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ABSTRACT

The purpose of this study was to survey the Nuffield Science Teaching Projects' adoption and diffusion into British secondary schools. This report presents a narrative of the three-phase research strategy. The first year was of an exploratory nature aimed at elucidating the various forms that adoption and rejection of innovations could take, the characteristics which were likely to distinguish teachers who adopted innovations from those who did not, and communication aspects which might have influenced diffusion and adoption. The next phase covering the second year dealt with data collection mainly by means of postal questionnaires. A third phase involved the analysis of data with emphasis on comparisons of samples of adopting and non-adopting teachers and qualitative analyses of communication activities. A complete report of the results, including data tables and findings, is presented. (Author/CP)

CURRICULUM DIFFUSION RESEARCH PROJECT

(Supported by the S.S.R.C. 1971 - 74)

OUTLINE REPORT

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April, 1975.

THE DIFFUSION OF CURRICULUM INNOVATION

The broad aims of this research can be stated quite simply. Some fifteen years ago the idea of using development projects to reform the school curriculum was first adopted in Britain. The projects were temporary agencies of innovation, developing new objectives, techniques and materials for changing the curriculum. We were concerned with finding out what happened to their innovations after they had been developed and how it happened.

The proposal for the research established that it would be focussed on the innovations produced by the Nuffield Science Teaching Projects; be concerned with diffusion related to both adoption and non-adoption (including rejection) of the innovations by schools; and would particularly examine the role of teachers in diffusion and adoption and the processes of communication involved. A three phase research strategy was envisaged. The first year was to be exploratory aimed at elucidating the various forms that adoption and rejection of innovations could take, the characteristics which are likely to distinguish teachers who adopt innovation from those that do not, the communication agents and systems involved in diffusion, and aspects of the communication process which might influence diffusion and adoption. The next phase covering the second year was to involve data collection mainly by means of postal questionnaires but with some follow-up interviews and case studies. The final phase was to be concerned with analysing results. It was envisaged that this would involve primarily comparisons of the characteristics of a variety of samples of adopting and non-adopting teachers and schools together with more qualitative analyses of communication activities.

PHASE 1
(September 1971 - August 1972)

The exploratory work had five major components.

1. The completion of earlier studies

These consisted of a review of the literature[1] especially concerned with the meaning of innovation and how this might be related to the Nuffield Teaching projects[2]; analyses of the geographical distribution and of the number, type and location of schools that had entered pupils for the special examination for Nuffield O-level biology, chemistry and physics since 1966; an analysis of sales figures for the books of the Nuffield projects; and a follow-up study of the adoption and implementation of Nuffield A-level Biological Science by 142 teachers who had attended briefing courses one year earlier and had expressed an intention to adopt the project's scheme[3].

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1. Nicodemus R.B. (1971) Annotated Bibliography on Change in Education in England and America with an Emphasis on Science Education. Centre for Science Education, Chelsea College, University of London, also ERIC Report ED 059 081.

2. Nicodemus R.B. (1973) Innovation in Education with special reference to some aspects of the Nuffield Science Teaching Project. Ph.D. thesis, University of London.

3. Kelly P.J. and Nicodemus R.B. (1973) "Early Stages in the Diffusion of the Nuffield A-level Biological Science Project" J. Bio. Ed. 7 6 15-22.

2. Consultative group discussions

Two consultative groups were established at the commencement of the project. One, an advisory group, consisted of the Staff Inspector (HMI) for Science, the Director of the Nuffield Science Teaching Projects, the then Chairman of the Association for Science Education (a senior science teacher), a recently retired Chief Education Officer and two academics concerned with studies related to curriculum diffusion. The other was a working group and consisted of the project's research staff together with two members of university departments of education and an LEA inspector (all with considerable school teaching experience) who were familiar with the areas of the country to be researched and were willing to obtain information about them and assist with interviewing. The two groups met together twice and the working group met separately on five occasions in Phase 1[1]. In addition a seminar on curriculum diffusion was organized with other researchers in the field and discussions were held with a group from the Schools Council.

Verbatim minutes were kept of these discussions which provided a continuous source of information, ideas and argument affecting both the strategy and content of the research. There is little doubt that this activity was particularly valuable in providing a broad perspective of issues and was of considerable help in the search for data, providing suggestions on where data could be obtained and also of what types of data would be of greatest value.

3. Interviews with LEA personnel and science teachers

Six Counties, seven County Boroughs and four Greater London Boroughs were studied. They were widely distributed in England, included rural and urban areas, large and small LEAs and LEAs who at the time had apparently high and low levels of adoption of the Nuffield science teaching projects by their schools. The LEAs were selected after discussions with the consultative groups. Collectively the LEAs were intended to provide a variety of circumstances not necessarily a representative sample of all LEAs.

One member of the research staff attended all the LEA interviews acting as recorder and providing guidance on the consistency of the approach of the interviewers. The interviews typically lasted two hours and were conducted by members of the working group. Up to three LEA officials took part on each occasion. With one small LEA this included the Chief Education Officer but in the others Assistant Education Officers, inspectors and advisers concerned with curriculum development participated. The interview schedule is appended to this report (A). It served as a guide for the interview, the discussion being kept as open as possible. A report of the interview was compiled by the recorder and distributed to both interviewers and interviewees for comment. Differences of interpretation were recorded.

Subsequently interviews were conducted in 26 schools in 7 of the LEAs. The schools were selected from those nominated by LEA officials as being either highly innovative or non-innovative. A common interview schedule was used but, in fact, the conditions in

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1. The working group also met twice a year during the later stages of the project.

which the interviews were conducted varied considerably depending on the facilities provided by the schools and their interpretation of our requests. Usually the head teacher and up to three science teachers were interviewed individually during a day and it was possible to observe the teaching laboratories and some activities in the school. However, on other occasions, less time and people were available and the facilities were not always conducive to adequate interviewing. A member of the working group undertook the interviews singly, each in at least two LEAs.

4. A study of early dissemination

We were fortunate in being able to work closely with Mrs. M. Waring, also of Chelsea College, who was conducting a study of the origins of the Nuffield Science Teaching Projects. During Phase 1 she undertook a special study for us of the early dissemination strategies of projects which provided a valuable socio-historical dimension to our work.

Information about dissemination was difficult to come by for relatively little had been committed to official files. Obtaining it entailed a great deal of 'detective' work through personal contacts and interviews, and appeals by letter and in journals. Fortunately we were able to locate some useful fortuitously stored material.

5. Pilot questionnaire study

During the Summer Term of 1972 a pilot questionnaire study was undertaken in three LEAs. In two - a County Borough and a County - questionnaires were distributed to all heads and science teachers of secondary schools, and in another County LEA a 10% sample was surveyed. Validation interviews with a sample of respondents were also undertaken. The objectives of the study were (a) to gain experience in the logistics of surveying before undertaking work on a larger scale, (b) to find out how feasible it was to obtain the data we required by using questionnaires, and (c) to involve a suitable strategy for the computer analysis of results. The questionnaires covered five areas: (i) the experience of teachers and heads and the organization of their schools; (ii) the extent of familiarity and use of projects; (iii) opinions on the desirability of current trends in science education; (iv) communication sources and activities; (v) perceived limiting and facilitating factors influencing adoption and rejection; and (vi) the decision-making processes involved in adoption and rejection.

CONCLUSIONS FROM PHASE 1

The decision to have a preliminary exploratory phase in the research rather than to have based it on assumed concepts and a more structured research design appears to have been justified. In particular it provided the opportunity to define key concepts with greater accuracy and relevance; it revealed the considerable complexity of the context in which curriculum diffusion occurs; and it pointed to important strategic and methodological issues and in particular the need to acquire a variety of data from different sources for valid interpretations of situations. In this light the original proposal was seen to be somewhat naive and, although in essence it remained intact, it had to be put into a broader perspective to be of real value.

Key Concepts

A central problem in the use of concepts in research of this nature is that they are used in two ways; by the researcher in his attempt to describe phenomena and ideas accurately and consistently, and by those being studied who may use them in a variety of ways and with a variety of meaning. For example, the adoption of a new course may be defined precisely in terms of the materials used by a school and whether or not pupils are entered for a special examination. However, when teachers are asked if they have adopted a course they may well have different interpretations. They may be using some materials but not others, or implementing a mixture of ideas from the new course and their own.

As it was clear that we would have to obtain most of our information by questionnaire and interview rather than by direct observations, we attempted - following the Phase 1 work - to define concepts in terms of what we had been able to detect and the meanings attributed to them by the groups being studied, provided this enabled us to use the concepts with reasonable consistency. In this way we aimed to ensure a mutually valid use of concepts between researcher and researched. This principle governed our interpretation and use of key concepts related to diffusion. The account that follows outlines the conceptual framework used for the work in Phases 2 and 3.

In this work curriculum diffusion, in its general sense, is conceived as the spread of innovations in the school curriculum over time from one location to another. The diffusion of innovations produced by curriculum development projects is one aspect of the general phenomenon and intimately entwined in it, so that it is not always possible to separate the diffusion of a curriculum development project innovation from that of comparable innovations (or traditions) originating elsewhere.

Curriculum development projects are seen as innovative in that they formulate and develop ideas about the curriculum, create teaching and learning methods or devise curriculum materials. These may be new in themselves, or new in the ways they are associated, or new to the time and circumstances to which a project is related. In the sense that they are new in one or more of these ways we can describe what the projects develop as innovations.

The projects also produce identifiable innovations. This may be a package of books, visual aids, equipment and instructions for teachers and pupils. It may only be a set of ideas aimed at stimulating teachers to introduce their own innovations. There is great variety, but in each case it is possible to identify the particular innovation developed by a project. Certainly it will be the intention of the people in the project, and those that sponsored it, that this should be so. However, it is well to stress that identify and define are not seen here as synonyms. Whilst it may be possible to identify an innovation - that is, to detect its salient features - it is another matter to give it an exclusively accurate definition.

It is also possible to identify the time and location of the origin of a curriculum development project's innovation. It may be that the ideas that nurtured a project's work had long and widespread antecedents but the point at which these were transformed into the particular form taken by an innovation is the time and location of the project itself.

A curriculum development project in association with other organizations such as LEAs will establish to some extent an intended strategy for distributing its innovation. This we term dissemination. Invariably it has four inter-related aspects:

(i) the movement of people and materials required to implement the innovation, e.g. participation of teachers in in-service courses, visits of advisers to schools and the distribution of books etc. to schools. This we term translocation.

(ii) the passage of information about the innovation through printed material, other media and personal contact. This we term communication.

(iii) the provision of stimulus for change either externally induced or self-generated. This we term motivation.

(iv) the development of the considerable understanding and commitment required for the effective implementation of an innovation. This we term re-education.

Diffusion is the product of the interaction between dissemination and the complex of influences in the social context in which it occurs.

The context of diffusion is extremely complex and an analysis of it could take many forms. From the work of Phase 1 six ideas appeared to be central to a worthwhile analysis.

(i) Social climate is a significant influence on diffusion. In the late 1950s and early 1960s there was in Britain, as in many other countries, an educational concern and growing respect for scientific literacy and attainment. Scientific discovery and scientific rationality had considerable social prestige. They were seen as the sources of social, economical and political advancement. This social climate was reflected, for example, in a multitude of reports, in the emphasis given to science and technology in the manifestos of the Labour Party which gained power in 1964, and in the initiation of tho science and mathematics curriculum development projects. In 1972 the social climate as it was interpreted by the people we questioned, had changed. Public discussion was as much about the dangers of science as its advantages. It was difficult to conceive a political party basing its platform on technological revolution. It was difficult, also, to conceive curriculum development projects in science and mathematics starting then with the fervour and support of a decade earlier. The advent in later years of projects in humanities, social studies and environmental studies were much more in keeping with the times.

Social climates do not change as simply as this portrayal suggests, nor are they as easy to describe as might be inferred: but even allowing for some absurdity in the generalization, the central point - that the diffusion of the innovations of curriculum development projects have limited niches in the time-span and fabric of social change - appeared a reasonable conclusion from our early research.

(ii) It is necessary to identify people, institutions and administrative systems which facilitate or inhibit diffusion. Much of this was done in Phase 1 and, in particular, it suggested that a relatively few key people had a predominant influence on diffusion and that a deeper study of some of these would be profitable.

(iii) A curriculum development project is an agency imposed on other, much more permanent, agencies which, at least in part, attempt to serve the function of curriculum innovation. A by no means exclusive list will illustrate their variety: examination boards, teachers' centres, teacher training institutions, publishers and suppliers, the national Inspectorate, local authority advisers, research bodies, teachers' organizations and subject organizations. To this list might be added those agencies which are less directly related to the curriculum but, nevertheless, are potential facilitators or inhibitors of curriculum innovation. Administration which determines the financial and, through its control of teacher supply and building, the environmental limits within which curriculum innovations can occur is an obvious example. The ramifications of communication systems - personal contacts, written and other media, and formal arrangements such as meetings and in-service courses - point to other agencies which may, with varying degrees of accuracy and motivation, influence the diffusion of an innovation. In a metaphorical sense communication can be depicted as the wheels of the diffusion vehicle carrying an innovation through space and time. The vehicle is powered by the economical, administrative and motivational support it receives from the range of agencies influencing educational change. This is a metaphor not to be pursued too far, else it be forgotten that diffusion is to do with people and the complexities and perplexities that inevitably beset human endeavours. It does, however, highlight the central role of the composite concept of communication and support in an analysis of a diffusion process.

(iv) People have different perspectives of the issues of curriculum diffusion and their interpretations of them vary accordingly.

These perspectives are compounded of three forms of relationship. The first is their relationship to the curriculum development projects either as intermediary (LEAs) or first-hand (teachers) consumers of the innovations. The term consumer is used deliberately. It indicates a marketing situation; the projects (producers) are offering and, in a sense, advertising their wares and the LEAs and teachers (including, of course, head teachers) are in the role of consumers being encouraged to purchase the products.

This simple, uni-directional relationship is distorted by relationships which arise from the other roles the consumers perform and which they see as important, sometimes more so. Thus both LEAs and teachers may perceive themselves as producers, developing their own innovations. LEA personnel may adopt a role of neutrality towards decisions about curriculum innovation. A teacher may see his pastoral role of such importance that the social and emotional welfare of pupils is considered to be undermined by his having too great a concern for curriculum innovation.

Thirdly, there are relationship of status, authority and personal emotion which influence a person's receptivity to externally produced innovation.

This description is by no means complete, but it does illustrate the important point that an adequate analysis of curriculum diffusion as a social process requires, first, the identification of the various perspectives through which the people involved in it perceive the issues involved and, secondly, an analysis of the relationships and influences which arise from them.

