1952), Cohen & Mannion (1980) and Henderson (1978) among others, give descriptions of various methods of enquiry for educational research and discuss the strengths and weaknesses of various approaches. It seems clear that a variety of research methods are likely to elicit information which can be checked for internal consistency.

Cohn & Mannion describe the importance of formulating hypotheses and quote Kerlinger as having identified two main criteria for 'good' hypotheses, that hypotheses are statements about the relations between variables and that hypotheses carry clear implications for testing the stated relations.

12.13 K. Lovell & K.S. Lawson (1970) describe some of the differences and similarities between research in the natural sciences and in the social sciences. In the natural sciences there are often few parameters involved, in the social sciences there tend to be many. In either field it is not always possible to observe directly. Human beings are unique and it is difficult to generalise from observations of their behaviour, though groups are more stable. The interests and prejudices of the research work tend to determine what is observed and the judgements made both in the natural and social sciences but the difficulties associated with this lack of objectivity may be assessed in the social sciences.

W.J. Goode, P.K. Hatt 'Methods in Social Research' McGraw Hill (1952)
L. Cohen and L. Mannion 'Research Methods in Education' Croom Helm 1980 p.19
F.N. Kerlinger 'Foundations of Behavioural Research' Holt Rinehart & Winston, New York, 1970
E.S. Henderson 'The Evaluation of In-Service Teacher Training' Croom Helm 1979
K. Lovell, K.S. Lawson 'Understanding Educational Research' University of London Press

They explain that a theory explains 'the facts' and the interrelation between them. 'Once a theoretical framework has been elaborated we know what facts to look for to confirm or deny the theory; also we have a conceptual framework inside which our evidence can be discussed.' It is not clear what is the relationship between 'facts' and the observations a scientist would normally make in an experiment.

12.14 Kerlinger's statement (12.12) brought to mind the work of Popper who quotes from J. Black writing in 1803 'A nice adaptation of conditions will make almost any hypothesis agree with the phenomena. This will please the imagination but does not advance our knowledge.'

12.15 Popper (1963) states that 'the criterion of the scientific status of a theory is its falsifiability, or refutability or testability.'

1. "It is easy to obtain confirmations, or verification, for nearly every theory if we look for confirmations.

2. Confirmations should count only if they are the result of risky predictions; that is to say, if, unenlightened by the theory in question, we should have expected a result which was incompatible with the theory - an event which would have refuted the theory.

3. Every good scientific theory is a prohibition; it forbids certain things to happen. The more a theory forbids, the better it is.

4. A theory which is not refutable by any conceivable event is non-scientific. Irrefutability is not a virtue of the theory (as people often think) but a vice.

5. Every genuine test of a theory is an attempt to falsify it, or to refute it.

..."

J. Black 'Lectures on the elements of Chemistry, Vol.1' Edinburgh 1803 p. 193
quoted in
K.R. Popper 'The Logic of Scientific Discovery' Hutchinson, London 1959 p.82
K.R. Popper 'Conjectures and Refutations' Routledge & Kegan Paul, London 1963 p.36-37

12.16 On this basis it is possible to conjecture that the evidence collected by the Research Project allows the refining of 'The course can be effective in influencing for good the teaching of mathematics and the organisation for mathematics in schools' to the statement quoted in Section 11.3.

> "The course, when it is well organised and taught and when conditions in the teachers' schools allow, can be effective in influencing for good the teaching of mathematics and the organisation for mathematics in schools."

(The word "when" is taken to mean "only if"). It is still not a very good theory, in terms of Popper's third condition quoted in the previous paragraph.

Many of the more descriptive studies of in-service evaluation do not seem to stand up well to this type of scrutiny.

12.17 Henderson (1979) discusses the politics of evaluation of in-service education and quotes MacDonald (1976) analysis of three styles of evaluation.

> "Bureaucratic evaluation is an unconditional service to those government agencies which have major control over the allocation of educational resources ... (The evaluator) acts as a management consultant and his criterion of success is client satisfaction...
>
> Autocratic evaluation is a conditional service to those government departments which have major control over the allocation of educational resources. It offers external validation of policy in exchange for compliance with its recommendations ...
>
> Democratic evaluation is an information service to the whole community about the characteristics of an educational programme. Sponsorship of the evaluation study does not itself confer a special claim upon this service. The democratic evaluator recognises value pluralism and seeks to represent a range of interests in his issue formulation ..."

The Diploma research project seemed to have substantial elements of the first and third of these styles of evaluation and none of the second.

12.18 Henderson (1979) examines some of the available strategies for evaluation and gives some practical hints to avoid, for example, collecting data in a form that is difficult to analyse, but it seems of general interest and some of the specific difficulties of in-service evaluation in a curriculum area where teachers may not feel confident do not feature prominently.

12.19 R. Bolam (1979) suggests 'an analytic framework' of three variables; the evaluator (school, providing agency, local authority or national authority), the evaluation target (individual teacher, school, providing agency, local authority or national authority) and the evaluation tasks (negotiate contract/entry, defined task, formulate evaluation design, implement evaluation design, analyse data/write report and disseminate findings). He draws a 3-dimensional diagram to illustrate his framework and is concerned upon the way in which these three factors interact in any one cell of the model.

12.20 Bradley (1979) reports on a survey for over 600 teachers carried out in 1975 in the East Midlands concerning in-service education in primary science. His findings do seem to be of direct interest to people interested in primary mathematics. His findings include statements about the value of a school policy for science (teaching it as it arises often 'seemed to be a euphemism for a minimum of activity'), the central role of the headteacher in curriculum planning and the desirability of a substantial course with three aspects:

B. MacDonald 'Evaluation and the Control of Education' in D. Towney 'Curriculum Evaluation Today: Trends and Implications' Schools Council Research Studies Macmillan Education Basingstoke 1976

R. Bolam 'Evaluating In-Service Education and Training: A National Perspective' British Journal of Teacher Education, Vol.5 No.1. 1979

H.W. Bradley 'Strategies for IWSET in Primary Science' Cambridge Journal of Education, Vol.9 No.2 1979

(i) extending the teacher's own knowledge of science, particularly physical science,

(ii) promoting understanding of curriculum planning, balance, progression evaluation,

(iii) developing experience of science activities for the primary classroom.

12.21 Salisbury (1979) gives a lively informal account of some of his school-based in-service work. He concludes "I hope it will be possible to produce some after-care by local authority officials and myself" otherwise presumably the effort may be dissipated.

12.22 Elton & Laurillard suggest that a purely psychometric research strategy is probably inadequate to find out about the complex situation of a practising teacher. They examine various new approaches that take a welcome more holistic view of situations, where the boundaries between research, development and practice may become blurred.

They claim 'that it is the aim of any scientific theory eventually to produce laws which unify substantial areas of knowledge and make predictions possible' and realise that the new approaches 'lack the precision to make verification of laws possible.'

Popper (Section 12.15) seems to be considering refining theories rather than producing laws and he has the insight that better theories result from successive refutations and so, on the basis of his work, it would be interesting to see whether the approaches described by Elton and Laurillard have the precision to make refutations of theories possible.

A. Salisbury 'Tractors, Fanny Craddock and Mathematics' Cambridge Journal of Education, Vol.9, No.2. 1979

L.R.B. Elton & D.M. Laurillard 'Studies in Higher Education' Vol.4, No.1 p.87-102 1979

12.23 Evans (1980) in his evaluation of the In-Service BEd Degree gives a useful list of statements/hypotheses that would be useful to attitude-scaling methods. The main addition to a list such as his that had to be made in the Dipoloma research were statements about the difficulty of the mathematics, about anxiety about examination and about the students' strategies for teaching.

12.24 Nisbet (1980) describes the strengths and weaknesses of varying modes of research, considers the presentation of action research as a challenge to the traditional model and concludes 'To some extent it is; but my position is that no one of these styles is right and none is altogether wrong. The most effective research employs a variety of strategies across the spectrum.' He quotes something of relevance to the background research project, a statement of Mrs. Thatcher when she was Secretary of State of Education in 1970

> "There was clearly only one direction that the Department's research policy could sensibly take. It had to move from a basis of patronage - the rather passive support of ideas which were essentially other peoples, related to problems that were of other people's choosing - to a basis of commission. This meant the active initiation of work by the Department on problems of its own choosing, within a procedure and timetable which were relevant to its needs. Above all, it meant focussing much more on issues which offered a real possibility of yielding usable results."

12.25 J. Reynolds (1980) in an unpublished paper 'In-Service Courses for Primary Teachers' describes the work of H.M.I. to observe short in-service courses provided by L.E.As for primary school teachers and to visit the schools of some of the teachers who attended the courses. The INSET activities 'would appear to have most value where they are part of or are associated with schools' curricula efforts and where heads give active support'.