(v) The process of diffusion is, in effect, a sequence or, if portrayed more accurately, a web of events. Each event, or a combination of events will be subject, in varying proportions, to the influences that have been outlined but the feature which specifically characterises an event in diffusion is the decision-making involved. This may be formal and deliberate as when a committee decides on a particular course of action in dissemination or it may be more personal and incidental as when teachers adopt innovations which conform closely to their present practice. The decision-making process may be positive - as with adoption, neutral - when no change occurs through ignorance or apathy, or negative - as with rejection which results from antagonistic reactions. Whatever its form, however, decision-making is an integral aspect of the diffusion process.

(vi) Curriculum diffusion in the general sense is a continuing and changing process and cannot be defined in terms of origins and end-points. Thus to the extent that the diffusion of the innovations of curriculum development projects is integrated within the general diffusion process any definition of their origins and end-points must inevitably be arbitrary. We have previously defined the origin of the diffusion of curriculum development project innovations in terms of the location of the project. This would appear to be an acceptable operational definition. The definition of the end-point of this diffusion process, however, is more difficult.

The dissemination strategies of the curriculum development projects had two main targets (i) teachers in schools and (ii) support agencies ranging from head teachers and LEAs to Examination Boards and equipment manufacturers. The aims of dissemination as expressed by the projects and as perceived by recipients of dissemination can be grouped into four categories:

(i) adoptive aims: which intend that teachers will adopt an innovation and implement it faithfully

(ii) adaptive aims: which intend that teachers will adapt some aspects of an innovation to their current practice. This is often expressed as a compromise between the 'ideals' of the innovation and the 'realities' which a teacher has to contend with.

(iii) innovative aims: which intend that the dissemination of an innovation will act as a stimulus for further innovation and, in this sense, foster the professional development of a teacher.

(iv) instrumental aims: which encourage the achievement of adoptive, adaptive or innovative aims by indirect means; for example, changing examinations in order to encourage changes in courses.

Each of these aims combines, in different ways, the attributes of familiarity and use. By familiarity we refer to a person's awareness, perception and understanding of an innovation. By use we refer to the activities and commitment of a person which involve the ideas and materials of an innovation.

This variety of targets and aims for dissemination was reflected in diffusion. The innovations diffused to a variety of locations and at them took a variety of forms. Thus, there is a variety of end-points of the diffusion process each of which can be defined in terms of its location (expressed as a period of time, the people involved and their situation) and its form (expressed as levels of familiarity and use of an innovation).

Methodological and strategic issues

Phase 1 revealed a number of methodological and strategic issues which influenced subsequent work. The major ones are listed here briefly.

(i) There was little available data on familiarity and use of curriculum development projects in schools.

(ii) Both the questionnaire and interview studies pointed to difficulties in obtaining data about past events. The section of the questionnaire concerned with the sequence of events leading to adoption or rejection provided little information. Several of the LEA staff interviewed were relatively new appointments and had little detailed knowledge of earlier diffusion in their areas.

(iii) There were potential sources of data about diffusion outside the schools and LEAs but they were difficult to detect. For example, information about previous in-service courses although not available in LEA files were obtainable from people who had participated in them but had moved to other appointments.

(iv) The problem, previously referred to, of variation in the expression of concepts by different people necessitated particular care in questionnaire design if adequate validity was to be obtained. Interviewing provided a greater opportunity for obtaining valid individual responses but, of course, restricted sample size.

(v) The criteria used to define familiarity and use by different groups of people varied. To ensure reasonable validity different perspectives needed to be used. Thus, for example, it appeared appropriate for Heads to define familiarity in terms of their awareness of aspects of the projects, particularly those with financial and administrative implications for their use. For teachers a scale related to reading the materials was more appropriate.

(vi) Familiarity and use should be studied as distinct variables as their levels were not always closely associated. Also non-use, and more specifically rejection, required special study.

(vii) The Nuffield science teaching projects were national in scope and their dissemination national in strategy. Thus an adequate study of their diffusion ought also to have a national coverage, particularly to show the extent of diffusion. The representative nature of the questionnaire sample needed to be more carefully considered.

(viii) There were evident differences between types of schools, e.g. boys, girls or co-educational, and teachers e.g. biologists, chemists and physicists, in relation to their levels of familiarity and use of projects. Studies of sub-samples would need to be an important feature of data analysis and, thus, the samples used had to be sufficiently large to cater for this.

(ix) The complexities of the processes of diffusion, especially communication and decision-making, that the Phase 1 studies revealed could only be adequately studied by in-depth studies and, hence, on a narrower front.

(x) An adequate consideration of the extent of diffusion and explanations of its processes requires an understanding of its context i.e. the communication and support systems within which it operates.

PHASES 2 AND 3

(September 1972 - December 1974)

A six-part research programme was adopted for Phases 2 and 3.

1. Completion of the dissemination study started in Phase 1.

2. Completion of the study of national diffusion patterns over time based on examination entries.

3. Questionnaire studies

   a) A national survey of schools through their Heads mainly to (i) obtain an assessment of the national influence of the projects which could support the study of national diffusion patterns over time and (ii) to check the representative nature of samples drawn from the 17 selected LEAs.

   b) A survey of Heads and Teachers of a sample of schools in 17 LEAs concerned with establishing relationships between nominal data, perceptions and opinions and familiarity and use of projects.

4. A study of the communication and support systems of the 17 LEAs to provide background data for interpreting the results of the questionnaire studies.

5. Case studies of schools in four LEAs mainly to elucidate the processes of communication and decision-making which affect diffusion.

6. Explorations of other sources of data. For example, contacts were made with HMIs, members of the development teams of projects and, through the journals of the Association for Science Education, with participants in in-service courses and other dissemination activities related to the Nuffield science teaching projects.

The people with major responsibilities for the studies were -

Dissemination Study - Mrs. M. Waring and Mrs. J. M. Harding
National Diffusion Patterns Study - Mrs. J. M. Harding
Questionnaire Studies - Dr. R. B. Nicodemus
LEA Communication and Support Study - Mrs. J. M. Harding and Mr. D. P. Marshall
School-based Case Studies - Mrs. J. M. Harding

In addition, Mr. E. Jenkins and Mr. W. Sheridan contributed significantly to several aspects of the work.

The questionnaire studies and the LEA study together with the school case studies were the central research activities and were pursued in parallel.

Although to some extent the various studies were independent, the attempt was made to co-ordinate their content and strategies in order to ensure the data collected would be complementary and relate to an overall view of the diffusion process.

DISSEMINATION STUDY

This was concerned with the Nuffield O-level biology, chemistry and physics projects. It involved interviews with people concerned with the projects in various capacities, an examination of correspondence and other papers from the projects' files, and analyses of national in-service provision for the projects based on data provided by the Schools Council and the Department of Education and Science, and of local in-service provision in three Greater London Boroughs (biology), a Northern Area Training Organization (chemistry) and part of East Anglia (physics) based on materials retained by the organizers and some participants.

The study showed that the dissemination of the innovations of these projects was extensive. In fact, as far as we can determine, no other projects in this country have been disseminated with such intensity. It reflected the very positive social climate in which the projects originated.

There was a variety of aims (cf p.7) for dissemination and a sensitive - in part apprehensive approach to communication. The main methods employed were (i) public statements from the Nuffield Science

Teaching Project (the umbrella organization for the projects based in its early years at the Nuffield Foundation), (ii) dissemination through the Association for Science Education (the science teachers' professional body) and the scientific institutes e.g. Royal Institute of Chemistry, (iii) dissemination through trials of the courses in schools (1963-5) covering a wide geographical distribution and involving meetings and courses for teachers, (iv) special in-service training for teachers who did not participate in the trials (in 1966 70 courses, each of approximately 36 teachers were involved), (v) communication with individuals and groups other than teachers (manufacturers, publishers, universities, HMIs, LEAs etc.), (vi) the establishment of area committees intended to foster dissemination in the post-development period, and (vii) dissemination through curriculum materials i.e. Students' texts, Teachers' Guides, etc. distributed by publishers and purchased mainly through the LEAs. An important dissemination agent - especially in a co-ordinating capacity - was the small central continuation group established by the Nuffield Foundation after the development phase of the project.

The response by LEAs varied and there was an apparent relationship between an LEA's level of activity in trials and in-service training and the level of early adoption of the projects' innovations by their schools.

There was a difference in response by teachers of the three science subjects. Biologists had a high level of participation in in-service training but a relatively low level of adoption.

NATIONAL DIFFUSION PATTERNS STUDY

This study was also concerned with the Nuffield O-level projects in biology, chemistry and physics. It was based on statistics for the period 1966-73 of entrants for the special Nuffield examinations provided by GCE Examination Boards. The use of the courses to the point of entering candidates for the examination represents a high level of adoptive use. As other studies showed it did not represent total use of the Nuffield materials in the schools. (See Tables 3-6 for examples.) Also studies of changes in non-Nuffield examinations and text books indicated the marked instrumental influences of the innovations.

The rate of uptake for the three courses, measured either as numbers of candidates or schools entering candidates, followed the S-shaped curve typically found in studies of the diffusion of innovations in education and other fields[1]. The initial lag-phase of the curves corresponded to the period of development trials. Soon after the trials (1968-72) the curves steepened and in 1972 tended to level off, suggesting that a maximum use was being reached. This was more clearly

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1. See Rogers E. M., and Shoemaker F.F. (1971) Communication of Innovations, New York Free Press.

apparent in the Direct Grant and Independent school and for biology and chemistry. There was, however, a delayed but marked increase in the use of the physics course.

The use of Nuffield biology for examinations was considerably less than that of the other two sciences. It was possible to obtain reliable data up to 1972 when 6.1% of possible examination candidates took the Nuffield O-level biology examination, 15.2% chemistry and 12.5% physics. Estimates for 1973 suggested an increase in biology to 7.3% and chemistry and physics to 17%.

The three courses tended to be adopted independently by schools. Even in 1973 the majority of schools entering candidates for the Nuffield O-level sciences did so for only one science. When more than one course was used the most popular combination was of physics and chemistry.

There was little change in the number of candidates entered per school over the period and, until 1972, virtually no discontinuance.

School organization appears to be a factor which affected the use of the courses. The uptake by grammar schools was proportionally much greater than by comprehensive schools during a period when nationally the proportion of comprehensive schools was increasing. This difference was most marked with biology for which the proportion of comprehensive schools using the course declined.

Proportionally more boys than girls were entered for the Nuffield examination in the three sciences compared with 'normal' O-level science examinations, and proportionally more boys' schools used the courses than mixed or girls' schools. There, thus, appears to have been an influence related to the sex of students which has affected uptake[1].

Most LEAs involved in the trial stage of the Nuffield O-level projects were concerned with one of the three sciences only. By 1971 most LEAs with schools entering candidates for the Nuffield examination were using all three sciences. However, still in 1973 just under 50% of LEAs had no schools entering candidates for the examination.

Comparisons were made between 'high adopter', 'low adopter' and 'non-adopter' LEAs in 1970 and 1973. It was found that an early (1970) adopter LEA was likely to be a large county authority, not committed to comprehensive reorganization, in which at least one trial school had been sited, and which had acquired additional information about the projects in 1967 when they were first published. In 1973 the influence of size and type of LEA was more variable but some regional differences were detected, particularly a low level of adoption in Wales. A high adopter LEA was still likely to be one less affected by comprehensive re-organization and have had trial schools. Twice as many 'high adopter' or 'adopter' LEAs had science advisers compared with 'non-adopters'.

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1. This topic is being further pursued in a research project conducted by Mrs. J. M. Harding and Miss J. Redston, supported by the Nuffield Foundation (1974-).

QUESTIONNAIRE STUDIES

Three surveys were undertaken.

1. Head teachers of schools in a national sample of secondary schools

An eight percent stratified random sample of all maintained secondary schools in England and Wales (January 1972) was obtained from the Department of Education and Science computer. Schools were sorted into three strata (i) Local Education Authority (Boroughs and Counties), (ii) type of school (secondary modern, grammar, comprehensive, other secondary) and (iii) sex of school.

The sample was then selected by taking every twelfth school on the sorted list starting with the third school. This gave a total sample of 402 schools plus 17 schools in the Inner London Education Authority. Other possible strata such as size of school or LEA were not used.

Sample size was determined by assuming a 60% response and the need for a sub-group of 10 single sex comprehensive schools. This type of school comprises 5% of all maintained secondary schools.

Since the D.E.S. only classifies 'middle schools' with pupils from the age of 9, the sample included two schools with ages 9-13 and two with ages 9-16, but excluded middle schools with pupils from age 8.

D.E.S. Statistics of Education 1971 (HMSO: 1972) gives a total of 5148 maintained secondary schools in England and Wales. Compared with data in this report the 8% sample slightly over-sampled Boroughs and under-sampled Counties, and also over-sampled comprehensive and mixed schools. Such small differences were likely to be due to the one-year difference in the 1971 national statistics and the D.E.S. January 1972 records.

There was a 72% response. Considerable variation in the percentage response from the ten D.E.S. divisions (56% in London Boroughs - 85% in South West) were obtained. However, this did not further distort the balance of the schools according to type, sex or size.

The questionnaire (B) covered (i) school information, (ii) the head teacher's qualifications and experience, (iii) head teacher's opinion of the influence of 25 curriculum development projects and awareness of aspects of the projects, (iv) the school's involvement with the projects, (v) the head teacher's opinion of the influence of educational changes on the curriculum, (vi) the usefulness of information sources, (vii) facilitating and limiting factors which influence take-up of projects in the school, and (viii) head teacher's opinions on the effects of curriculum development projects.

2. Head teachers of schools in a 25% random sample of secondary schools in 17 LEAs

The LEAs were selected from those used in the work of Phase 1. The schools were obtained by numbering all the secondary schools in an LEA and selecting a 25% sample using a table of random numbers. The LEAs provided details of the 167 schools included in the sample. 70% of the heads responded to the same questionnaire as used for the national sample. There was considerable variation in the response from different LEAs (20% to 100%) and compared to the 8% national sample this response sample had twice the percentage of mixed comprehensive schools. This intensified the bias already apparent in the national sample. However, overall the responses to this survey were similar to those obtained with the national sample and we have confidence that the sample of 17 LEAs generally reflected the national situation.

3. Science teachers of schools in a 25% random sample of secondary schools in 17 LEAs

The same 167 schools were used. 13 LEAs provided lists of science teachers. 4 LEAs requested we obtain these from schools. Questionnaires were sent to 849 full-time science teachers. 51% of these teachers responded from 85% of the schools. In some cases we have evidence that some teachers responded collectively on behalf of other science teachers in their school.

There was variation in response from the LEAs (20% - 65%) and an over-sampling of teachers from grammar and comprehensive schools and an under-sampling from secondary modern. There were equal proportions (28%) of teachers whose main teaching subject was biology, chemistry or physics. 9% taught mainly General Science. For the remainder (7%) science was an ancillary interest.

The questionnaire (C) covered (i) the teacher's qualifications, experience and appointment, (ii) familiarity with and use of science curriculum development projects, (iii) facilitating and limiting factors related to their use of projects, (iv) information sources, (v) opinions about the role of science advisers, (vi) personal opinions on the outcomes of science teaching compared with those attributed to projects, and (vii) opinions on the effects of curriculum projects.

With both the Heads' and Teachers' questionnaire, statements used for rating opinions were derived from those collected in Phase 1 and their validity checked through interviews with respondents and non-respondents in the pilot survey.[1]

The analysis of the data was undertaken almost entirely using the SPSS programme[2]. Its capacity for data management is superior to any other available package and its use does not require a detailed knowledge of programme language. Initially four internal research reports were produced, one for each survey plus one comparing heads' and teachers' responses. The analysis is continuing with the preparation of accounts of the projects' work for dissemination, and could take a further 6-12 months as further relationships are explored and the variance within the dependent variables more carefully controlled.

The time taken for the analysis was far in excess of our original estimates, despite the valuable experience of the pilot study. For the analysis to have taken less time it would have been necessary to have had the support of more trained personnel for handling the data.

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1. Nicodemus R.B. (1975) "Validating a questionnaire on aims and objectives of science teaching" Journal of Applied Educational Studies 3 2 13-16.

2. Die N.H., Bent D.H., Hull C.H. (1970) Statistical Package for the Social Sciences. London, McGraw Hill.

TIME-TABLE OF QUESTIONNAIRE STUDIES

1972 June July Aug	1972 Sept Oct	1972 Nov Dec	1973 Jan Feb March	1973 April May June	1973 July Aug	1973 Sept - Dec.	1974 Jan - April	1974 May -
Pilot questionnaire study conducted in three LEAs	Development and production of final questionnaire.							
	Request for list of schools from 17 LEAs and selection of 25% sample.	Head teacher questionnaire posted Nov.15.	Reminder to "no responders" Jan.15	Punching of results on computer cards		analysis	Publication of internal research reports	
	Request for approval from 17 LEAs to send questionnaire to selected schools		Letter to LEAs requesting names of science teachers Jan. 9.					
			Letter to heads of selected schools requesting their approval of our sending questionnaire direct to teachers Feb. 23.					
	DES computer selection of 8% sample of head teachers.		Teacher questionnaire posted to 13 LEAs March 8	reminder to "no responders" May 9.	Punching of results	analysis		
			Head of Dept. in 4 LEAs sent copies of questionnaire for distribution in schools not providing list of teachers March 8.	reminder to "no responders" May 11.				

Most valuable advice was obtained from the Computer Unit of the Institute of Education of London University. The CDC 6600 computer at ULCC was used from Chelsea College for the operation and valuable assistance was obtained from the College's Computer Unit.

Outline of analysis

Head teachers (National sample)

Head teachers can have an indirect influence on the use of curriculum innovations in their schools. It was assumed that this influence would be related to the level of their familiarity with curriculum development projects. Thus an analysis of data was undertaken to:

a) determine which information sources were seen as most useful by the Heads

b) determine the limiting and facilitating factors which the Heads saw as influential in their own schools

c) determine which effects of curriculum development projects the Heads saw as most significant

d) determine the relation between the Heads' levels of familiarity and some characteristics of themselves and their schools of potential influence on diffusion

e) determine the relation between characteristics of Heads and their schools and the levels of use of projects in the schools.

Most useful information sources

The Heads ranked a list of 24 possible personal and impersonal information sources compiled from the Phase 1 studies. The four seen as most important were, in order -

1. Their heads of departments
2. Information direct from curriculum development projects
3. Schools Council's 'Dialogue' journal
4. LEA advisers or inspectors

Limiting and facilitating factors

A five point scale was used by the Heads to rate the influence of 21 possible factors affecting the taking up of curriculum project materials and ideas. The percentage of total responses (N = 6358) occurring in each category was -

5 - strongly facilitate	10%
4 - moderately facilitate	20%
3 - no effect	35%
2 - moderately limit	16%
1 - strongly limit	8%
0 - no response	11%
	100%

The most facilitating factors were considered to be the qualifications of teaching staff, and local activities through teachers' centres, contacts between schools and the initiative of the LEA through its advisory services. The most limiting factors were seen to be uncertainty about school reorganization, inadequate money and accommodation, and overworked staff.

Twenty-four other factors were mentioned by the Heads but none had more than three responses. Most were concerned with the attitudes and activities of staff and virtually all were seen as limiting factors.

Effects of curriculum projects

The four effects of curriculum development projects considered, on the whole, to have been the most significant were -

providing resources from which teachers may select,
improving the quality of pupils' school experience,
supporting those teachers who are already attempting to bring about change in schools, and
increasing the burden of preparation for teachers.

Measurement of familiarity

The extent to which the Heads were familiar with twenty-five curriculum development projects was measured by them indicating their awareness of six aspects of the projects. This provides a maximum familiarity scale of 150 points (25 x 6). For the 289 Head Teachers responses ranged from 0 to 133 points.

The percentage distribution of the total number of responses (N = 11,145) for the six aspects of projects were:

Awareness of -

B.	the project's existence	27%
C.	age and ability range	19%
D.	main objectives	18%
E.	main teaching methods	15%
F.	materials produced or planned	12%
G.	approximate cost of adoption	9%

Heads responding to items C - G also invariably responded to B. Thus, of the 289 Heads most (70%) were aware of the Humanities Curriculum Project and fewest were aware of the Scottish Integrated Science project (11%) and Project Environment (14%). On average Heads were aware of the existence of 44% of the twenty-five projects.

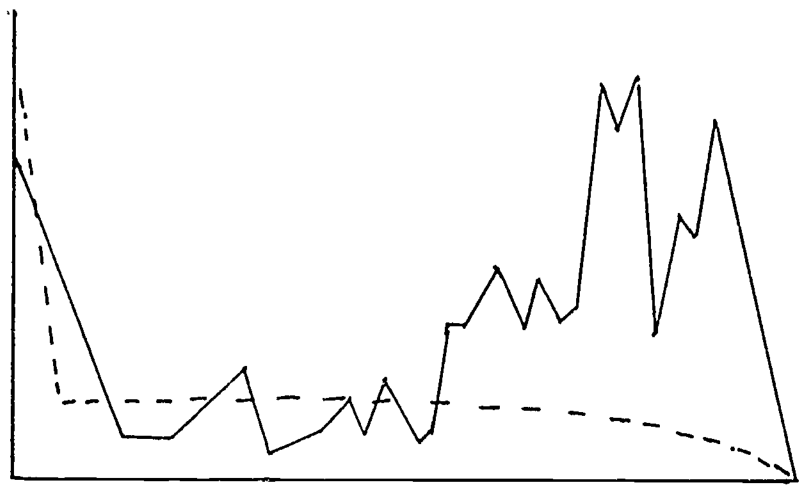
The distribution of the total familiarity scores was divided into thirds by use of the mean (38.6) and standard deviation (28.1). Since the scores were not normally distributed the number of Heads in each group was unequal.

Levels of familiarity	Distribution of total awareness scores	Number of Head Teachers
Low	0 - 24	107
Middle	24 - 52	98
High	52 - 133	84
		289

Distribution of familiarity scores

The frequency response curve of the total familiarity scores approximates to the shape in Fig. 1. It is flat (Kurtosis = -0.13) positively skewed (0.6) and bimodal with a large number of "0" values. A number of transformations were tried to improve the kurtosis and skewness values but no consistent improvement was achieved.

Fig. 1. Frequency response of familiarity scores N = 289



------ Total familiarity scores (maximum = 133)

The 31 questionnaires with a familiarity score of zero were examined closely for their validity. Discrepancies in responses on different parts of the questionnaire identified fourteen "0" scores as false i.e. the Heads were clearly familiar with some project's existence but did not bother to indicate their awareness. The "real" scores for these cases probably fall at least between 6 and 15 which would place them in the low familiarity group. Of the 14 cases, 6 are from secondary modern, 3 from comprehensive and 5 from grammar schools. Of the 17 evidently valid "0" scores 13 are from secondary modern, 1 from comprehensive and 3 from grammar schools. For both groups combined (N = 31) the respective percentages are 61%, 13% and 26%. The percentages of schools according to size were - 45% under 400, 19% under 600, 29% under 800 and 6% 800 or larger. 71% of the Heads were qualified in the humanities and 61% still taught. The average total experience as Head was 10 years, with a range of 1 - 28 years.

For the purpose of correlation or multivariate analysis this group of 31 Heads was excluded.

This measure of familiarity (awareness of a project's existence) appears to be affected by the appropriateness of the project for the type of school (see Table 1).

For the majority of projects the percentage of Heads aware of their existence increases from secondary modern through grammar to comprehensive schools. The academic background of a Head appears only to have a limited relation to the type of project he is aware of.

Table 1. Two measures of Head teacher's familiarity (a) percentage aware of existence[1] and (b) percentage of total awareness score contributed by each project

	(a) Percentage of Heads aware of a project's existence			(b) Percentage of total familiarity score
	Secondary Modern	Compre-hensive	Grammar	
Projects supported by Schools Council				
Environmental Studies	54	64	66	5.1
General Studies Project	34	59	69	4.5
Humanities Curriculum Project	67	82	57	8.2
Integrated Science (SCISP)	32	57	49	3.6
Keele Integrated Studies	27	38	29	2.6
Loughborough Engineering Science	13	26	24	1.2
Mathematics for the Majority	50	57	36	3.6
Mathematics for the Majority Continuation Project	21	27	15	1.7
Midlands Mathematics Experiment	32	40	43	2.8
Moral Education 13 - 16	36	50	46	3.5
North West Regional Curriculum Development Project	28	31	18	2.4
Project Environment	11	18	13	0.8
Project Technology	43	56	51	4.6
Science 5 - 13	20	28	18	1.7
Nuffield Projects				
O-level Biology	51	80	79	7.5
O-level Chemistry	48	79	82	7.4
O-level Physics	50	79	80	7.5
A-level Biological Science	19	47	67	3.3
A-level Chemistry	20	54	77	4.2
A-level Physics	20	57	72	4.0
A-level Physical Science	19	47	54	2.7
Combined Science	58	62	57	6.3
Secondary Science	53	61	43	5.4
Nuffield Mathematics	37	55	59	4.0
Other				
Scottish Integrated Science	11	17	5	1.0
Number of Head teachers =	123	96	61	289[2]

1. Gave at least one tick on the questionnaire in columns B-G.

2. In the fourth column (b) 289 Heads gave a total of 11,145 responses.

Familiarity with groups of projects

A factor analysis of the famililiarity scores for the 25 projects was undertaken. All default options were taken giving principal factoring with iteration, extraction of factors with eigen values greater than or equal to 1.0, diagonals of correlation matrix replaced by squared multiple correlations, and varimax rotation.

This analysis indicated that the projects can be classified into four groups. The Heads tend to have similar levels of familiarity with the projects included in a group. The groups were -

(i) the four Nuffield A-level science projects

(ii) the three Nuffield O-level science projects plus the Schools Council projects for higher ability pupils. The O-level projects also had high factor loadings in group (i) indicating a close association of projects related to high ability pupils.

(iii) Schools Council projects for lower ability pupils

(iv) Nuffield Combined Science and Secondary Science projects.

Characteristics of Heads related to level of familiarity
Personal and school

Heads with high total familiarity scores compared with those with low scores[1] tended to -

be less experienced as Heads,
be in a grammar or comprehensive school rather than a secondary modern school,
and be in a large school.

The last two variables are obviously interrelated. Large schools will also tend to have a broader ability and age range and thus more projects will be relevant to the school.

Useful information sources, limiting and facilitating factors and effects of curriculum development projects

Sections 5-9 of the questionnaire cover items in these categories. They contain 79 potential predictors of level of familiarity measured on a 4 or 5 point scale. Only five individual items discriminated significantly between Heads with high and low familiarity scores. Those with high familiarity tended to consider that -

school governors were less useful sources of information,
Schools Council publications other than Dialogue and the Project Profile and Index were more useful,
LEA circulars were less useful,
LEA initiative was more facilitating for the use of projects,

and agreed less strongly that projects introduce uniformity into school programmes.

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1. Categorical or nominal distributions were tested by chi square and those with probability levels of p = 0.05 or less were included as significant. Questionnaire items with 4 or 5 point scales were tested with a Kolmogorov-Smirnov one-tailed test for two samples. Significant items have probability levels of 0.05.

The scores on these items in the five sections were also subjected to factor analysis and 14 factors were extracted. Of these, five discriminated between the high and low familiarity groups of Heads.

In this respect Heads with high familiarity scores compared to those with low scores tended to -

find the publications of the Schools Council more useful as sources of information,

be more active users of personal information sources, i.e. university and college lecturers and HMIs,

consider secondary reorganization as less limiting as an influence on the take up of curriculum projects' materials and ideas in their own schools,

consider the effects of curriculum projects on the whole to have been more positive,

and disagree more strongly with the idea that curriculum projects on the whole have fostered selective effects such as divisions between subjects and the classification of children into ability groups.

Characteristics of Heads and level of use

The Heads were asked to list which of the 25 projects were being used fully or in part in their schools. The results were as given in Table 2.

In addition, 88 other projects were being used. SMP Maths was mentioned by 38 Heads and 9 cited Nuffield French. 65 projects were mentioned only once and the rest never by more than five respondents.

Only 49 Heads (17.5%) did not report any use of projects. The mean number of projects used was 2.72 and the maximum 10.

For all projects low users (55%) were defined by their use of two, one or no projects and high users (45%) by their use of three or more projects.

Personal and school characteristics which discriminated between high and low users were the same that discriminated between Heads with high and low familiarity scores.

Of the 79 items in sections 5 (future influences), 6 (information sources), 8 (limiting and facilitating factors) and 9 (effects of curriculum development projects) only four discriminated between high and low users.

Compared with low users, Heads in high user schools tend to -

find information in supply catalogues as less useful,

consider qualifications of their teaching staff as more facilitating,

agree less that projects "enable an atypical group to impose unrealistic standards",

and agree less that the projects promise more improvements than can be expected.