N. Evans 'Preliminary Evaluation of the In-Service BEd Degree' N.F.E.R. Nelson 1980

J. Nisbet 'Education Research: The State of the Art' in W.B. Dockrell & D. Hamilton 'Rethinking Educational Research' 1980 p.8

12.26 Wragg (1982) in reviewing in-service education describes Withall & Fagan (1966) who visited teachers before and after a 6 week in-service course for teachers of England and reading to disadvantaged children. The teachers made greater use of teacher prepared materials but their predominant teaching style was not significantly different. The validity of the study is reduced because of the small sample size of 12 and because of its use of teacher-recorded audio tapes of single lessons.

Wragg comments more generally. 'Astonishingly there are almost no British studies of the effects in terms of changes in teachers' attitudes, behaviour or pupil learning such as the one by Withall & Fagan cited above. Although there are serious difficulties both logistically and methodologically of watching and interviewing teachers before and after an in-service course and then ascribing changes to the course, let alone deciding what is worthwhile the risks should be taken ... Unless we question, observe and enquire we can only guess.'

12.27 The Mathematical Diploma Research Project certainly monitored the progress of the Diploma. It seems right to be cautious about assessing the effectiveness of the Diploma but the research design did allow it to go a certain way towards answering Wragg's general criticism.

The helpfulness and friendliness of the teachers and of everyone else associated with the research project needs to be reiterated.

Suggestions for further in-service education

12.28 A number of suggestions are made in Section 10.14. The most significant addition to these is for a pilot scheme to develop models of school focussed and (partly at least) school based in-service education in mathematics in primary schools. A sample of

E.C. Wragg 'A Review of Research in Teacher Education' N.F.E.R. Nelson p.58, 75. 1982

the current literature, Watkins (1973), Henderson (1979), Donouhue (1981) does not seem to give any special prominence to mathematics in-service education and yet the Cockcroft report HMSO (1981) considers some of the advantages and difficulties involved.

Above all there is the need to encourage those forms of in-service education which enable teachers to have independence and confidence and to be much more than the acceptors of received wisdom on courses provided for them.

Suggestions for further research

12.29 Many suggestions have been made implicitly or explicitly in the various sections of this document. Others that seem apparent are the need for the 'pressure diagrams' (see Appendix 3) to be developed, the need for the graphs (see Appendix 3) to be used in various situations to determine the limits of their effectiveness, the need for a comparable study investigating e.g. the Science Diploma developed by the Association for Science Education, or the Low Attainers Diploma developed by the Mathematical Association.

It was observed that the effect of turning the tape recorder off at the end of an interview often prompted much valuable information. The ethics of exploiting this observed phenomenon is questionable but certainly some detail was lost to the research in this way.

There seems to be the need for much more school focussed research. The research project did seem to be at its weakest when gaining information from the students' classrooms. It is not clear how best to collect evidence from the children given that some of them had barely started school and others were bright articulate 13 year olds.

A suggestion of a study of matched samples of teachers, Section 12.8, to try to give some information of the perturbing influence of a research worker on a teacher doing an in-service course has been made.

An appropriate final suggestion might be to investigate whether the D.E.S. who were funding the research, felt that it and other such projects, in practice, did 'offer a real possibility of yielding usable results.

APPENDIX 1

N.B. The symbol <1% is used to indicate a non-zero percentage p which would be rounded to 0% (i.e. a percentage p where $0 < p < \frac{1}{2}$)

Please do not write in this column

SECTION 1

1				

1-5

1. Please state:

The name of the centre at which you are doing the Diploma .....

The starting date of the course (e.g. Sept. '79) .....

6 7

8 9 10

The outcome of the course

(PLEASE TICK ONE BOX)

Passed	26%	1
Passed with distinction	8%	4
Failed	1%	3
Repeating part of course	<1%	7
Passed after repeating part of the course	1%	2
Withdrawn	16%	9
Still doing the course	48%	5
Other (Please specify)	0%	6

12

2. So that we can compare the teachers doing the Diploma with the population of all teachers,

Please would you classify yourself as

(TICK AS APPROPRIATE)

Mr.	39%	2
Mrs.	52%	3
Miss	9%	4

13

and state your age

No response - <1%

Under 25	1%	1
25-29	18%	2
30-34	21%	3
35-39	20%	4
40-44	18%	5
45-49	13%	6
50-54	6%	7
55-59	2%	8
60 and over	0%	9

14

Please do not write in this column

3. How long does it take to get from school/home (whichever is applicable) to the centre for the Diploma Course?

No response - 1%

Less than 10 mins.	10%	1	
10 mins. to less than 20 mins.	24%	2	
20 mins. to less than 40 mins.	44%	3	15
40 mins. to less than 80 mins.	19%	4	
80 mins. or more	3%	5	

Is your journey to the centre normally by car?

No response - 1%

YES	90%	1	16
NO	9%	2	

4. Have you had to make special arrangements at home as a result of doing the Diploma Course?

No response - 3%

YES	37%	1	18
NO	61%	2	

If YES, please give details ....Involving spouse only 5%.....

children only 11%, spouse and children 12%, other 8%.....

.....No response - 63%..

19 ☐

5. When you started doing the Diploma course, were you

No response - 1%

a full time teacher	92%	1	
a part-time teacher	2%	2	
a temporary supply teacher, paid daily	2%	3	20
a permanent supply teacher on permanent contract	1%	4	
not teaching	1%	5	
other (please specify)	1%	6	

Has your position changed since?

No response - 2%

YES	5%	1	21
NO	94%	2	

If YES, please give details .....

.....

.....No response - 95%..

22 ☐

Please do not write in this column

When you started the Diploma course, what scale of post were you on?

No response - 2%

1	27%	1	
2	46%	2	
3	12%	3	
4	1%	4	24
Senior Teacher	<1%	7	
Deputy Head	8%	5	
Head	5%	6	

Has your status changed since?
No response - 2%

YES	22%	1	25
NO	77%	2	

If YES, please give details .....

No response - 78%

26

6. Which age group(s) were you trained to teach?

(PLEASE TICK ONE OR MORE BOXES AS APPROPRIATE)

Other - 1%

No response - 1%

Infant (include Nursery)	6%	1	
First	22%	2	
Junior	29%	3	28
Middle	29%	4	
Secondary	13%	5	

7. No. of years you have taught as a qualified teacher in U.K. schools — median approx. $8\frac{1}{2}$ years

29 30

8. Please give details of any in-service courses relating to Mathematics you have attended.

Course	Organised by	Duration	Year of attendance
Short courses 44% Longer courses e.g. 1 week or 1 term of 2 hrs./wk. 7% Long courses e.g. Secondment for a term <1% No courses 49%			

32

Please do not write in this column

9. Are you a member of any local or national Maths' teachers group or organisation?

No response - 2%

YES	18%	1
NO	80%	2

33

If YES, please give details ..A.T.M. - 11%, M.A. - 4%, ...

A.T.M. + M.A. - <1%, Other - 2%, No response - 82% .....

34

10. Have you got 'O' level Maths (or equivalent, e.g. C.S.E. grade 1, School Certificate)?

No response - 1%

YES	85%	1
NO	14%	2

35

11. How many children are there in the school in which you teach?

No response - 4%

Up to 25	1%	01
26-50	3%	02
51-100	5%	03
101-200	21%	04
201-300	30%	05
301-400	18%	06
401-600	11%	07
601-800	3%	08
801-1000	2%	09
1001-1500	2%	10
1501 or over	1%	11

36-37

12. What is the age range of children in the school (e.g. 7-11)?

No response - 4% .....

39 40

41 42

13. Type of school

No response - 2%

Nursery	<1%	1
Infant	7%	2
First	11%	3
Junior	23%	4
J.M.I.	30%	5
Middle	14%	6
Secondary	8%	7
Other (please specify)	6%	8

43

14. Which L.E.A. is it in?

No response - 3% .....

45 46

Please do not write in this column

15. Please would you classify the catchment area of the school.

(PLEASE TICK ONE BOX) No response - 3%

Inner city:	the centre of large conurbations and the inner rings of large cities	15%	1	47
Rural:	hamlets, villages and small towns with a population of 15,000 or less	29%	2	
Other Urban:	any area not classed as "Inner City" or "Rural", including towns with populations greater than 15,000 and certain parts of cities and conurbations	54%	3	

16. Are teachers in your school paid the S.P.A. allowance? No response - 5%

YES	13%	1	48
NO	82%	2	

17. Please mention anything special or unusual about the children in your school. 49

No response - 69%

.....

.....

18. Why did you decide to take a Maths. Diploma course?

(PLEASE TICK BOXES AS APPROPRIATE)

	1 Major Factor	2 Contributory Factor	
To help with teaching Mathematics	67%	23%	51
To improve your own Maths	27%	40%	52
To help with organising Maths in the school	34%	24%	53
To help to gain promotion	20%	30%	54
Pressure from Headteacher	<1%	2%	55
Pressure from L.E.A. Adviser	<1%	1%	56
Out of interest	40%	30%	57
Because friends/colleagues also taking course	<1%	7%	58
Other (please specify)	7%	6%	59

Please do not write in this column

2				

1-5

Median approx. £34,50...