Table 2. Heads' reported use of projects

	A Number using project	% of total column A	% of total schools	Number taking part in project's trials
Projects supported by Schools Council				
Environmental Studies	28	3.6	9.7	1
General Studies Project	30	3.8	10.4	2
Humanities Curriculum Project	84	10.7	29.1	6
Integrated Science (SCISP)	4	0.5	1.4	1
Keele Integrated Studies	6	0.8	2.1	1
Loughborough Engineering Science	3	0.4	1.0	-
Mathematics for the Majority	20	2.5	6.9	10
Mathematics for the Majority Continuation Project	11	1.4	3.8	5
Midlands Mathematics Experiment	12	1.5	4.2	1
Moral Education 13 -16	14	1.8	4.8	1
North West Regional Curriculum Development Project	20	2.5	6.9	8
Project Environment	1	0.1	0.3	-
Project Technology	33	4.2	11.4	6
Science 5 - 13	1	0.1	0.3	1
Nuffield Projects				
O-level Biology	99	12.6	34.2	2
O-level Chemistry	86	10.9	29.8	3
O-level Physics	92	11.7	31.8	3
A-level Biological Science	22	2.8	7.6	1
A-level Chemistry	30	3.8	10.4	1
A-level Physics	22	2.8	7.6	3
A-level Physical Science	1	0.1	0.3	1
Combined Science	81	10.3	28.0	3
Secondary Science	56	7.1	19.4	14
Nuffield Mathematics	23	2.9	8.0	7
Other				
Scottish Integrated Science	7	0.9	2.4	-
TOTAL	786			81

When the heads were classified into sub-groups different patterns of responses associated both with high and low familiarity were obtained. Only some of the results for Heads with different levels of use are included here.

Heads in three types of schools were divided separately into two groups containing approximately half of each population. The high and low use groups were defined thus -

Type of school	Number of projects used	
	Low users	High users
Grammar	0 - 2	3 - 8
Comprehensive	0 - 1	2 - 7
Secondary Modern	0 - 1	2 - 6

High users of Nuffield projects compared with low users in grammar schools -

rate the Schools Council journal 'Dialogue' and BBC T.V. educational programmes as less useful sources of information

rate staff turnover as less facilitating

rate 'materials produced for a restricted ability range' as less facilitating

agree more strongly that projects 'provide packages that can be fully adopted'.

High users of Nuffield projects in comprehensive schools -

rate other head teachers as more useful sources of information about projects

rate the LEA science adviser/inspector as more useful

rate LEA circulars as more useful

rate LEA advisory services as more facilitating

agree less strongly that projects 'promise more improvements than can be reasonably expected'.

High users of Nuffield projects in secondary modern schools -

rate availability of report on project evaluation as more facilitating

rate availabilaty of CSE Mode 3 as more facilitating

agree less strongly that projects 'maintain specialist divisions between subjects'.

Head Teachers in the 17 LEA sample

The overall pattern of familiarity and use of the Heads in this sample was very similar to that of those in the national sample. However the variables that discriminated between groups of Heads with high and low familiarity and use scores were rarely the same. Thus, for example, although size of school discriminated, type of school and the extent of a Head's experience did not. On the other hand there was a significant difference in the association between the subject of a Head's academic qualification and his level of familiarity with projects in the 17 LEA sample but not in the national sample. A relatively small number of other items on the questionnaire discriminated but again the pattern was markedly different.

Science Teachers

The teacher questionnaire covered seventeen curriculum projects either completely or in part concerned with science teaching. Nine were supported by the Nuffield Foundation, seven by the Schools Council and one initiated by the Scottish Education Department but used also in England and Wales. In addition teachers were asked to report on any school or LEA projects.

The main analyses were concerned with -

a) the characteristics which distinguish science teachers with high and low total familiarity scores

b) the characteristics which distinguish science teachers with high and low use scores

c) the characteristics which distinguish high and low familiarity and use groups among biology, chemistry, physics and 'general' science teachers.

The initial analyses were particularly concerned with the use of information sources and teachers' perception of facilitating and limiting factors influencing the use of projects, the outcomes of science teaching and the effects of curriculum development projects. The results of these are briefly reported here.

Measurement of familiarity

A four point scale was used - 1 = not familiar
2 = read about or heard of project
3 = read a few of the materials
4 = read most of materials.

7.4 - 11.1% of teachers did not respond (coded 0) for individual projects. These were combined with the 'not familiar' category. Percentage responses per category are shown in Tables 3 and 4. Fig. 2 shows the distribution of the total familiarity scores.

High and low total familiarity groups were distinguished as -

	Score range	Number of teachers
High	18.53 - 35.00	137
Middle	11.06 - 18.35	156
Low	0.00 - 11.05	140

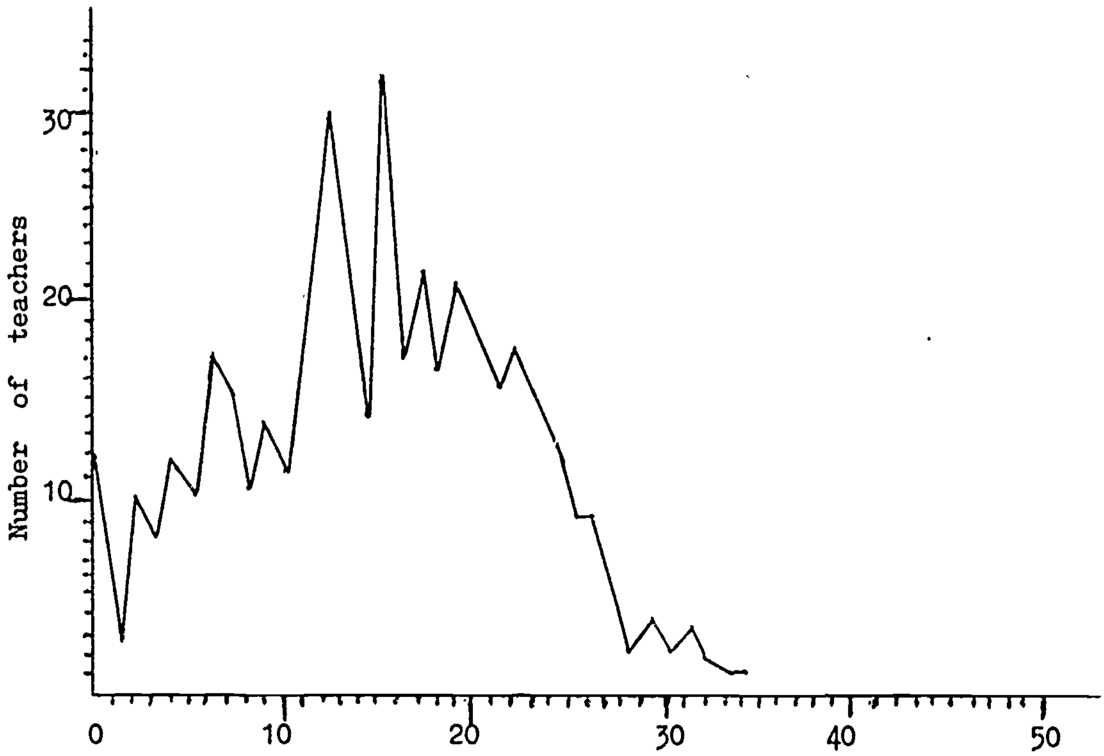
Table 3. Percentage of all teachers response to Familiarity categories

	FAMILIARITY				
	No response	Not familiar	Read or heard about	Read a few of materials	Read all or most of materials
Nuffield Projects					
O-level Biology	7.6	20.3	15.5	25.9	30.7
O-level Chemistry	8.5	19.9	16.2	22.2	33.2
O-level Physics	7.6	17.6	16.8	25.2	32.8
A-level Biological Science	9.9	47.8	21.5	11.3	9.5
A-level Chemistry	10.2	42.0	21.5	10.4	15.9
A-level Physics	10.3	43.2	24.9	14.3	7.2
A-level Physical Science	11.1	49.4	26.1	10.8	2.3
Combined Science	7.4	10.8	16.4	24.7	40.6
Secondary Science	7.6	15.5	19.2	30.0	27.7
Projects supported by Schools Council					
Integrated Science Project (SCISP)	8.3	38.8	33.0	15.0	4.8
Science 5 - 13	9.5	51.0	24.7	12.2	2.8
Project Technology	9.5	53.1	19.4	14.1	3.9
Loughborough Engineering Science	9.7	82.7	6.0	1.1	0.5
Keele Integrated Studies	9.7	85.0	4.8	0.2	0.2
Environmental Studies	9.7	65.4	19.4	4.8	0.7
Project Environment	9.7	80.1	8.1	2.1	-
Others -					
Scottish Integrated Science	9.7	43.9	19.6	16.6	10.2

Table 4. Familiarity by main teaching subject
Percentage of teachers in four categories of main teaching subject responding to different categories of familiarity with Nuffield materials.

MAIN SUBJECT (N)	FAMILIARITY No response or not familiar (0)	Read or heard about (1)	Read few of materials (2)	Read all or most of materials (3)	Mean Rating
Biologists (123)					
O-Biology	10.6	0.8	13.0	75.6	2.5
O-Chemistry	40.7	22.8	28.5	8.1	1.0
O-Physics	47.2	26.0	19.5	7.3	0.9
Combined Science	17.9	20.3	24.4	37.4	1.8
Secondary Science	27.6	17.1	30.9	24.4	1.5
Chemists (120)					
O-Biology	29.2	25.8	34.2	10.8	1.3
O-Chemistry	5.8	1.7	5.8	86.7	2.7
O-Physics	22.5	21.7	36.7	19.2	1.5
Combined Science	21.7	15.8	27.5	35.0	1.7
Secondary Science	24.2	24.2	30.8	20.8	1.5
Physicists (124)					
O-Biology	41.9	20.2	29.0	8.9	1.0
O-Chemistry	39.9	18.5	30.6	12.9	1.2
O-Physics	4.0	3.2	15.3	77.4	2.7
Combined Science	16.1	19.4	24.2	40.3	1.9
Secondary Science	16.9	21.0	32.3	29.8	1.8
General Scientists (41)					
O-Biology	29.3	19.5	26.8	24.4	1.5
O-Chemistry	26.8	29.3	29.3	14.6	1.3
O-Physics	22.0	24.4	31.7	22.0	1.5
Combined Science	12.2	4.9	22.0	61.0	2.3
Secondary Science	22.0	12.2	22.0	43.9	1.9

Fig. 2. Distribution of teachers' total Familiarity scores



Measurement of use

A five-point scale was used -
1 = do not use
2 = using ideas but not the materials at present
3 = less than 1/3 of the materials used at present
4 = more than 1/3 but less than 2/3 of the materials used at present
5 = all or most of the materials used at present

A similar proportion of teachers did not respond as with familiarity and these were combined with the 'do not use' category. Percentage responses per category are shown in Tables 5 and 6. Fig. 3 shows the distribution of the total use scores.

High and low total use scores were distinguished as -

	Score range	Number of teachers
High	9.68 - 35.00	156
Middle	4.42 - 9.67	195
Low	0 - 4.41	80

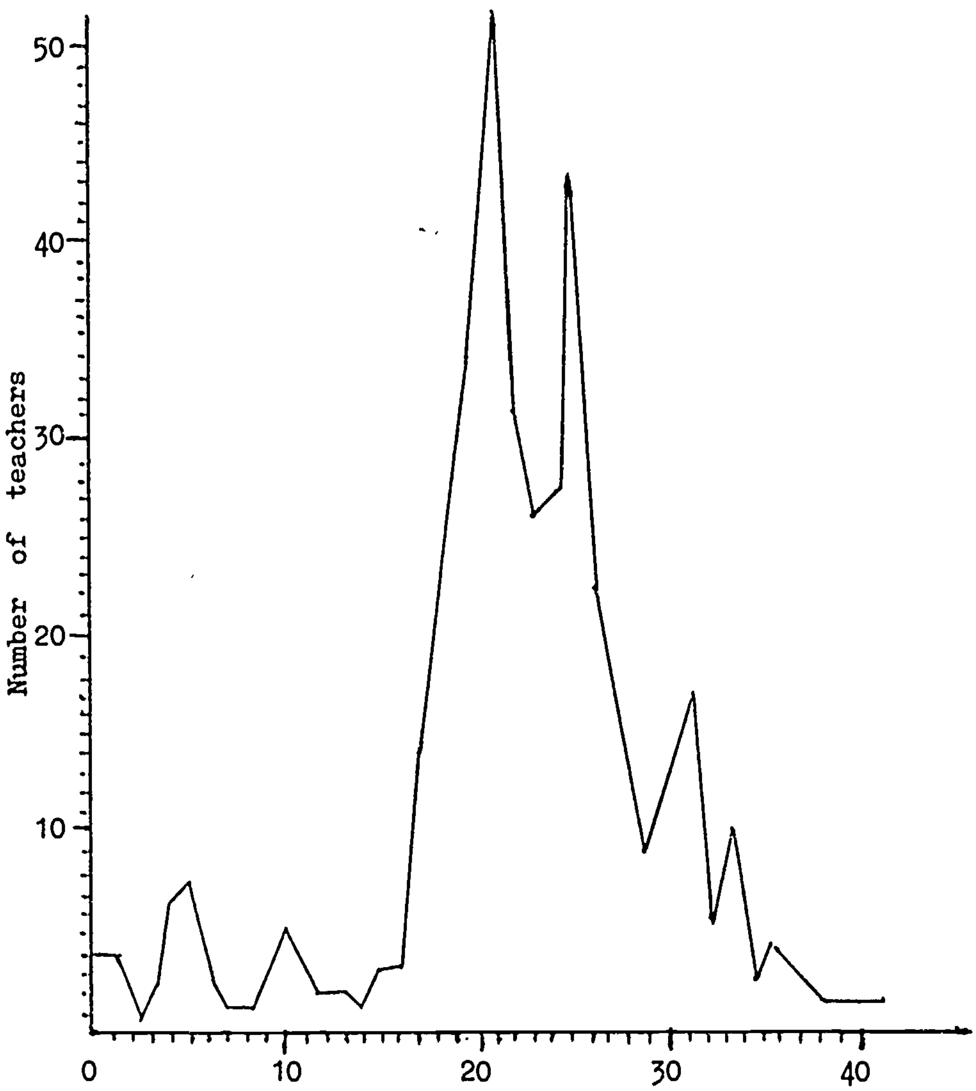
Table 5. Percentage of all teachers' response to categories of USE of Nuffield materials

	USE					
	No response	Not using	Using ideas	Using less than ½	Using less than ¾	Using all or most
Nuffield Projects						
O-level Biology	8.8	51.0	12.5	11.5	8.8	7.4
O-level Chemistry	9.0	50.3	10.9	8.1	11.5	10.2
O-level Physics	8.8	48.3	11.3	13.9	8.3	9.5
A-level Biological Science	11.8	77.6	5.1	2.3	1.2	2.1
A-level Chemistry	11.3	69.3	7.9	2.5	1.8	7.2
A-level Physics	11.8	80.1	3.9	2.3	-	1.8
A-level Physical Science	12.9	84.3	0.9	1.2	-	0.7
Combined Science	8.5	42.3	12.0	8.3	9.0	19.9
Secondary Science	9.0	48.7	19.4	10.6	5.8	6.5
Projects supported by Schools Council						
Integrated Science Project (SCISP)	9.9	83.4	4.6	-	0.2	1.8
Science 5 - 13	10.4	82.0	6.0	1.2	-	0.5
Project Technology	11.8	80.6	6.2	0.5	0.5	0.5
Loughborough Engineering Science	11.8	87.1	0.7	0.2	-	0.2
Keele Integrated Studies	12.0	87.8	0.2	-	-	-
Environmental Studies	12.2	83.8	3.0	0.9	-	-
Project Environment	12.0	86.4	1.6	-	-	-
Others -						
Scottish Integrated Science	10.9	71.4	13.2	2.5	0.2	1.8

Table 6. Use by main teaching subject
Percentage of teachers in four categories of main teaching subject responding to different categories of use of Nuffield materials.