6 7

2. (a) How much were the College/Institute fees?

(b) How much financial support did you get from the L.E.A. towards

(PLEASE TICK THE APPROPRIATE BOX)

	1 All	2 Some	3 None	
Maths. Association fee	60%	13%	22%	8
College fee	60%	15%	20%	9
Travelling expenses	42%	27%	25%	10
Other expenses e.g. books (please specify)	1%	2%	89%	11

No response - 6%

No response - 7%

No response - 6%

No response - 8%

(c) Do you consider the L.E.A.'s financial support to be

Adequate	75%	1
Inadequate	17%	2

12

No response - 8%

Add further comment (if you want to) .....

.....

No response - 71%

13

3. Please list any books which you have found particularly useful for the course.

Author	Title of Book
No response - 46%	

15

16

4. These are some teachers' comments about the course. Please will you say whether you agree or disagree with them.

	No response	1 Agree	2 Un-decided	3 Disagree	Please do not write in this column
The Maths in the course is too hard	3%	17%	23%	57%	18
Half a day release is needed for teachers doing the course	2%	63%	16%	19%	19
The Maths exam should be easy so that students get high marks and their confidence increases	4%	5%	22%	69%	20
The Maths Education assignments/essays should draw on classroom experience and incidents	4%	76%	14%	6%	21
The course is out of touch with the problems of teaching children Maths	4%	19%	26%	52%	22
You are too tired after teaching all day to take much in	6%	41%	24%	30%	23
There is not much point in Infant School teachers doing work on vectors and matrices	3%	15%	19%	63%	24
Students get anxious about the exams	3%	78%	10%	8%	25
I still do not know all the students on the course	4%	21%	5%	71%	26
My enjoyment of the course was spoiled by having to be assessed	4%	16%	17%	63%	27
More tutorial time is needed in the course	4%	40%	21%	35%	28
It was useful to hear about Maths in other schools("We didn't" - 12 teachers - 2%)	3%	89%	5%	1%	29
More attention needs to be paid to the theoretical psychological development of children	4%	20%	28%	48%	30
Being on the course has encouraged me to try new ways of teaching Maths	4%	79%	7%	10%	31
An examination is the best way of assessing the Maths component of the course	4%	35%	29%	33%	32
Dates for handing in work have not been well spaced	4%	19%	15%	62%	33
The course has increased my confidence in doing Maths	3%	62%	17%	17%	34
The course is more relevant to junior and middle school teachers than to teachers of younger children	3%	42%	22%	33%	35
Talking to other teachers on the course was useful and helpful	3%	91%	4%	3%	36
The coffee break was a waste of time	3%	7%	4%	87%	37

5. Please can you indicate how you felt about the time spent on various topics in the course.

	No response	1 None or None so far	2 Not enough	3 About right	4 Too much	Please do not write in this column
Number and arithmetic operations	11%	3%	18%	66%	2%	39
Calculators	13%	30%	22%	33%	3%	40
Sets	12%	4%	10%	64%	10%	41
Properties of shapes	14%	13%	15%	54%	3%	42
Transformation geometry	14%	13%	14%	49%	10%	43
Vectors	15%	23%	17%	37%	8%	44
Algebra - solving equations	14%	17%	20%	44%	6%	45
Matrices	14%	20%	12%	44%	10%	46
Probability	14%	21%	12%	46%	7%	47
Maths in relation to other parts of the curriculum	14%	33%	38%	15%	1%	48
Proof in Mathematics	18%	25%	19%	34%	5%	49
History of Maths	14%	17%	14%	45%	10%	50
Piaget, Dienes, Skemp etc.	13%	7%	18%	53%	8%	51
Maths for 3-5 year olds	13%	33%	31%	22%	1%	52
Maths for bright children	14%	30%	38%	18%	1%	53
Maths for slow learners	13%	30%	42%	15%	<1%	54
Children's Mathematical Language	14%	20%	28%	38%	<1%	55
Structural Apparatus in teaching Number Work	13%	9%	28%	49%	2%	56
Constructing a school Maths Scheme	13%	31%	37%	18%	2%	57
Getting a good sequence of work for children to follow	13%	29%	38%	19%	1%	58
Looking at guidelines from L.E.A.s and other sources	14%	30%	28%	27%	2%	59
The value of Mathematical Games	13%	16%	25%	43%	2%	60
Selecting a Maths textbook (or published workcards)	13%	24%	33%	29%	1%	61
Coping with children's mistakes in Maths	13%	31%	38%	18%	0%	62
Priorities in buying equipment	14%	46%	27%	13%	<1%	63
The responsibilities of a Maths consultant	14%	44%	25%	17%	<1%	64
Assessing children's progress	13%	31%	34%	22%	1%	65

Please do not write in this column

SECTION 3

1. Do you teach Mathematics

(PLEASE TICK ONE BOX)

No response - 2%

to more than one class regularly	23%	1	
to one class regularly	70%	2	67
occasional lessons only	4%	3	
not at all	2%	4	

2. Do the classes you teach contain children of more than one academic year group?

No response - 4%

YES	39%	1	68
NO	57%	2	

3. What ages of children do you teach?

(PLEASE TICK BOXES AS APPROPRIATE)

Age	✓ =1	
less than 5	7%	70
5-6	16%	71
6-7	18%	72
7-8	24%	73
8-9	26%	74
9-10	32%	75
10-11	33%	76
11-12	18%	77
12-13	12%	78
13 and over	9%	79

3					1-5

4. Please indicate how you organise the Mathematics teaching.

	No response	1 Frequently	2 Occasionally	3 Never	
Teach the whole class	4%	41%	49%	6%	6
Teach in groups	4%	57%	34%	5%	7
Use individual assignments	4%	40%	47%	9%	8

Please do not write in this column

5. Please indicate the dominant characteristic by which groups are formed for Mathematics.

(TICK ONE BOX PLEASE)

No response - 4%

by ability	73%	1	
by mixed ability	10%	2	
by friendship	3%	3	
by shared interest	2%	4	9
by sex	0%	5	
by age	2%	6	
not grouped	7%	7	

6. Please indicate what sort of starting points you use for Mathematics teaching.

	No response	1 Nearly Always	2 Frequently	3 Occasionally	4 Never	
Published textbook(s)	4%	19%	37%	29%	11%	11
Published workcard scheme	4%	5%	11%	27%	53%	12
Work cards/sheets produced by you	4%	10%	41%	36%	10%	13
Work cards/sheets produced teachers in the school	5%	2%	5%	24%	64%	14
Television programmes	5%	1%	7%	43%	46%	15
Investigations arising from children's questions or initiated by you	4%	6%	27%	51%	12%	16
Practice of skills directed from the blackboard	4%	6%	34%	44%	12%	17

7. What provision do you make for

(a) the slow learners .....

.....

.....

No response - 8%

.....

19 ☐

(b) the more able children .....

.....

.....

No response - 10%

.....

20 ☐

8. Here are some statements made by teachers about teaching Mathematics. Please indicate to what extent you agree with them.

	No response	1 Agree	2 Un-decided	3 Dis-agree	Please do not write in this column
Children like to work at their own rate from a book so they can see their own progress	3%	43%	35%	20%	22
Sometimes I do not know where the Maths I am teaching the children may lead	3%	26%	15%	56%	23
Sometimes I feel that the bright children are not "stretched" enough	3%	64%	11%	23%	24
It is easier to get the level of work right for slow learners than for bright children	3%	33%	15%	50%	25
Open ended work is difficult to mark	3%	43%	27%	27%	26
I normally stick to the teaching order in a text book or in a Maths scheme	3%	21%	9%	67%	27
I would rather follow a child's interests than follow a rigid sequence of work in Mathematics	3%	32%	38%	27%	28
Mathematical games and puzzles waste a lot of teaching time.	3%	3%	13%	81%	29
It is important that bright children have lots of practice in number work	3%	21%	24%	52%	30
Children prefer Maths questions to have one definite answer	3%	59%	22%	15%	31
It is more efficient to teach the whole class than to teach a new aspect of Mathematics individually to each child	3%	48%	25%	24%	32
Work cards prepared by teachers rarely match the professionally produced material	3%	16%	18%	63%	33
It is important to cover a scheme of work completely	3%	20%	24%	54%	34
It is important to match the Mathematics to the level and interests of the individual child	3%	87%	8%	3%	35
Children like investigating Mathematical problems and puzzles	3%	78%	17%	3%	36
Bright children are best left to get on by themselves at their own pace	3%	9%	15%	74%	37

Please do not write in this column

9. (a) Please can you indicate how each of the four components of the Diploma course has helped you (if at all) in your teaching of Mathematics.