MAIN SUBJECT (N)	USE: No response or no use (0)	Using ideas (1)	Using less than ½ (2)	Using less than ¾ (3)	Using all or most (4)	Mean Rating
Biologists (123)						
O-Biology	11.4	22.0	25.2	22.8	18.7	2.2
O-Chemistry	80.5	5.7	8.1	2.4	3.3	0.4
O-Physics	84.6	4.1	8.9	1.6	0.8	0.3
Combined Science	52.0	14.6	8.9	6.5	17.9	1.2
Secondary Science	61.8	22.0	8.9	6.5	0.8	0.6
Chemists (120)						
O-Biology	80.8	5.0	7.5	3.3	3.3	0.4
O-Chemistry	9.2	15.0	13.3	33.3	29.2	2.6
O-Physics	69.2	12.5	10.8	4.2	3.3	0.6
Combined Science	60.0	10.0	5.0	10.8	14.2	1.1
Secondary Science	67.5	16.7	8.3	4.2	3.3	0.6
Physicists (124)						
O-Biology	86.3	3.2	5.6	2.4	2.4	0.3
O-Chemistry	79.0	8.1	5.6	4.8	2.4	0.4
O-Physics	11.3	12.9	25.8	21.8	28.2	2.4
Combined Science	56.5	8.9	12.1	5.6	16.9	1.2
Secondary Science	55.6	19.4	12.1	4.0	8.9	0.9
General Scientists (41)						
O-Biology	68.3	24.4	2.4	2.4	2.4	0.5
O-Chemistry	82.9	14.6	0.0	2.4	0.0	0.2
O-Physics	75.6	22.0	0.0	2.4	0.0	0.3
Combined Science	12.2	22.0	9.8	17.1	39.0	2.5
Secondary Science	31.7	24.4	12.2	12.2	19.5	1.6

Fig. 3. Distribution of teachers' total Use scores



Measurement of combined extremes of familiarity and use: 'adoption' v 'rejection'

The teachers were asked to name one project with which they were most familiar or used most and one which they found least useful and had rejected. The two categories represented high and low measures of a combination of familiarity and use which reflected an alternative distinction made by teachers in Phase 1. The groups were termed respectively 'adopters' and 'rejectors'. The largest differences in response to questionnaire items were obtained with this classification of teachers.

94% of the teachers named a "most familiar or used" (adopted) project and 42% named a "least useful or rejected" (rejected) project. The three Nuffield O-level projects and Combined Science accounted nearly equally (18-21%) for 77% of all the "most familiar or used" responses. Responses to "least useful or rejected" projects were more evenly spread out between ten projects.

Table 7. "Adopters" and "Rejectors"

	"Adopters"		"Rejectors"	
	Number of responses	% of total N=433	Number of responses	% of total N=433
Nuffield Projects				
O-level Biology	78	18	17	4
O-level Chemistry	85	20	6	1
O-level Physics	77	18	11	2
A-level Biological Science	8	2	8	2
A-level Chemistry	20	5	4	1
A-level Physics	2	< 1	1	
A-level Physical Science	3	< 1	12	3
Combined Science	91	21	24	6
Secondary Science	21	5	25	6
Projects supported by Schools Council				
Integrated Science Project (SCISP)	5	1	30	7
Science 5 - 13	5	1	11	2
Project Technology	2	< 1	15	4
Loughborough Engineering Science	2	< 1	2	
Keele Integrated Studies	0		3	1
Environmental Studies	0			
Project Environment	1		1	
Others -				
Scottish Integrated Science	4	1	11	2
Your school or LEA project	1		1	
none mentioned	28	6	250	58

Information sources

For the science teachers the most useful source (out of a list of 34 sources) for information about curriculum projects was clearly the publications of the Association for Science Education. Five other sources stood out as important. In order they were science teachers from their own school, Times Educational Supplement, science teachers from other schools, science journals and magazines, circulars from curriculum development projects and information from publishers.

Courses and meetings were relatively infrequently ranked in the first five as useful sources.

The evidence suggests that science teachers and their Heads use different sources for information about curriculum development projects.

High familiarity of projects was associated with a greater use of the 34 listed sources of information. The mean score for the use of each source was significantly higher for the high familiarity group compared with the low familiarity group. However, only the following distinguished the high and low 'use of projects' groups -

science teachers from your own school
catalogues from scientific supply companies
publications of the Association for Science Education
science journals and magazines
science teachers from other schools
DES memoranda and circulars
circulars from curriculum development projects
LEA science advisers/inspectors
other Schools Councils publications (i.e. not Dialogue or 'Project Profiles and Index')

Teachers from different types of schools used different sources of information. Thus, for example, Secondary Modern teachers reported the greatest use of DES memoranda and circulars while teachers from grammar and comprehensive schools apparently used circulars from curriculum development projects much more.

When the teachers were categorised into three subject areas and 'adopters' compared with 'rejectors' for specific projects in their subjects more discriminated for biologists and physicists than for chemists. There was only one instance where the same variable discriminated for biologists, chemists and physicists, three instances for biologists and physicists and one for chemists and physicists.

It was also possible to detect that the 'rejectors', irrespective of their subject, were a distinct group different from the low familiarity and use groups in that, compared with the adopters, they were often significantly <u>more</u> frequent users of information sources. This, no doubt, indicates that their decision to 'reject' was positive and based on knowledge rather than ignorance.

Facilitating and limiting factors

Eleven factors, as perceived by the teachers, discriminated significantly between both the high and low familiarity and the high and low use groups.

Both the high use and familiarity groups rated as more facilitating -

requirements of external examination,
flexibility of use of project materials,
objectives of the project,
attitude of colleagues in your school,
school organization,
availability of special grants to start project,
and availability of technicians.

In addition, the low familiarity group compared with the high familiarity group rated as significantly more facilitating -

availability of information about curriculum project, and similarity of content or methods in the project with previous teaching.

No other factors discriminated for use or familiarity.

There were variations in the patterns of discrimination between biology, chemistry and physics teachers.

This is also seen when 'adopters' are compared with 'rejectors'. Then, taking O-level biology, combined science and secondary science as examples, six patterns of combination of factors emerge which discriminate between the 'adopters' and 'rejectors' of these projects. However, the discrimination is always positive i.e. adopters rate the factors as more facilitating than do the rejectors.

I <u>All three projects</u>

availability of grants to start projects
objectives of project

II <u>Biology, Combined Science</u>

availability of money to keep project going
similarity of content or methods in the project with previous teaching

III <u>Biology, Secondary Science</u>

school organization

IV <u>Combined Science, Secondary Science</u>

flexibility of use of project materials
attitude of colleagues in your school

V <u>Combined Science</u>

your pre-service education
activity of LEA teachers' centre
availability of information about curriculum projects

VI <u>Secondary Science</u>

availability of mode 3 CSE
contact with trial schools involved in project
developments related to the school leaving age
provision of special examination related to the project
accommodation available
availability of technicians.

From these results it is possible to detect a relationship between characteristics of the projects and the factors which discriminate between adopters and rejectors. Thus, for example, for Group I which includes all three projects the factors are ones that can apply to virtually any project; for Group IV (Combined Science and Secondary Science) factors are cited which relate to the flexible use of materials and their use with a wide ability range which are particular features of the projects; and 'contact with trial schools', an information source of the early stages of diffusion, is cited for Secondary Science (VI) compared with items more associated with later stages of diffusion which are cited for the more established project Combined Science (V).

The relation between perceived limiting and facilitating factors and the level of the teachers' familiarity and use of curriculum projects varies according to the group of teachers concerned, the type of school and the curriculum project referred to. However, the results that have been obtained do allow a few generalizations to be suggested about the factors that discriminate between groups of high and lower familiarity and high and low use.

- For specialist subjects or those intended for pupils in the higher ability ranges, external examinations and university entry requirements influence familiarity.
- For integrated subjects or those catering for a broad ability range, availability of CSE Mode 3 or special examinations influences familiarity with and use of new curricula.
- In general the use of a project is more likely the higher teachers rate as facilitating the objectives of the project, flexibility of use of its materials and the similarity of its content and methods with their previous experience.
- Perceptions of secondary reorganization influences the use of new curricula.
- Availability of information influences the use of new curricula.
- Contact with trial schools influences familiarity and use of new curricula.

Not related to familiarity with and use of new curricula are teachers perceptions of -

raising the school leaving age,
pupils' need for a formal qualification,
staff over-work or time available, and
activity of teachers' centres

Outcomes of science teaching

The teachers were asked to rate the importance of nineteen possible outcomes of science teaching (obtained during the Phase 1 studies) in terms of their personal opinion and the curriculum development project with which they were most familiar.

With most items there was a significant difference in the rates of personal opinion and that for a project. For all but three of the items the rating of personal opinion was always highest. The exceptions were "an ability to handle the investigation of open-ended problems", "the development of experimental skills" and "an understanding and ability to use the scientific method".

Personal ratings were particularly higher for the items -

a knowledge of the basic facts of science,
an understanding of the social implications of scientific discovery, and
the development of critical attitudes towards the effects of technology on the quality of life.

There were a few, but interesting, differences between the ratings of teachers of biology, chemistry, physics and General Science.

For the ratings of the teacher's personal opinion of the importance of outcomes the following items discriminated significantly between the groups of high and low familiarity and use. None discriminated for both familiarity and use.

High familiarity teachers rated as more important -

an ability to handle the investigation of open-ended problems,
the development of critical attitudes towards the effects of technology on the quality of life.

High familiarity teachers rated as less important -

educational benefits of individual sciences.

High use teachers rated as less important -

a knowledge of the basic facts of science,
preparation for future studies,
the supply of well qualified scientists and technologists for the nation's needs,
to facilitate competition with other countries in science and technology.

The relationship between the characteristics of projects and the factors which discriminate between 'adopter' and 'rejector' groups of teachers seen for limiting and facilitating factors was also apparent with the teachers' opinions of science teaching outcomes. Thus, for example, adopters of O-level Biology rated as more important and adopters of Secondary Science rated as less important -

an understanding of and ability to use the scientific method
an ability to delay conclusions until convincing evidence is available.

Effects of curriculum development projects

The list of twenty-nine statements about the effects of curriculum development projects was obtained from the Phase 1 interviews. Approximately half the statements were negative in the sense that agreement with them would be expected to be related to rejection, low familiarity or low use. In contrast to the sections on 'limiting and facilitating factors' and 'outcomes of science teaching' these statements were not directed specifically at the teacher's school situation. They were intended to reflect more the climate of opinion in which decisions are made.

There was a close association between positive and negative statements and the levels of familiarity and use. High familiarity and use groups tend to agree more strongly with positive statement than do the low groups. Conversely, high familiarity and use groups agree less strongly with negative statements than do low groups.

In particular five statements discriminated for both familiarity and use. Both the 'high' groups agree more strongly that curriculum development projects -

improve the quality of pupils' school experience, and
provide packages that can be fully adopted.

and less strongly that they -

promise more improvements than can reasonably be expected,
over-emphasize the role of technical aids in teaching (e.g. programmed learning),
and promote dissatisfaction with what has been tested over time and shown to work.

Fewer items discriminated between adopters and rejectors and there were differences between teachers of different subjects. Even when high and low adopters of the Nuffield A-level projects were compared with high and low adopters of the O-level projects a completely different set of items was found to discriminate between them. At this stage it is difficult to determine meaningful patterns in the results obtained other than the general discriminating influence of positive and negative statements

Other analyses

The analyses outlined here have been extended and the additional data are available in survey reports. They will be incorporated into publications by members of the project. In addition a comparison of the responses of Heads and teachers from the same schools has been undertaken.

LEA COMMUNICATION AND SUPPORT SYSTEM STUDY

The Phase 1 studies had indicated that whilst it was clear that there were relationships between response of schools to innovation and the form of support and communication existing in their local education authorities the exact nature of this relationship was difficult to discern. The Phase 1 interviews had mainly provided information about LEAs' perceptions of change and their curricular responsibilities. This was followed up in Phase 2 by a questionnaire study of the LEAs' provision of facilities for communication and support. The questionnaire (D) was designed with the help of three science advisers from LEAs not included in the sample. It was sent to the authorities in our sample in the spring of 1973, but was completed by only twelve of them. Of the seven county authorities five responded, but only three of the seven county boroughs did so; replies were obtained from all four London Boroughs. Although the date for local government reorganization was more than a year away, the extra work associated with this was given, in some cases, as the reason for not completing the questionnaire. But in others (and this was apparent too in some of the returns we did receive, and was evident from the Phase 1 studies) there was no readily available record of the kind of information we required.

However, the data provided by the twelve responding LEAs were analysed and for each of fifteen items the LEAs were graded over a five point scale.

Outline of responses

a) Teachers' Centres

By the spring of 1973 each of the twelve authorities had set up at least one Teachers' Centre, but the pattern of provision bore little relationship to the size of an authority. There were sixteen Centres in all. They were used most extensively for primary school work although half of them provided more than 25% of the programme for secondary teachers. Two Centres were specifically for Science but for the multi-purpose Centres only in one authority did the time given to secondary school science exceed 5% of the total programme. In general it seemed that the authorities were content for other agencies to be used for science teachers.

b) Alternative centres of support for science teachers

The local authorities were asked to name, in order of importance, any centres or institutions organizing meetings or courses for science teachers that were accessible to teachers in their area.

The pattern of use appears to vary with the regional position of the authority. Colleges of Education, though numerous in London, are seen apparently to have little value for science education in the area, but assume more importance in other parts of the country. In all areas Universities are used and two of the London LEAs reported using Polytechnics.

Between them the twelve authorities mentioned 29 institutions and in view of this provision of support elsewhere, they may feel that additional meetings and courses provided by the LEA are unnecessary. Indeed the expectation that science courses would be provided by the university centres or within the A.T.O. organization was expressed more than once in the original interviews with the local authorities.

This balance of provision was in marked contrast to the responses of the science teachers when asked how often they were able to attend meetings and courses. Those organized by LEAs gained the higher ratings than those organized by universities and other bodies.

c) Industrial links

In spite of recent attempts to relate technology to the science work of schools only one authority claims that a high level of contact exists between its schools and local industries. Five claim moderate links, three think they are low, two do not know and one did not reply. Seven authorities were located in high density industrial areas, but only four had formal links involving a "link-man" based in industry. No local person from industry was mentioned as being influential in science education: the orientation of school science appears still to be academic rather than technological.

d) Communication

The authorities were asked twice about the communication of science curriculum information to teachers. First they were asked to rank seven methods of general communication from the LEA to the science teachers in schools, and, later in the questionnaire, they were asked to rank statements of how they expect teachers to get to know about national curriculum development projects

Communication from Education Office to schools	Mean Ranking
letter to head teacher	2.2
visit to inspector/adviser	2.5
general bulletin	3.2
special curriculum bulletin	3.3
telephone to head of science	4.3
through teachers' centre	4.4
telephone to head teacher	5.1

Expected method used by teachers for National curriculum development projects	Mean Ranking
through advisory service	1.5
direct from Schools Council or other body	2.9
by teacher's own efforts	3.5
through teachers' centres	3.7
LEA's contacts with head teacher	4.1
from professional organizations	5.2

These responses indicate that while the customary route for passing information from office to school is via the head teacher (8 ranked this in first place), the authorities did not see this as effective in establishing the teachers' familiarity with curriculum development projects in science. Teachers' responses to their questionnaire support this in that they report they seldom to occasionally consult with head teachers for information.

e) Response to curriculum development projects

Our enquiry encountered a severe limitation when we attempted to discover the local authorities' responses to curriculum development projects in the form of provision of trial schools, finance and in-service courses for teachers. In the majority of cases records had not been preserved and personnel had been appointed later than the development and early diffusion stage of the initial projects.

(i) Trial schools

Three of the 12 authorities could provide no information at all as to whether an approach had been made for a trial school to be established in their area for any of 16 science projects, and what their reaction had been to any such approach, although other records had shown one to have had a maintained school in O-level Biology trials and in another several schools participated in the development of Secondary Science material.

Information about the more recent projects - Secondary Science and SCISP - was more forthcoming and more LEAs claimed to have trial schools for these. This difference between early and later projects may reflect the different strategies of the project developers: the early ones tended to approach first the schools and then the authority, while more recently the procedure has been to make the initial request to the LEA.

Several replies indicated that the authorities had not been invited to support trials for some of the projects. One claimed it had not been approached for any of the 16 projects.

Apparently the LEAs rarely sought to take part in trials. The usual pattern is to respond - by acceptance or rejection - to the approach from a development team.

Only one authority reported rejecting a request for trial schools but gave no reason for it.

In only one case were reports on trials given to the Education Committee with requests for further adoption. This was in the LEA with the most intensive use of projects and carefully planned development and financial support for them.

(ii) Financial support

In no cases were requests for financial support to start projects turned down by Education Committees. Apparently decisions about the level of support were made by administration before the requests were submitted. One administration reported a policy of itemizing requests as 'councillors were more reluctant to cut out particular items than to trim a global sum'.

There was variation in the time the LEAs started giving financial help for projects, and in the balance of support over time - some gave larger initial sums which were reduced in subsequent years, others gradually increased the amount available. There was a tendency for the amount of money provided to be proportional to the size of the LEA.

Discussions with schools had revealed irritation with apparent inflexible financial controls in some LEAs: two or three years elapsing before requested funds became available, restrictions on suppliers to be used for apparatus and small petty cash allowances.

From the responses of the LEAs it appeared that special funds for curriculum projects were more readily accessible than those for "capital" items. Six authorities required only 6 months notice, while 5 required 12 months. For capital items most required 12 months and one 2 years.

In most cases, therefore, the time interval required forward planning and preparation from school science departments but only created problems when staff turn-over was high.

Two of the twelve authorities had restrictions on the use of suppliers, three on the purchase of surplus equipment, while another limited the purchase of "consumables" in science to £25 in any one year.

The limitations on petty cash varied from 'postage only' to 'no limit'. The LEA reporting no limit to petty cash also reported no restrictions on the other factors. Paradoxically, this was in an area where teachers were most resentful of restrictions.

(iii) Provision of in-service courses

The LEAs were asked to give the number of in-service courses for different curriculum development projects they had organized each year from 1968. There was considerable variation in both the number of courses provided and the range of projects they served. To some extent this was related to provision in other institutions.

Several authorities staffed courses with their own teachers who had become familiar with projects by working in trial schools or attending national courses. These were supplemented by advisory staff, HMIs and College of Education tutors.

When asked about the methods they would use to enable teachers to become proficient in implementing projects the LEAs again gave a variety of replies. There was a division of opinion which indicated that some LEAs considered the initiative for providing facilities for teachers to take up innovations should come from themselves, whilst others thought that they should provide it only when teachers ask for it.

Three LEAs stated they offered teachers full support for travel, tuition and accommodation for in-service courses. With the others at least 25% of the cost had to be met by teachers.

f) Special problems reported

(i) Local government reorganization

Four of our sample LEAs had been newly established in 1965 consequent upon the reorganization of London boroughs. The remaining eight experienced considerable changes in 1974. Few of these anticipated in 1973 that this would affect curriculum development appreciably. However, one authority reported that it had experimented with the use of teacher-advisers in mathematics and would have gone on to make similar appointments in science for 1973/4 but for the changes imminent in the LEA, while another also reported a "delay in the making of decisions". One of the four London boroughs commented that there had been a slowing down of the development of new ideas and the adoption of projects in the years immediately following reorganization.

The 1974 local authority reorganization involved the creation of new posts, the appointment of new personnel, the development of new procedures and the appearance of colleagues fulfilling similar functions. It appeared, from our enquiries, that inevitably LEA initiative in curriculum development would be withdrawn to some extent while relationships were established and the potentials of the new situation explored. On the other hand, in the long term, where the change is accompanied by the creation in the enlarged LEA units of advisory posts, that did not previously exist, there may be an increase in LEA initiative in curriculum development.

(ii) Comprehensive reorganization

All twelve LEAs had planned some form of comprehensive system of secondary schools by 1973. Six had implemented changes early, in five they were phased over several years, while one initiated changes only in September 1973. There was great variety in the forms of reorganization which pointed to the difficulty of implementing curriculum innovations presented as 'packages' for several years or restricted ability ranges, and of the need to modify innovations for local use.

(iii) Accommodation

Over the period 1964-72 there had been considerable expansion in the provision of accommodation for science teaching in schools. It contrasted markedly with the views of Heads and teachers who clearly considered lack of accommodation as an important limiting factor in the uptake of innovation.

(iv) Population changes

Although only one of the LEAs had been designated an Educational Priority Area in all but two there had been changes in their school populations - in more than half through an influx of immigrants - which had necessitated special provision of courses for teachers and sometimes pupils.

(v) Staffing

The LEAs reported a range of staff turnover from less than 10% to over 30%; the highest changes being in the London LEAs. In only one case (a London Borough) was the turnover of science staff considered to be greater than that for other subjects. Otherwise it was the same.

(vi) Travel

All LEAs saw travel as a major discouragement to all but the most committed teachers from attendance at meetings, especially those at the end of a school day. In rural areas this is because of the geographical distances involved whilst in urban areas shorter distances can take an inordinate time to travel because of traffic and public transport problems. They reported also a sense of insularity that may develop within small urban communities or isolated areas of a large County authority, where commuting is not extensive and geographically adjacent areas may be psychologically distant.

g) Key persons

Each of the authorities mentioned at least one person with some responsibility for science at the advisory level in 1973. All of these posts had been created in the previous ten years and all but three of them since the publication of the first of the Nuffield Science teaching materials. In some authorities the position of science adviser has been created without corresponding posts in other areas of the curriculum. This is perhaps an indication of the considerable response by the authorities to the activities of the Nuffield Science teaching projects.

The advisory personnel in our sample were variously described and the time each spent on science ranged from 1% to 100%. In a more detailed study three science advisers kept diaries of their activities over two periods of time. In particular this showed that the amount of contact they had with schools was small and that their functions were predominantly administrative.

All twelve of the authorities were able to identify at least one other person in the area who was important for science education there. Those persons fell into the following categories:

Persons mentioned	No. of LEAs mentioning them
HMIs	8
University staff (Department of Education mainly)	4
College of Education (science tutors)	3
Project team members	3
Science Centre staff	2
Teachers	2
Schools Council Field Officer	1

Significantly those whose appointment carried specific responsibility for science education - the HMIs and Science Centre staff - were seen to be influential. The Schools Council Field Officers are so sparsely distributed that it is not surprising that their influence was detected in only one of our small sample. University Department and College of Education tutors, with school contacts arising from teaching practice and in-service courses, were seen as important by only half of the sample.

The sense of isolation which came from the teachers' responses to their questionnaire was apparent in only one LEA reply - "There seems to be nobody with any real influence; there are no colleges in the area, HMIs visit only rarely; the two technical colleges are beginning to offer more help."

The "effective local leadership" from among the teachers themselves anticipated by the Schools Council does not appear to be visible to the LEA administrators. Only two made reference to teachers in this context - one after four other categories of person had been mentioned. The other - a largely rural area, with no specialist advisory staff - made first mention of a local teachers group which had recently revived under the leadership of a local head of science. It is possible that in an area well-served by persons outside the schools, with responsibilities in science education, the teacher may experience fewer demands on himself to assume leadership.

No person identified with the ASE was mentioned by the authorities. It is apparent that the importance of the Association as an information source was not displayed in its local activities in these areas.

h) Grading LEA communication and support

From the completed LEA questionnaires information was extracted for the following fourteen items which appeared to be particularly important as discriminators of high and low communication and support.

Teachers' Centres - science programme and staffing.
Other centres of use to science education.
Contacts between teachers organized by LEA.
Communication to schools about projects.
Industry and links with schools.
Advisers: number and date of establishment.
Other influential persons in science education.

Response to requests for trial schools.
Finance to projects.
New laboratories.
Timing of requests for funds)
Financial restrictions) (converted to one item)
Implementation support for curriculum development projects.
Course support for teachers.
Course provision in science curriculum development projects.

For each item the information for all twelve LEAs was displayed on one continuous sheet and three persons, all with wide experience of teaching, of curriculum projects and science education, were asked to grade the information contained in the response over a five point scale (5 = very good to 1 = poor) for each LEA in each item. In some items the graders were instructed to take into account the size category of the LEA.

The scores were entered into a grid and a total score was calculated. When compared with measurements of use of the Nuffield science teaching projects the significant feature to emerge was the considerable variation in the relationship. For example, whilst the LEA with apparently the second highest level of use had the highest communication and support score, the two LEAs with the lowest communication and support scores had the next two highest use scores. In the latter cases the strong interest of teachers in their grammar schools which were not being reorganized appeared to have been more influential in fostering the use of the projects.

	LEAs											
Communication and support score	52	44	42	38	34	34	33	33	32	30	27	23
% use of projects	50	21	7	2	22	3	0	0	4	15	58	29

No clear cut association between an LEA's use of projects and its level of communication and support was revealed by this analysis. Two main reasons can be suggested for this.

(i) Inadequacies in the enquiry. For example, there were obvious incomplete responses from some LEAs; there was a possible loss of validity obtained by giving items equal weighting in the Communication and Support score; and there may have been inadequacies in the measurement of use.

(ii) Other factors, for example those more related to the school situation, were influential.

With the evidence of the Phase 1 LEA interviews in mind, our judgement rested more with the second reason. Some idea of these school-based influences were obtained from the school case studies.

CASE STUDIES

The chief aim of the case studies programme was to explore the processes of communication and decision-making. To this was added the investigation of teachers' perceptions of curriculum development projects in science after it became clear how closely communication and decision-making were influenced by perception.

Choice of local authority areas for case studies

The concept of a communication-support system was used to identify locations in which to pursue the studies. It was suggested that one way of structuring the enquiry to encompass the aims would be to identify LEA areas scoring high in communication-support and those with low scores. Teachers in the schools in these areas operate within identifiably different environments. In each area one would expect to find those who use projects extensively and those who do not, leading to a four-cell arrangement as follows:

		Local Authority Level	
		High Communication-Support	Low Communication-Support
At Teacher Level	Adopters	P	Q
	Non-adopters	R	S

It was anticipated that enquiries in schools within cells P, Q, R and S would lead to interesting comparisons of communication patterns and decision-making processes.

The county Authority scoring highest and that obtaining the lowest score for communication and support as described in the previous section were first selected. This was to be matched with two county boroughs but this proved a problem. The borough obtaining the highest score was excluded as it was very large and would demand too much of the time available for case studies to cover the same proportion of school visits as was planned in the county Authorities. The borough scoring lowest was excluded since it appeared to have too little activity within it to provide populations in the high adopter/low communication-support category. It was decided to choose the next lowest county borough in rank order and to select a borough that appeared to match it in situation and size from the middle rank of scorers.

When percentage adoption scores of Nuffield O-level projects in 1973 for these four Authorities were examined it was found that the two low in communication-support scores were also non-adopters, while the high and moderate communication-support Authorities were among the high adopters.

Choice of schools for case studies

The following criteria were kept in mind when choice of schools was made:

at least half of the secondary schools in the Local Education Authority area should be visited;

as many as possible of the schools receiving mailed questionnaires from the project should be included;

where variety in organization, size, sex of pupil and situation existed as representative a sample as possible should be chosen;

where a tiered system of secondary schools operated the choice should be largely from the schools containing 13 - 16 year old pupils;

schools should be accessible from a convenient centre.

Choice of projects discussed

It was decided initially to include those projects relevant to the 13-16 age group, (i.e. the O-level projects in the separate sciences, Secondary Science and SCISP) since pupils in this range would be found in grammar, comprehensive and secondary modern schools. These five projects represented a useful range in ability of target population, in time interval from publication date and of specialist or integrated science programmes.

However, it became apparent that to attempt a comprehensive survey of communication patterns it would be necessary to visit at least some of the junior secondary schools where a tiered system operated. This required that Combined Science be added to the projects under enquiry and it emerged as an important project in one other area where the schools were organized on an 11-16 or 11-18 pattern.

Procedures for arranging a case study visit

An approach was made to the Local Education Authority, through the person who had become the Curriculum Diffusion Research Project contact in the Authority, to obtain permission to carry out a programme of visits to the schools. This was readily given, but, in three of the four areas, it was stressed that the schools were entirely free to accept or reject a visit as they saw fit. In the fourth area the Science Adviser offered to negotiate for the visits. This offer was accepted and a list of the schools chosen, with alternatives, was provided by the project.