	No response	1 Very helpful	2 Fairly helpful	3 Marginally helpful	4 Not helpful	
Mathematics	11%	30%	30%	22%	7%	39
Maths. Education	15%	20%	38%	23%	5%	40
Child Study	34%	20%	25%	13%	8%	41
Investigation	27%	12%	23%	21%	17%	42

(b) Please can you describe briefly how each of the components of the Diploma course has helped you (if at all) in your teaching of Mathematics.

Mathematics Saw maths progression - 12%, Interest/confidence - 5%, Inadequacy - 7%, Increase of knowledge/understanding - 20%, Increase of confidence/knowledge - 8%, positive links with classroom - 11%, Not enough links with classroom - 9%, No help - 4%, Other - 3%

No response - 22%. 43

Maths. Education Relevance to classroom - 25%, Relevance to classroom + school organisation - 5%, Irrelevance to classroom - 3%, Disappointing - 14%, Helpful - 15%, Other - 6%

No response - 31%. 44

Child Study Made aware of children's problems/difficulties - 25%, Valuable - 15%, Useless - 5%, Took a lot of time - 3%, Uncertainty of approach - 2%, Other - 6%

No response - 44%. 45

Investigation Difficult - 3%, Valuable only personally - 23%, Valuable + transfer to classroom - 17%, Useless/waste of time - 11%, Other - 7%

No response - 39% 46

Please do not write in this column

SECTION 4

1. How many teachers are there in your school? (include the Headteacher)

Median approx ...10... 4849

2. How many teachers teach Mathematics?

Median approx ....8½.. 5051

3. How many teachers teach Mathematics to more than one class?

0 in over half the schools 5253

4. (a) Is there a Mathematics specialist/ consultant?

No response - 5%

	a	
YES	62%	1
NO	33%	2

55

(b) What (if any) special duties or responsibilities do they have?

.....

.....

No response - 41%

56

(c) Are you the Mathematics specialist/ consultant?

No response - 7%

YES	38%	1
NO	55%	2

57

5. Has your school written guidelines or a scheme of work for Mathematics?

No response - 5%

YES	78%	1
NO	17%	2

58

6. Who in the school makes decisions about ordering books and equipment for Mathematics?

(TICK ONE OR MORE BOXES)

	✓ = 1	
The Headteacher	57%	60
The Deputy Head	16%	61
The Maths Specialist	51%	62
Another specific teacher	4%	63
Each teacher for their own class	30%	64
Discussed at staff meeting	38%	65
Other (please specify)	8%	66

Please do not write in this column

7. How is the children's Mathematics assessed in your school?

(PLEASE TICK ONE OR MORE BOXES)

	✓=1	
A written test set once a year or more by the school	36%	69
Informal assessment by class teachers	62%	70
An appropriate standardised test (e.g. N.F.E.R. or Moray House)	41%	71
Class teacher completing a check list of children's progress	43%	72
L.E.A. monitoring of standards	11%	73
No assessment for Mathematics but assessment for reading	6%	74
We think assessment is inappropriate for the children	1%	75
Other (please specify)	8%	76

8. (a) How effective do you think the Diploma is in helping teachers to organise and lead the Mathematics in a school?

(PLEASE TICK ONE BOX)

No response - 15%

Highly effective	15%	1	77
Fairly effective	40%	2	
Of limited effect	26%	3	
No effect	5%	4	
A hindrance	<1%	5	

(b) How would you suggest the Mathematical Education component of the course might be modified to make the Diploma more effective in helping teachers to organise and provide leadership in the Mathematics in a school?

78 ☐

.....

.....

.....

.....

.....

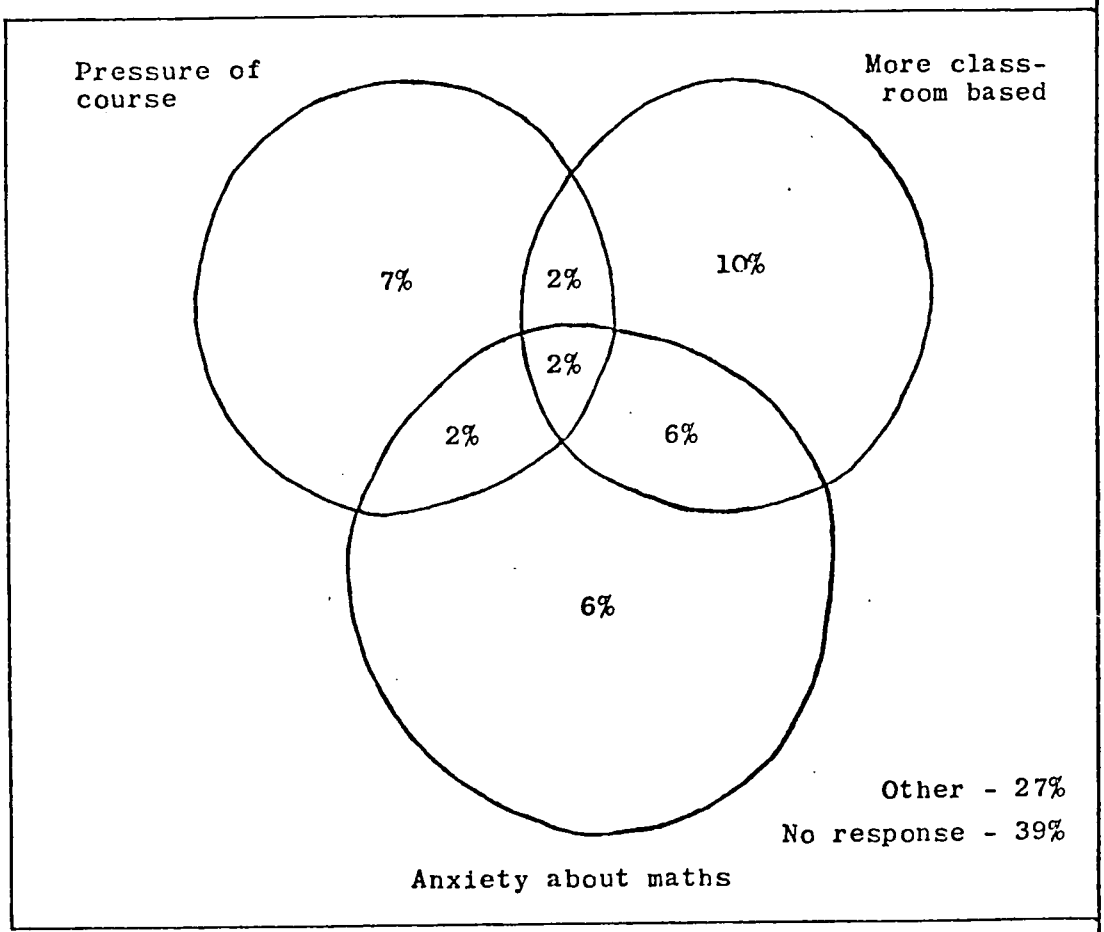
No response - 37%

Please do not write in this column

79

SECTION 5

Please add any other comments you would like to make about the Diploma in Mathematical Education (e.g. any improvements, suggestions for changes, things which would be worth investigating in the research project).



In addition 44 teachers (6% of the population) indicated anxiety about assessment (including examinations).

MANY THANKS FOR YOUR HELP.

Information from this section is incorporated in Chapter 8, sections 19-25.

Please do not write in this column

4				

1-5

IF YOU HAVE WITHDRAWN FROM THE COURSE, PLEASE WILL YOU COMPLETE THIS SHEET AND AS MUCH OF THE GREEN BOOKLET AS YOU ARE ABLE.

1. How long after starting the course was it that you withdrew?

(PLEASE TICK ONE BOX)

Less than 1 month		1
1 month to less than 2 months		2
2 months to less than 4 months		3
4 months to less than 8 months		4
8 months to less than 16 months		5
16 months or more		6

6

2. Please would you indicate to what extent you found the Diploma course helpful to you as a teacher.

(PLEASE TICK ONE BOX)

a hindrance		1
no help at all		2
of limited use		3
fairly helpful		4
other (please specify)		5

7

Please give further details (if you want to) .....

.....

.....

.....

8

The information in this question will be treated as strictly confidential and only a national picture will be reported.

Please do not write in this column

3. These are some reasons students have given for withdrawing from the course. Please will you help us to form a global picture by ticking those that are appropriate to you.

(a) Diploma course

Maths too hard		9
Pressure of work or assessment associated with the course		10
Course inappropriate		11
Lack of adequate financial support		12
Travelling distance too great		13

(b) School

Pressure of school work		14
Promotion		15
Changed schools		16
Left teaching		17

(c) Home or domestic

Pregnancy		18
Own illness		19
Family illness		20
Other personal problems/reasons		21
General family or domestic pressure		22
Moved to another area		23
Outside commitments		24

If you would like to give more details or if there were other reasons why you withdrew that you would like to tell us about, please do so. 26

.....

.....

.....

.....