In two other areas a letter was sent to Head Teachers, giving information about the research project, referring to the questionnaire study, if relevant, and suggesting that the interviewer would telephone the following week. Some Heads replied at once (only one with a refusal to burden his staff with further commitments at a time of reorganization and following a prolonged involvement with another project based at the local university) and final arrangements were made with the Head, the school secretary or the head of science. This was followed by a letter confirming the date of the visit and anticipated time of arrival and repeating the interviewer's request to talk with the head of science and as many of the other science teachers as possible as and when they were available during the day. In a few cases the visit was restricted to a half day only, but mostly the interviewer was able to spend the whole day in a school and was able to have lunch with the Head Teacher and/or members of the science staff.

Plans were made to visit the remaining area in the spring. Difficulties arose over term dates involving an early Easter. The LEA representative advised an initial approach by telephone to certain schools for visits the following week. This was done, but proved less satisfactory, as the request to talk with as many teachers as possible was misunderstood and the interviewer found herself talking only with the head of science, or with a whole group of science teachers. Arrangements made as described above, with the other schools in the area, were more successful.

A visit to a school

A case study visit to a school typically involved a brief meeting with the Head Teacher, several of whom were interested to know more about the research project. The interviewer would then be passed to the head of science, with whom the pattern of science courses in the school was discussed.

When preceding communications were clear the head of science had most probably arranged a programme of meetings during the day with members of the science staff, sometimes arranging for colleagues to be freed to talk with the interviewer. Where some confusion existed about the purpose of the visit hasty consultations took place, discussions were pursued in front of classes, or at break in a crowded staffroom - not ideal arrangements for any of the participants. More than once some absence of a science colleague upset carefully laid plans. The most relaxed interviewing took place in Authority (B) where the bulk of visits coincided fortuitously with school examinations! In Authority (D) the problems associated with the first term of a major reorganization of sch schools caused an added preoccupation for the staff involved.

When talking with a teacher the interviewer would most likely begin by asking what teachers thought of the Nuffield Science Teaching Projects, using a lightly structured framework of questions (E). Then if time permitted, they would proceed to the more personal structured communication questionnaire (F).

Time too frequently ran out before this could be completed, so that in the second round of visits an attempt was made to distribute copies of the questionnaire to teachers at the beginning of a visit, if an opportunity arose (e.g. during morning break in a prep. room). Some hostility was aroused in a few cases by the wording of the document (it was intended as a prompt schedule for the interviewer who entered replies on it) and in one school its completion became a joint activity accompanied by a certain amount of ribaldry! In the later work in LEAs C and D, therefore, the questionnaire was used only by the interviewer as the opportunity arose.

Any person or institution from outside the school, mentioned by any science teacher, was approached while the interviewer was in the area, or later by post, in an attempt to map the communication patterns involving the science teachers in an area.

In retrospect the programme for one visit appears too ambitious to be carried out rigorously. A head of science may possibly arrange to be free, or arrange for a visit to occur when he is not timetabled with a class, but the interviewer found that it was unrealistic to expect more than about 15 or 20 minutes to be spent with other teachers. If research requires more contact time, several return visits would be necessary, with the possible outcome that the school would be unwilling to entertain involvement with future research.

The general impression gained was that the interruption caused by one day's visit was not resented: the interviewer was almost invariably received with great courtesy and kindness and a large number of teachers expressed their appreciation of the opportunity to discuss some of the fundamental issues of science education.

Number of schools and teachers

LEA	Schools visited	Teachers interviewed: Men	Women	Total
A	12	32	7	39
B	10	28	8	36
C	7	15	5	20
D	5	9	8	17
Totals	34	84	28	112

The analysis of the Case Study results is still continuing. The following represents a sample of the data and findings only. It refers only to communication and decision-making. Detailed analyses of perception and leadership have also been undertaken.

Communication channels and processes

These examples refer predominantly to communication within local education authorities as a whole. Complementary analyses of communication within schools were also undertaken.

LEA (A)

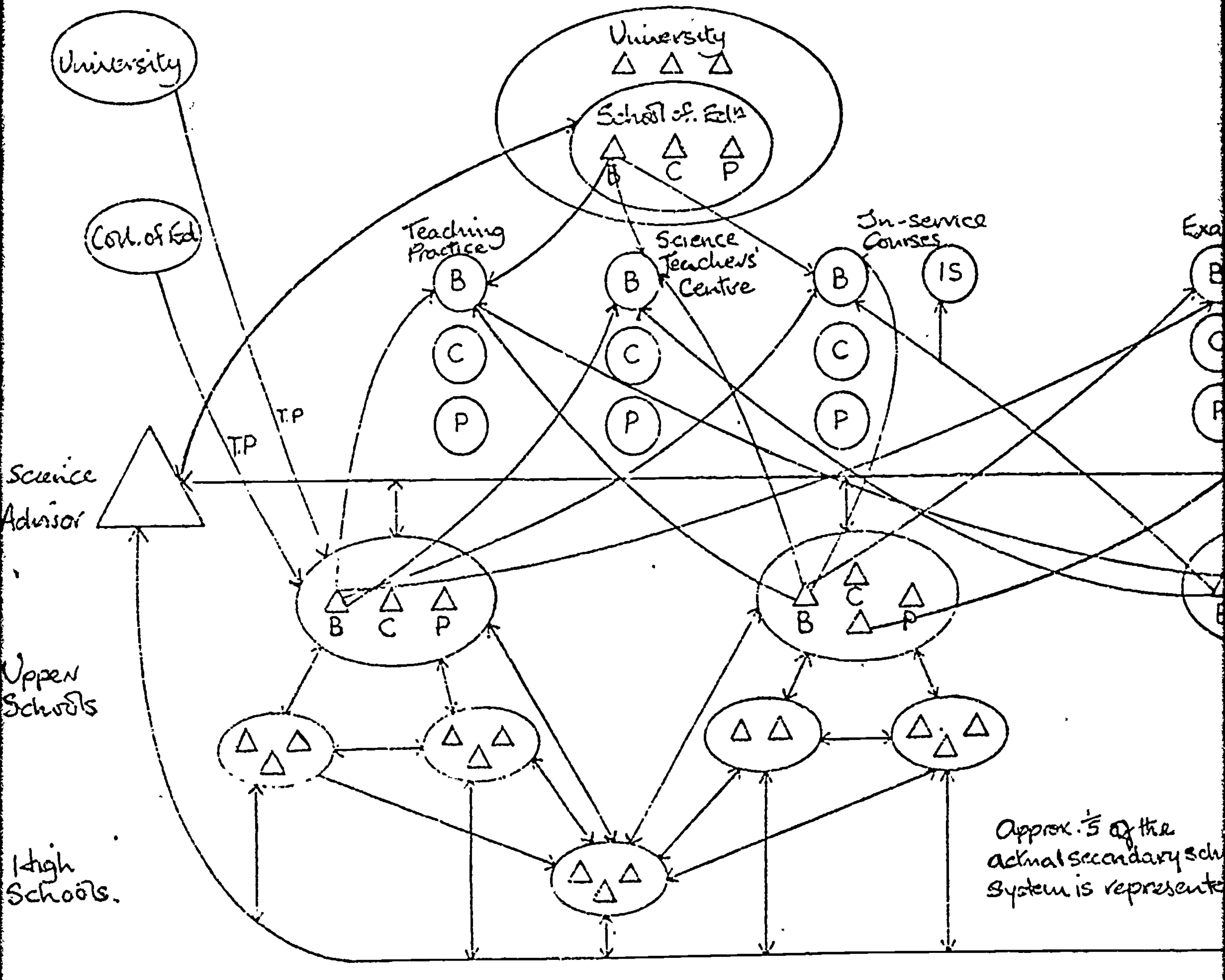
Figure 4 displays some of the structures revealed during case studies carried out in LEA (A). For simplicity the communication channels for upper school biology teachers only are shown in detail. Similar patterns of communication existed for the chemistry and physics teachers, linking them via teaching practice, teachers' centres, in-service courses and examining.

A key institution: the School of Education

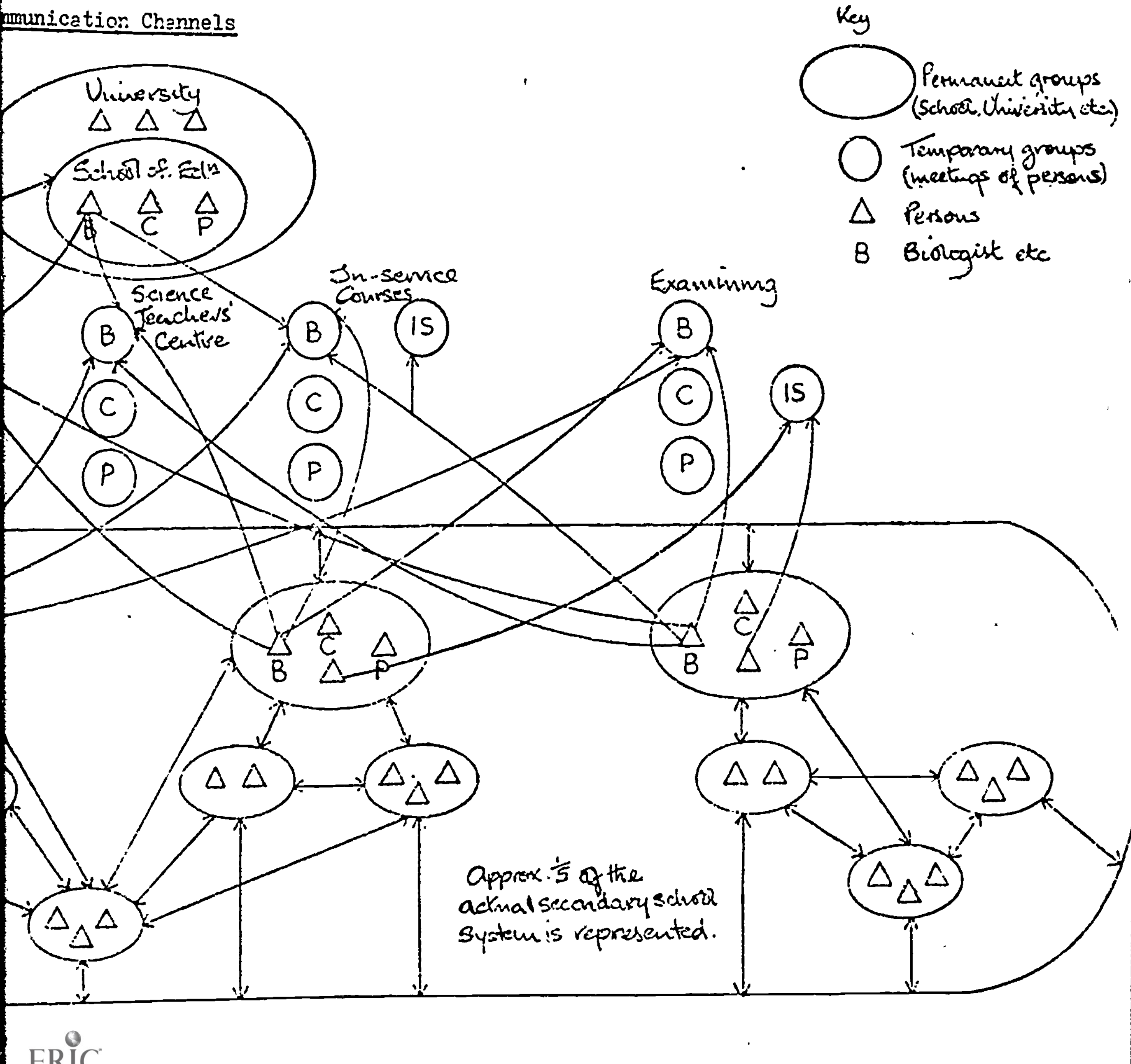
The diagram shows the importance of the University School of Education personnel in maintaining three communication structures: teaching practice organized through a co-tutor system, teachers' centres and in-service cour..es. In addition, together with the science advisers, they were responsible for the organization of the annual "teach-ins" for separate groups of upper school biology, chemistry and physics teachers (not shown). It is important to note that these structures involved upper schools, but not high schools.

Teachers within the LEA schools referred to other institutions (two Universities and two Colleges of Education) in connection with

Figure 4. LEA (A) Communication Channels



mmunication Channels



teaching practice, but although personal contacts developed for a few individual teachers from tutors' visits to the schools, this did not result in teachers coming together as a group.

Mode 3 examining

The decision within the LEA to use Mode 3 examining for grouped schools for CSE (a fourth communication structure) had resulted in more frequent contacts between science teachers. Again high school teachers were not involved.

Structural support for specialist science

Figure 4 also displays the effect of all four structures in maintaining the identity of specialist science teachers and their separation from the other two sciences. Communications between, for example, biologists were strengthened by these structures, which did little to establish communications between teachers of different science specialisms. It was more often a junior member of a department who was responsible for the development of integrated science courses. Four heads of department, however, had reported attendance at a Nuffield Secondary Science course.

Interdisciplinary contacts between science teachers

The opportunity for science teachers of different disciplines to meet was provided in the schools, informally through daily casual contacts, or formally through departmental meetings. However, the isolation of one of the sciences in a separate building was found to reduce their communication with other science teachers.

The scheduled departmental or faculty meeting arose either from an hierarchical committee structure within the school, or from the innovative climate of the institution which required regular consultation in its problem-solving approach. (This was apparent in two new schools where there existed a self-conscious emphasis on the social aims of education.)

The amount of social interaction between science teachers in a school was found elsewhere to depend not only on structures and objectives but also on the leadership style of the head of science and the constraints offered to this in the personality characteristics of other members of the department.

Inter-school contacts

Again, for simplicity, the inter-school channels of communication are shown as single lines, linking institutions; in reality these were between persons. The structure of the upper schools imposed separate biology, chemistry and physics meetings on the high schools, even where the course and department in the latter were wholely integrated. Contacts between the high schools feeding into a common upper school appeared to be frequent, although there was a suggestion from one upper school (its high schools were not visited) that the very different philosophies found within its "feeder schools" made communications difficult, and where a high school fed into more than one upper school communication was more diffuse.

There were no direct formal links between upper school science teachers (as there were between head teachers), but evidence from the interviews showed that the teachers knew each other well, recognized strengths and expertises where they existed, and were prepared to call upon them when the need arose. There was, however, evidence that one large school which had been closely associated with the development and trials of the Nuffield O-level Biology and Physics schemes had been a useful communication source to others. The most frequently detected attitude to the "new" schools in the area was that of slightly amused tolerance. There was little evidence, at that time, that the individualized learning programmes in science being developed in those schools was influencing practice in the others. Indeed there had been little contact between the two new schools themselves even though they were attempting to solve common problems.