APPENDIX 2

LIST OF INSTITUTIONS

● denotes a Diploma centre currently running courses
* denotes a Diploma centre (with outpost(s)) currently running courses
ɸ denotes a Diploma centre no longer running courses
≠ denotes a Diploma centre (with outpost(s)) no longer running courses

Code No. (see map in section 2.2)		Institution
●	1.	Westminster College, Oxford
●	2.	Derby Lonsdale College of Higher Education
●	4.	Bristol Polytechnic
●	6.	West Sussex Institute of Higher Education
*	9.	Roehampton Institute of Higher Education
●	12.	Newcastle Polytechnic
*	15.	Rolle College, Exmouth
●	16.	Doncaster Metropolitan Institute of Higher Education
*	17.	Bishop Grosseteste College, Lincoln
●	18.	New College, Durham
●	19.	Hull College of Higher Education
●	21.	Sunderland Polytechnic
*	22.	College of St. Mark and St. John, Plymouth
●	24.	Matlock College of Higher Education
ɸ	26.	Christ Church College, Canterbury
●	27.	Trinity and All Saints' College, Leeds
●	28.	Kingston Polytechnic
●	29.	Barnsley College of Technology
*	30.	Chelmer Institute of Higher Education, Brentwood
●	31.	City of Liverpool College of Higher Education
●	32.	The College of Ripon & York St. John, York
ɸ	33.	Leeds Polytechnic
≠	34.	Keswick Hall College of Education, Norwich
●	35.	Homerton College, Cambridge

●	36	Buckinghamshire College of Higher Education, Chalfont St. Giles
●	37	Polytechnic of the South Bank
●	38	Liverpool Institute of Higher Education
●	41	West London Institute of Higher Education, Twickenham
●	43	North Worcestershire College, Bromsgrove
*	45	Edge Hill College of Higher Education
●	46	Nene College, Northampton
●	47	Hertfordshire College of Higher Education, Watford
●	48	Ilkley College
●	49	Milton Keynes College
●	50	North Riding College of Education, Scarborough
●	51	Wolverhampton Polytechnic
*	52	City of Manchester College of Higher Education
*	53	Crewe & Alsager College of Higher Education
●	54	Bedford College of Higher Education
●	55	Bulmershe College of Higher Education
●	56	Teesside Polytechnic
●	57	Worcester College of Higher Education
●	59	North Cheshire College, Warrington
●	60	South Glamorgan Institute of Higher Education, Cardiff
●	61	St. Mary's College, Twickenham
●	64	West Glamorgan Institute of Higher Education, Swansea
●	66	St. Mary's College, Belfast
*	68	La Sainte Union College of Higher Education
●	69	De La Salle College of Higher Education, Manchester
●	71	Leicester Polytechnic
●	75	West Midlands College of Higher Education, Walsall
●	76	Polytechnic of Wales, Pontypridd

APPENDIX 3

INTERVIEW SCHEDULE FOR HEADTEACHERS

JANUARY 1981

Notes: 1. Tape recorded (with their permission)

2. Estimated time - 30 minutes

Form of introduction in the school

I'm Jean Melrose and I am evaluating the Mathematical Association Diploma in Mathematical Education. I wrote to (headteacher's name) and he suggested that I should call to see him now.

Form of introduction to the headteacher

Hello/Good morning, I'm Jean Melrose, the research worker evaluating the Mathematical Association Diploma in Mathematical Education.

Please, first of all, could I explain a bit more about the Diploma course. It's an in-service course for qualified teachers aiming to "equip them to make a strong personal contribution to the teaching of mathematics within their own schools". The nearest ones to here are ( ). Typically teachers will have meetings on one evening per week over two years with occasional extra meetings. Diploma courses started about 3 years ago and so far about 1700 students have registered.

The holding of the Diploma entitles a teacher to a Burnham increment, and the DES have financed a research project to evaluate and monitor the progress of the Diploma.

Part of the work of the research project is looking in depth at forty students throughout the country who are taking the course and finding out about their teaching of mathematics, the organisation and philosophy of mathematics teaching in their schools, the influence of the Diploma course on both of these, as well as their views about the Diploma course.

Please could I ask you some questions about the organisation and scope of mathematics teaching in your school. The information will be treated as confidential; no names or specific indications of place will appear in reports to the DES or anyone else. Please would you mind if I tape record the interview? I will take the information I need from the tapes, without names, and then the tapes will be cleaned.

1. How many children are there in the school?
   Up to 25/ 26-50/ 51-100/ 101-200/ 201-300/ 301-400/ 401-600/ 601-800/ 801-1000/ 1001-1500/ 1501 or over

2. How would you describe the catchment area of the school?
   (Probe e.g. does this mean there are children for whom English is not their first language?)

3. Do all class teachers in the school teach some mathematics?

4. Have you a mathematics specialist/leader/consultant?

5. (if YES to 4)
   What do they do?

   (if NO to 4)
   If the school did have such a person, what do you think their role should be?

6. (Give them a pressure diagram) (see page 279)

   I've made out this diagram showing some of the pressures or influences on the mathematics curriculum in the school. Please could you mark each box with one of the numbers from one to five as indicated on the scale.

   Please could you tell me about the influence of each one as you are doing so. There are spaces at the bottom for influences I've missed.

(At end)

(Pause) Do you think I've covered the most important influences or is there anything that really stands out to you that I've missed?

7. Do you have a scheme of work or written guidelines for mathematics in the school?

In order that I can get a picture of the structure of the mathematics teaching in the school, would it be possible to have a look at it?

We need to find out about the background of teachers on the course, what mathematics they teach and what type of scheme of work they follow, so that we can try to find out whether a particular type of teacher goes on the course. Would it be at all possible to get a copy of the maths scheme - the centre at (') would allow me to use their photocopier if needed. The scheme would not be seen by anyone outside the research team. The aim is not to evaluate the particular teacher or the school but the success (or otherwise) of the Diploma in providing for the needs of teachers in mathematically different schools. Would it be possible please?

Who constructed the scheme of work?

(Indicate different mode)

8. Please could we now talk more specifically about the influence of the Diploma. I want you to tell me as much as possible about any effect you have noticed.

Please can I {emphasise / say again} that what you say will be treated in confidence.

Mr./Mrs./Miss X is doing/has done the Diploma course.

(a) Please could you tell me if you have seen any influence of this in his/her own teaching.

(b) Please could you tell me if you have seen any influence of this in the mathematics in the school.

THANK THEM.

INTERVIEW SCHEDULE FOR STUDENTS

JANUARY 1981

Notes:
1. Tape recorded with their permission.
2. Estimated time - less than 30 minutes (pressure of school times)
3. Already have information from application forms
4. They will have completed draft large sample questionnaire
5. Assure of anonymity and try to get permission to go into their classrooms
6. Look at all the work they have done for the course.

1. If a teacher who was starting the Diploma course next September came to you for advice, what would you say?

(Probe if (i) organisation of home life) (ii) preliminary reading) not mentioned

2. What do you think should be the special responsibilities and duties of a mathematics specialist/consultant/leader in a school?

3. Pressure diagram (See section 7 in headteacher interview schedule)

4. After finishing } the Diploma course, do you have any
Now you have finished } plans for or thoughts of doing any further study

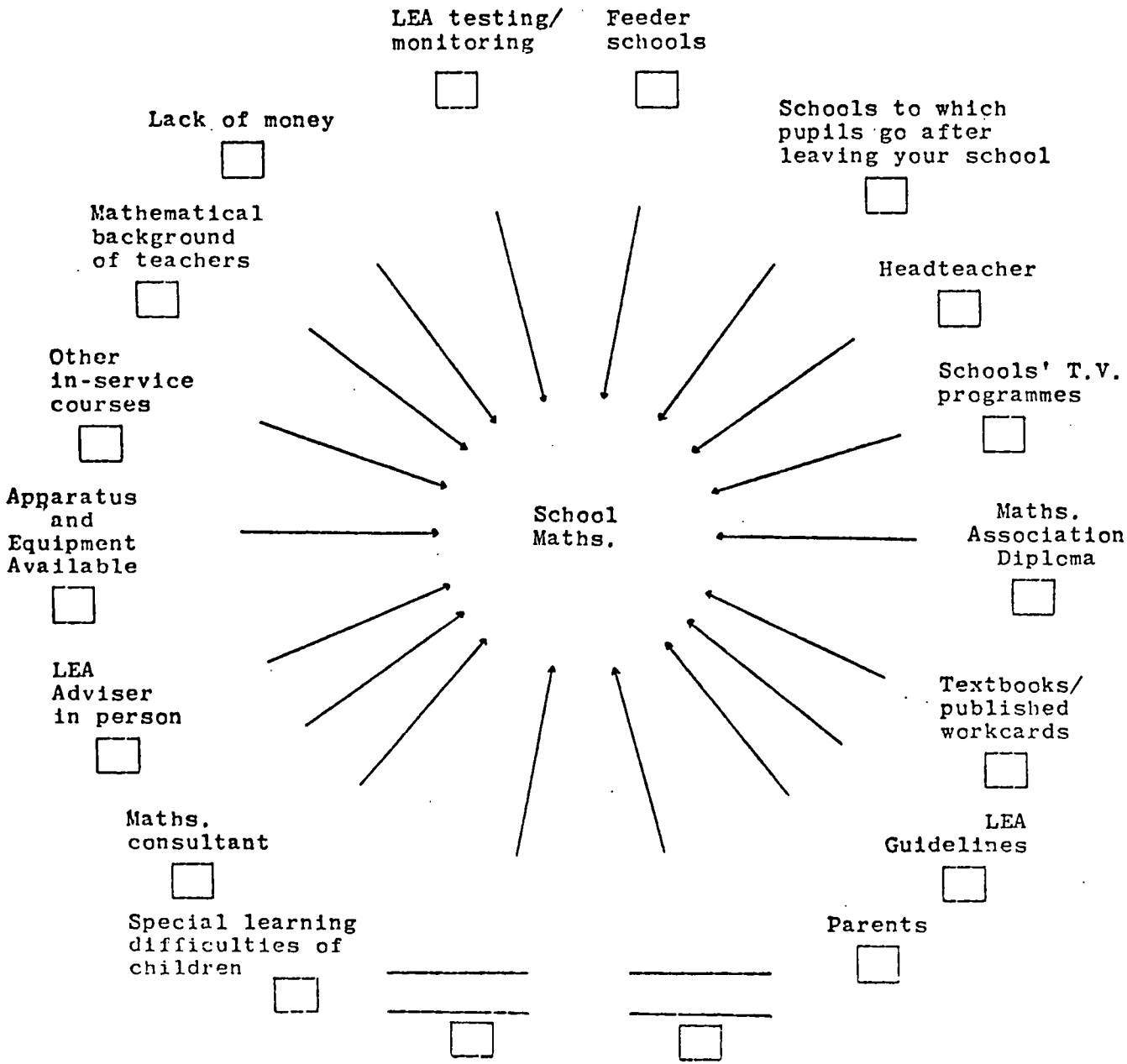
5. What things have you done in your school (if any) as a result of attending the Diploma course?

(If needed, take each component separately and ask specific questions).

6. (Follow up any points raised in the questionnaire).

THANK THEM.

Pressure Diagram 1981



1 No effect or influence whatsoever

2 A limited influence on a few teachers

3 A limited influence on most teachers

OR

A significant influence on a few teachers

4 Influences the mathematics in the whole school

5 Is a dominant influence on the mathematics in the whole school

INTERVIEW SCHEDULES FOR HEADTEACHERS AND TEACHERS

JANUARY 1982

It is impossible to have the same schedule for all people as last year; the common objectives of attempting to assess reported change in the mathematics in the school and of attempting to assess the reported influence of the Diploma will have to be approached from different starting points in different schools.

Form of introduction in the school

Hello/Good morning. I'm Jean Melrose, the research worker evaluating the Mathematical Association Diploma. I wrote to (headteacher's name) and he suggested that I should call to see him now.

Headteacher

Hello/Good morning. I'm Jean Melrose, the research worker evaluating the Mathematical Association Diploma. Thank you for making arrangements for this visit.

Please may I ask you questions to get an up-to-date picture of the mathematics in the school and to see whether you feel ( ) being on the Diploma course is having/has had any influence.

Whatever you say will be confidential; no names of people, or the school, or the LEA or the centre at which the course was held will be reported.

Please would you mind if I tape recorded the interview. I will take the information I need from the tapes without names and then the tapes will be cleaned.

1. How many children are there in the school?
   Up to 25/ 26-50/ 51-100/ 101-200/ 201-300/ 301-400/ 401-600/ 601-800/ 801-1000/ 1001-1500/ 1501 or over

2. Please would you tell me about any changes that have been made in the way mathematics is organised in the school in the last year.

(Probe if necessary:-
Last year you told me about .....
Have you had the opportunity to {develop this....
{make any progress on this..)

3. Please can you tell me how you feel this year about how useful the Diploma has been to you in the school.

(Probe further if necessary:-
in Mr./Mrs. .....'s classroom
in the school as a whole

Mr./Mrs. ..... finished the Diploma course last year/2 years ago. Can you see any lasting benefit that has come from it?

How do you think the Diploma might be improved to be more useful in schools?)

Teacher

(Assure informally of confidentiality and ask for permission to tape record.)

Question for first-year students:-

0. How is the Diploma going this year?

(Probe e.g. How are you coping with fitting in all the work?

Ask about Mathematics
Mathematical Education
Child Study
Investigation)

Questions for all students:-

1. What age group are you teaching for mathematics this year?

2. Have you made any changes since last year in the way in which you teach mathematics?
(Probe e.g. Tell me about them)

3. Have there been any changes in the way mathematics is organised in the school?
(Probe e.g. Tell me about them)

4. Pressure diagram (see page 284):- This is a diagram, rather like the one you completed last year. It is to show how you feel the Diploma has or has not helped you in your teaching and in the mathematics in the school. Please could you mark each of the boxes with one of the numbers from 1 to 4 as in the scale on the right hand side.

   Can you suggest how the Diploma might be improved?

   There are two empty spaces. Do you think I have covered the most important things or is there anything that really stands out to you that I've missed?

5. Graphs:- The diagram (on page 285) shows sketch graphs of the influence of the Diploma course on three students.

   The first student has not been influenced at all by the course either during or after the course.

   The second student has been influenced by the course and the influence has persisted and grown after the course has finished.

   The third student has been influenced by the course but the influence has ceased fairly soon after the end of the course.

Would you, in the fourth space, draw a rough sketch graph that shows your experience.

Would you mark the end of the course on the axis.

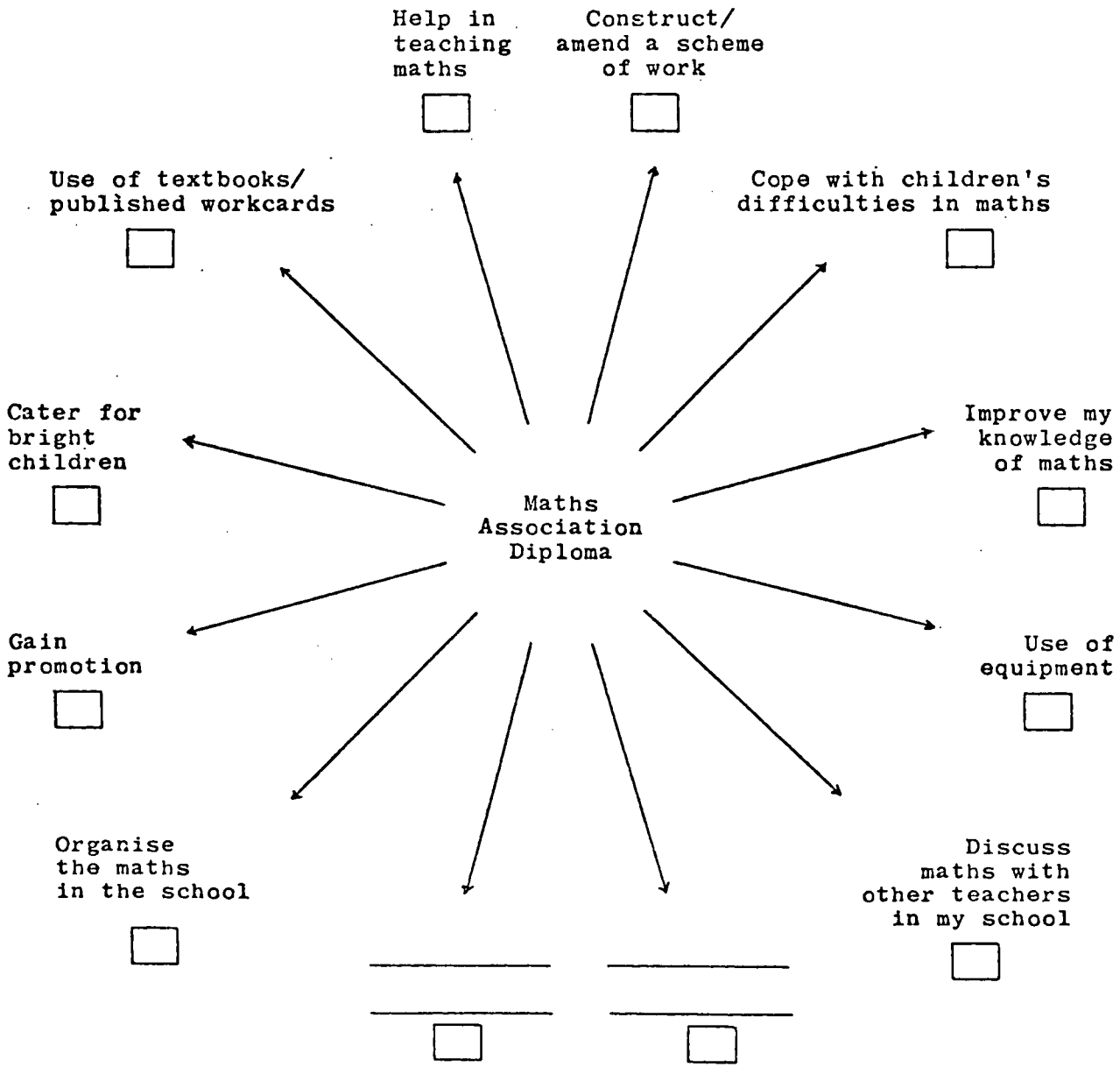
6. either
Have you any thoughts of or plans for doing any further study?

or
Have you thought about doing any further study after the Diploma course?

7. Have you kept in touch with any of the people on the course?

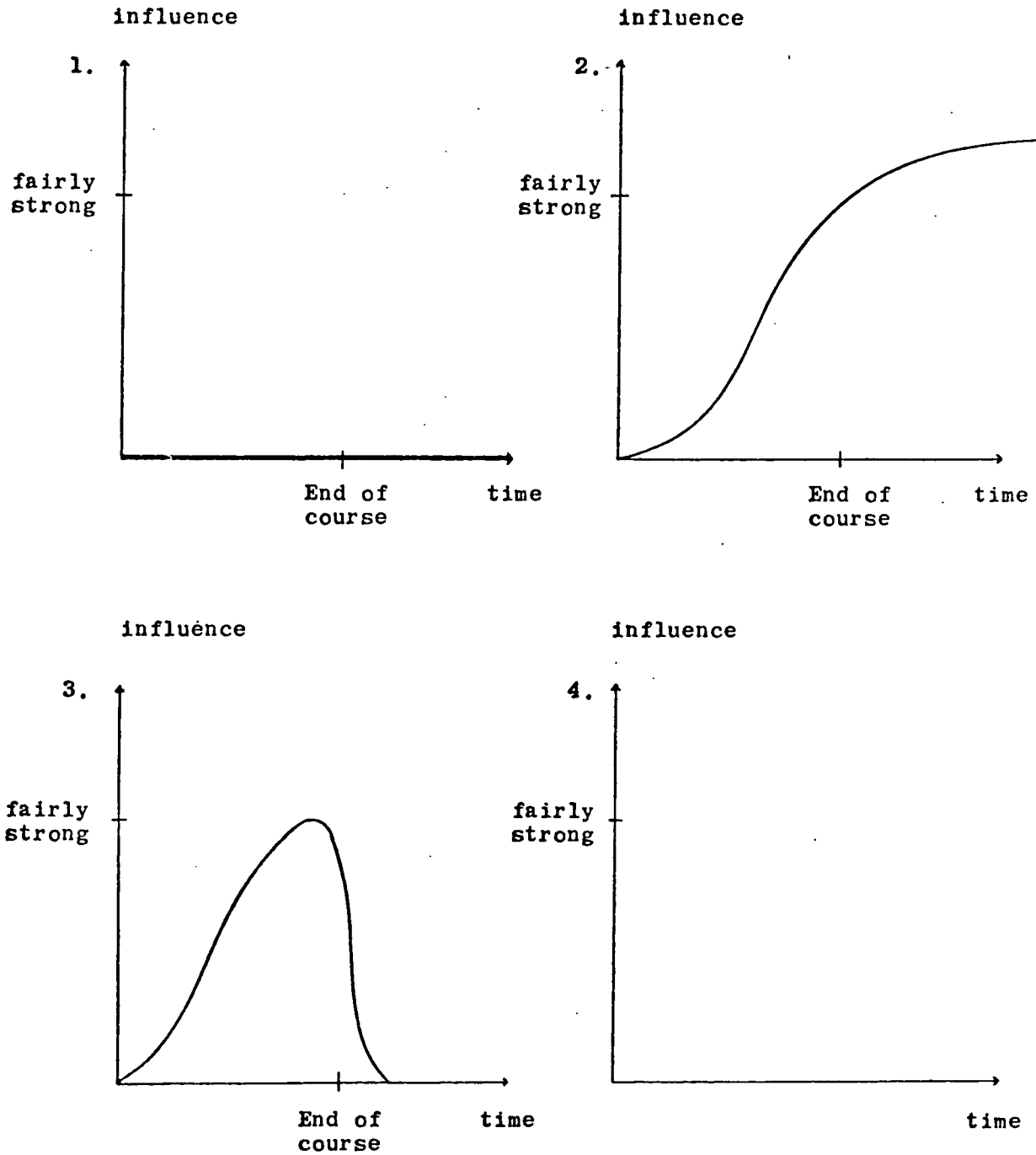
(Probe for frequency and purpose of meetings.)

Pressure Diagram 1982



1. Very helpful.
2. Fairly helpful.
3. Of limited help.
4. No help at all.

Graph 1982


influence
1.
fairly strong
End of course
time
influence
2.
fairly strong
End of course
time
influence
3.
fairly strong
End of course
time
influence
4.
fairly strong
time

APPENDIX 4

MATHEMATICAL ASSOCIATION DIPLOMA RESEARCH PROJECT

Research Design

Research Project

The Research Fellow will have two main objectives:-

(a) to monitor the progress of the Diploma,
and

(b) to assess the effectiveness of the Diploma.

Monitoring the progress of the Diploma

The Fellow will collect data relating to institutions, courses, teachers and students by means of visits and questionnaires and analysis of information already held by the Association. He will produce a simple statistical breakdown giving comparative details of courses approved, their contents, modes of assessment and teaching methods. He will also provide information on students, giving details of their backgrounds, experience, ages and reasons for taking Diploma courses.

The information on courses will be obtained from Association records, a questionnaire, and perhaps a limited number of visits to institutions. The information on students will be obtained by questionnaire, by examination of Student Registration Forms and perhaps by a small number of individual interviews.

Much of the data required is already held by the Association. A questionnaire to all colleges (about 70) is envisaged together with a second questionnaire to a large sample (about 1000) of students.

Assessing the effectiveness of the Diploma

The Fellow will carry out a detailed, in-depth study of a stratified random sample of 40 Diploma students. The study will be longitudinal in nature and involve the collection of information by questionnaire, interviews and visits on two separate occasions for

each student selected. It is proposed that the students be selected to represent an appropriate range of ages, schools and locations and that the 40 will be drawn in pairs from 20 colleges. The sample will contain students at different stages in Diploma courses, i.e. some who have completed a course, some in the second year and some in the first year.

By selecting the sample in this way the Fellow will be able to investigate various aspects including the extent to which the Diploma has influenced e.g.

changes in teachers' schools;
confidence of teachers in writing schemes;
liaison with colleagues within the teachers' own schools, and with other schools and with local advisers;
attitudes of teachers towards the teaching of mathematics.

The Fellow will also investigate improvement in teachers' knowledge of mathematics and mathematical education and attempt to discover what categories of teachers appear to derive most benefit from courses. In addition to the in-depth studies, some of the data collected by questionnaire (see paragraph 4 above) could be used. The effects of different teaching styles and starting times for courses will also be investigated.

The Fellow will make visits to teachers' schools and have discussions with headteachers and other teachers within these schools. It will be the task if the Fellow to study the relationships between the students and the conditions within which they are working.

Possible timetable

A possible timetable is outlined below although this should be regarded as tentative in the first instance.

Term 1: Familiarisation with Diploma procedures, documents and submissions

Design and use of pilot questionnaires for colleges and students for general data collection.

Selection of sample of 40 students for in-depth investigation. Pilot interviews.

Term 1/2: First round of interviews with the sample of 40 students.

Term 2/3: Circulation of general questionnaire to colleges and large sample of students.

Term 4/5: Second round of interviews with sample of 40. Begin analysis of questionnaire returns.

Term 5/6: Analysis of returns and interview data. Writing of report.

The Diploma Board considers the appointment of a Research Fellow to be a most important step in providing information on which to base decisions concerning future policy on Diploma courses. It seems likely that there will continue to be a demand for the Diploma for many years to come and thus considerable benefit should be derived from the work of a Fellow. In addition, the results of the investigation should be of value to other providers of in-service education for teachers in primary schools.

To ensure a professional standard of reporting, a suitable candidate is likely to hold a senior post in a school or college, possibly at Scale 4 or deputy headteacher level. The Research Fellow will need to be able to work independently, to show judgement and initiative and to be aware of the sensitive nature of many of his enquiries. The day-to-day supervision of the Fellow's work would be the responsibility of the Board's Secretary in Durham. The Fellow will report at all Board meetings (about 5 or 6 each year) and thus will receive the continuing advice and support of the whole Board.

The work of the Fellow will be overseen by a steering committee consisting of:-

1 HMI, 1 representative of the DES, 1 college lecturer involved in teaching Diploma courses, 1 student or ex-student of a Diploma course, the Chairman, Secretary and two other members of the Diploma Board, and the headteacher of a primary school.

Location: The location will be within the School of Education in the University of Durham. The Secretary of the Diploma Board, Mr. M.L. Cornelius, is located there and hence relevant documents are readily available. The Durham School of Education will provide suitable accommodation, access to professional advice and resources, including libraries, and the use of the University computer.

Duration: The project will last for two years from September 1980.

The Research Fellow will be expected to produce reports which will be widely available to interested parties. The Diploma Board wishes to encourage the publication of findings in appropriate journals and the communication of results to other groups such as LEA advisers, college lecturers and teachers' associations.

BIBLIOGRAPHY

Adams L.D. 'A Background to Primary School Mathematics' Oxford University Press

Anderson D.C. Evaluating Curriculum Proposals' Croom Helm 1981

A.T.M. 'Notes on Mathematics in Primary Schools' Cambridge University Press 1967

Ball D. 'The first year' Mathematics in School Vol.9 No.5

Biggs E. 'Confident Mathematics Teaching 5-13' N.F.E.R. Nelson 1983

Biggs E. 'Teaching Mathematics 7-13' N.F.E.R. Nelson 1985

Bishop A.J. & Nickson M. 'Research on the Social Context of Mathematics Education - A review of research in mathematical education. Part B' N.F.E.R. Nelson 1983

Bolam R. 'Evaluating in-service education and training: a national perspective' British Journal of Teacher Education Vol.5 No.1 January 1979

Bradley H. 'Strategies for INSET in Primary Science' Cambridge Journal of Education Vol.9 Nos.2,3 1979

Brookes W. 'Ten Years' Mathematics Teaching No.71 p.2-4 September 1975

Cane B. 'In-Service Training' N.F.E.R. Slough 1969

Cohen L. & Mannion L. 'Research Methods in Education' Croom Helm 1980

Conover W.J. 'Practical Nonparametric Statistics' John Wiley 1971

ed. Cornelius M. 'Teaching Mathematics' Croom Helm 1982

Davies J.T. 'The Scientific Approach' Academic Press 1965

ed. Donoughue C. 'In-Service: The Teacher and the School' Kogan Page, London 1981

Elton L.R.B. & Laurillard D.M. 'Trends in Research on Student Learning' Studies in Higher Education Vol.4 No.1 1979

Evans N. 'Preliminary Evaluation of the In-Service B.Ed. Degree' N.F.E.R. Nelson 1980

Goode W.J. & Hatt P.K. 'Methods in Social Research' McGraw-Hill 1952

Griffiths H.B. and Howson A.G. 'Mathematics: Society and Curricula' Cambridge University Press 1974

Henderson E.S. 'The Evaluation of In-Service Teacher Training' Croom Helm 1978

Henderson E.S. 'School focussed INSET Evaluation' Cambridge Journal of Education Vol.9 No.3 1979

H.M.S.O. (1967) 'Children and their Primary Schools. A report of the Central Advisory Council for Education' 1967

H.M.S.O. (1970) 'Statistics of Education. Special Series 2. Survey of In-Service Training for Teachers 1967' 1970

H.M.S.O. (1972) 'Teacher Education and Training. A report by a committee of inquiry under the chairmanship of Lord James of Rusholme' 1972

H.M.S.O. (1972) Education: A Framework for Expansion' House of Commons Command Papers (1972)

H.M.S.O. (1977) 'Mathematics in the Maintained Schools of England. A General Appraisal by H.M.Inspectorate' 1977.

H.M.S.O. (1978) 'Primary Education in England. A Survey by H.M. Inspectors of Schools.' 1978

H.M.S.O. (1979) 'Mathematics 5-11' HMI Series: Matters for Discussion 1979

H.M.S.O. (1980) 'Aspects of Secondary Education in England. Supplementary information on Mathematics' 1980

H.M.S.O. (1981) 'Mathematics Counts. Report of the committee of Inquiry under the chairmanship of Dr. W.H. Cockcroft.' 1981

H.M.S.O. (1981) 'Statistics of Education 1979' Vol.1 Schools, Vol.4 Teachers. 1981

H.M.S.O. (1982) 'Education 5 to 9: an illustrative survey of 80 first schools in England' DES. 1981

H.M.S.O. (1983) 'Teaching quality' House of Commons Command Papers 1983

Howson A.G. 'A History of Mathematics Education in England' Cambridge University Press 1982

Howson A.G. 'Curriculum Development and Curriculum Research - A review of research in mathematical education Part C.' N.F.E.R. Nelson 1983

Kevill F. et al. 'In Service Diploma Course Evaluation using Repertory Grids' British Educational Research Journal Vol.8 No.1 1982

Lovell K., Lawson K.S. 'Understanding Research in Education' University of London Press 1970

Maclure J.S. 'Educational Documents. England and Wales. 1816 to the present day.' Methuen London 1965

Mathematical Association 'The Teaching of Mathematics in Primary Schools' G. Bell 1956

Mathematical Association 'The Supply and Training of Teachers of Mathematics' G. Bell 1963

Mathematical Association 'Primary Mathematics, a further report' Mathematical Association, Leicester 1970

Mathematical Association 'The Mathematical Association Diploma in Mathematical Education - A selection of Students' and Tutors' Work' Mathematical Association, Leicester 1982

McCabe C. 'Evaluating Inservice Training for Teachers' N.F.E.R. 1980

McNamara D.R. & Ross A.M. 'The B.Ed. degree and its future' University of Lancaster School of Education 1982

National Union of Teachers 'James - Cause for Concern' N.U.T. 1971

Nisbet J. 'Educational Research: The State of the Art' in Dockrell W.B. & Hamilton D. 'Rethinking Educational Research' Hodder & Stoughton London 1980

Oppenheim A.N. 'Questionnaire Design and Attitude Measurement' Heinemann 1966

Pinner Sr. M.T. & Shuard H.B. 'In-Service Education in Primary Mathematics' Open University Press, Milton Keynes 1985

Popper K.R. 'The Logic of Scientific Discovery' Hutchindon 1959

Popper K.R. 'Conjectures and Refutations' Routledge & Kegan Paul 1963

Reynolds J. 'In-Service Courses for Primary Teachers' unpublished paper

Reynolds P. 'In-Service Education of Teachers of Mathematics' British Journal of In-Service Education Vol.8 No.1 1981

Richards F. 'Mathematics inside a multi-purpose Teachers' Centre' Mathematics Teaching No.72 p.25-27 September 1975

Rogers C.R. 'Client Centered Therapy' Constable 1951

Ruddock J. 'Making the most of the short in-service course' Schools Council Working Paper 71. Methuen 1981

Salisbury A. 'Tractors, Fanny Craddock and Mathematics' Cambridge Journal of Education Vol.9 No.2 1979

Schools Council Curriculum Bulletin No. 1. 'Mathematics in Primary Schools' H.M.S.O. 1965

Schools Council Working Paper No. 10. 'Curriculum Development: Teachers' Groups and Centres' H.M.S.O. 1967

Siddons A.W. 'Progress' Mathematical Gazette Vol.20 p.7-26 1936

Siegel S. 'Non-parametric statistics for the behavioural sciences' McGraw-Hill 1956

Stone R.J. 'Running a Maths Centre' Mathematics Teaching No.72 p.28-29 September 1075

Sturgess, D. 'The problems of teachers of mathematics' Nottingham University School of Education 1980

Tahta D.G. 'A Boolean Anthology' A.T.M. 1972

Taylor W. 'Research and Reform in Teacher Education' N.F.E.R. Slough 1978

U.N.E.S.C.O. 'In-Service Training for Primary Teachers' 1962

Walker R. 'The Conduct of Educational Case Studies: Ethics Theory and Procedure' in Dockrell W.B. & Hamilton D. 'Rethinking Educational Research' Hodder & Stoughton London 1980

ed. Watkins R. 'In-service training: Structure and content' Ward Lock 1973

Watson F.R. 'Developments in Mathematics Teaching' Open Books, London 1976

Willey F.T. & Maddison R.E. 'An enquiry into Teaching Training' University of London Press 1971

Williams E.M. 'The Geometrical Notions of Young Children' Mathematical Gazette Vol.18 p.112-118 1934

Williams E.M. & Shuard H.B. 'Primary Mathematics Today' Longman 1970

Wragg E.C. 'A review of research in teacher education' N.F.E.R. Nelson 1982

Wragg E.C. 'Conducting and Analysing Interviews' Rediguide 11. University of Nottingham School of Education 1978

Youngman, M.B. 'Computer Usage' Rediguide 19. University of Nottingham School of Education 1978

Youngman M.B. 'Designing and Analysing questionnaires' Rediguide 21 University of Nottingham School of Education 1978

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