A key person: the Science Adviser

The communication links of schools with the science adviser are shown as feeding into a loop enclosing the schools. This symbolises the communication role perceived for the Adviser. In practice contacts occurred through persons: all science teachers had potential access to the Adviser, but apparently his most frequent contacts were with head teachers, heads of department and probationary teachers. From the interviews it appeared that in the upper schools the Adviser was seen as a source of information about equipment rather than curricula as a whole. For the high schools he assumed a wider advisory role. However, the time demands on such an appointment, with responsibility spreading to the primary sector also, made personal contacts infrequent.

Communication processes directly relating to curriculum development projects

The Adviser's tactics in spreading information about curriculum development projects was interesting, for it showed an inventive use of many opportunities, as is illustrated by the case of Nuffield Secondary Science materials. The procedure had been:

1. at the trial stage the LEA had provided three trials schools, but two withdrew after one year,
2. in 1970, with a neighbouring LEA, it had run the first local authority in-service course in the country,
3. in 1971, two half-day courses on Secondary Science were run, but had little response from the schools,
4. the materials were included in the annual residential courses directed towards ROSLA work (little response from science departments),
5. in 1972, all upper schools were offered "mini" ROSLA courses in their own schools in the last weeks of the summer term (only 4 schools took up the offer),
6. in 1973, Secondary Science and SCISP materials were presented at a high school "think-in", organized by the Adviser,
7. the teacher most expert in the use of Secondary Science materials was given a sabbatical year (1973-4). Before taking up his studies in October 1973 the LEA was planning to use him for one week in each of four upper schools "to try to get something going".

The interviews also revealed the process of communication relating to the Schools Council Integrated Science Project (SCISP). They took place in the schools, some before and some after a one-day (Saturday) Dissemination Conference, held some sixty miles from the LEA. In one school high familiarity with SCISP materials was apparent even before the Conference, while from other schools teachers were going to find out more about the project. (This was true even of one school where, organizationally, three entirely separate departments existed: the heads of biology and physics were planning to attend the Conference.) However, in two schools it seemed that junior staff had no knowledge of the Conference.

The communication channel had been:.

SCISP team

↓

LEAs (Science Adviser, in this case)

↓

Head teachers (special communication)

↓

Heads of science or heads of departments

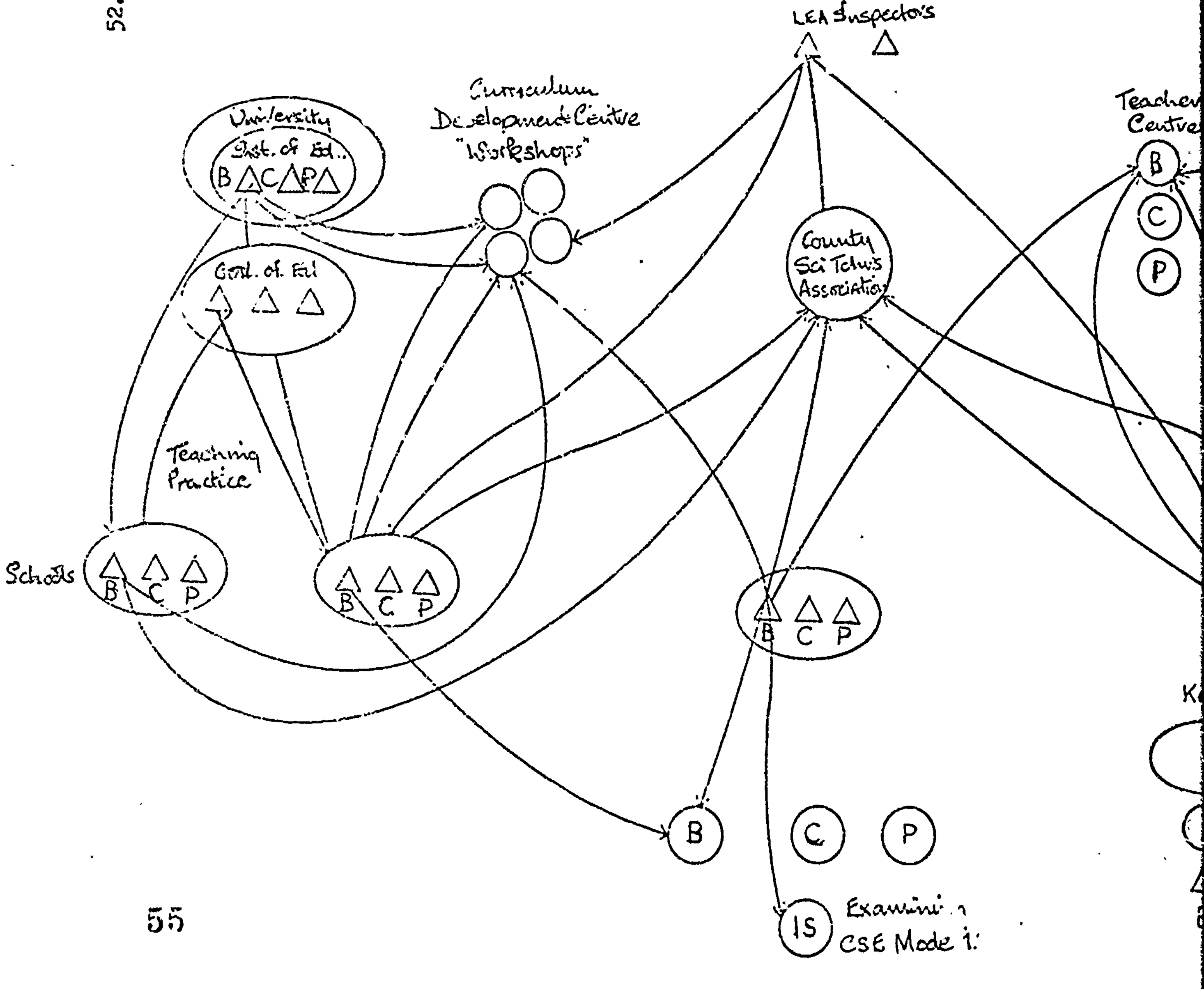
↓

Science teachers

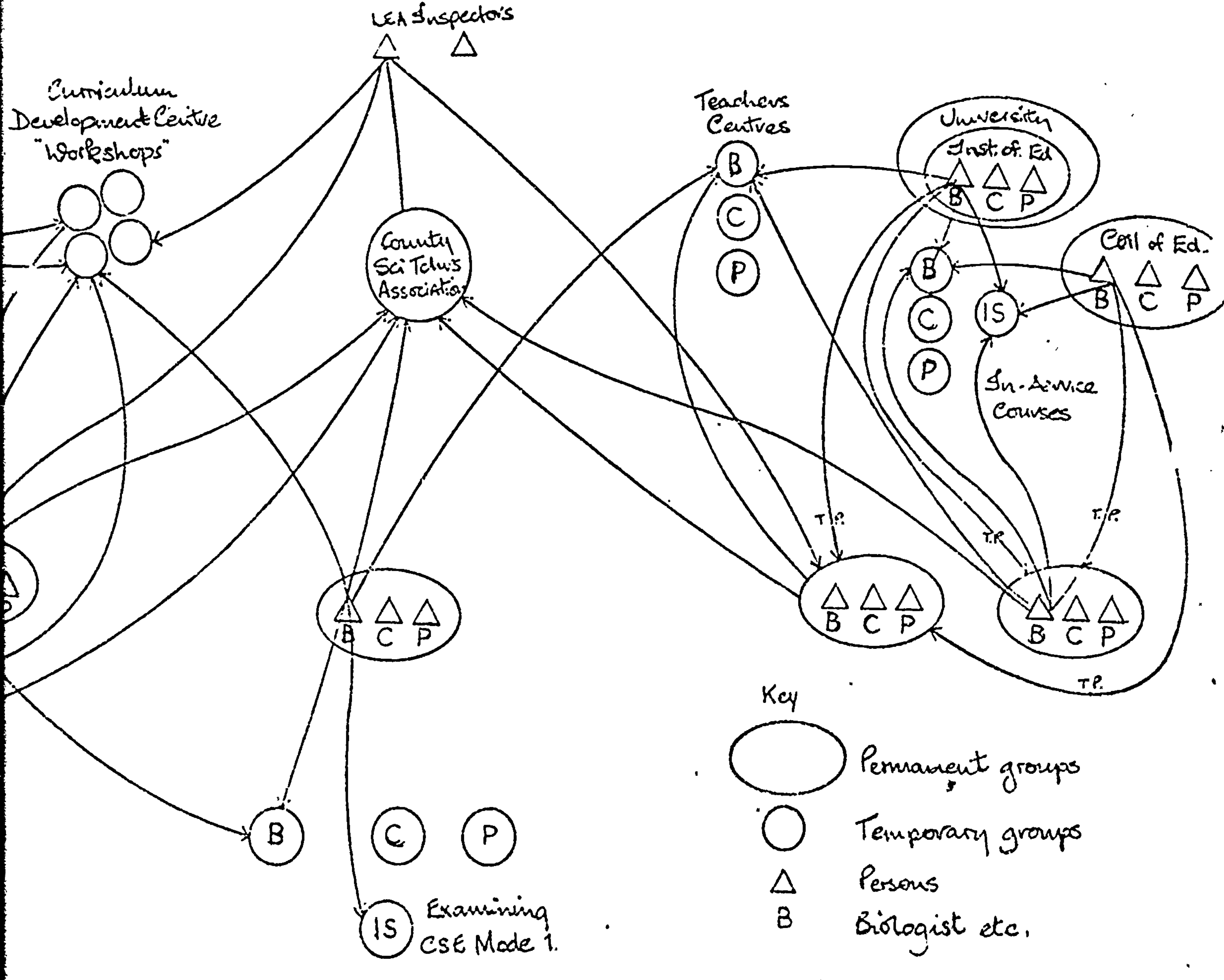
Incidentally, with LEA (B) (p.55) a different procedure resulted in only one teacher attending the Conference.

In most cases the information had reached individual science teachers, who had made their own decision about attendance. In two cases the channel had become blocked at some stage, possibly at the Head teacher, but also possibly at the head of science, as both men stated they could see no place for such a course. In one school integrated courses were confined to pupils of lesser ability than O-level, and a separate Combined Science department created to provide them; in another school the departments were said to be isolated, even though there was an overall head of science. Apparently these contexts had caused the information to go unnoticed.

Figure 5. LEA (B) Communication Channels



Communication Channels



LEA (B)

Community sense

Within most of the schools visited there was a general sense of contentment, achievement and well-being - teachers felt they were doing a good job and, for many, their role was seen as a service to the community. These teachers had a sense of being part of the community. Their contacts out of school, in many cases, arose from their community involvements, whether it was in church work, youth work or recreation. A third of them talked frequently with other teachers out of school and the wives of half of them were actively engaged in teaching or some form of social or medical service.

Associated with this sense of community was sometimes a parochial vision that tended to limit activities to the immediate local situation. The geographical location of population centres did not help here, as apart from clusters around the outskirts of the two university cities on the county borders, these were scattered, and travel in winter particularly was difficult.

Institutions of higher education

Figure 5 indicates how communication channels linked schools generally with their nearest institution. Some 50% of the teachers in each area reported participation in activities organized from the Centres. These took the form of single meetings at the "professional" centres or series of meetings or courses within the Curriculum Development Centre ("workshops") or more conventional in-service courses. Two-thirds of those interviewed had attended an extended course in the last three years (some in the vacation at centres elsewhere in the country), but only four of these courses had any direct association with Nuffield curriculum development materials.

Teaching practice for students of these institutions did not result in the coming together of teachers. Contacts were between individual tutors and teachers and the visits were often described as hurried and infrequent.

There was some evidence that support for the practice of mixed ability teaching groups in LEA (B) may have spread from one institution (or the LEA in which it was situated). There were certainly signs of the influence of one chemistry tutor hostile to the Nuffield O-level chemistry scheme. More than one local teacher had been trained in his department and others quoted his opinions. The overall effect was to sharpen criticism of the scheme, but not, in every case, towards hostility.

The County Science Teachers' Association

The structure out of which the new Science Teachers' Association had grown had been laid by LEA personnel in the 1960s, who set up Curriculum Development Groups in the different subject areas. These had been made up entirely of teachers and, in science, the group had been convened by a rota of heads of science, for a year each. Activities had lapsed over recent years and when the LEA approached a relative newcomer to undertake the convening for 1972-3, he had accepted on condition that the LEA would agree to run a residential week-end course based on Nuffield Combined Science materials. This they did and the Association grew out of the contacts made. Each school was asked to nominate a committee member for the organizing committee, and most teachers interviewed considered themselves to be members of the Association. Several had attended meetings and plans were being made to organize "banks" of organisms, teaching aids and equipment.

The relative importance of this Association at the time of interviewing is indicated by its central position in Figure 5, but its future was uncertain as the LEA would not exist after 1974 and its schools would be the responsibility of three other newly-formed LEAs.

The fate of the earlier Curriculum Development Group indicates that such an impermanent structure is vulnerable and highly dependent on the vision and organizing ability of each temporary "leader".

Support for specialist science

The "professional" teachers centres associated with the one University were organized separately and much of the "workshop" activity in the other was carried out within the separate science disciplines. This certainly reflected the organization of the work in the schools, but the programme of the Science Teachers' Association had been more generally based thereby providing a communication channel embracing all science teachers.

In the schools in this LEA the laboratories were more often than not an integral part of the main school building so that science teachers were less likely to form a separate unit. At least two science department staffs took "tea-break" together during the day - in one case this occurred in a school with no overall head of science and partially counteracted the separation of departments; in the other a very high level of morale and job satisfaction existed. This was largely dependent on the leadership of the head of science who used the daily prep. room gathering as a departmental meeting.

Examining

Only two of the teachers interviewed were involved with GCE examining and a third of them with CSE meetings so that, for many, examining did not form an effective communication channel.

Communication processes directly relating to Curriculum Development Projects

Faced with the curriculum development activities of the 1960s the LEA, with scattered schools and limited personnel, had created the Curriculum Development Groups of teachers and provided a continuing structure for their convening. It is possible that the LEA reminded each head of department as his turn as convener came round by asking if he would be willing to act in this capacity.

Information arriving within the LEA from curriculum projects was then passed on to the convener, on the assumption that it would reach other schools, but no further mechanism had been provided for this in science until the Combined Science course of 1972. The insistence that this should be a residential course reflected one head of science's assessment of the problems confronting personal communications in a scattered population.

The LEA appeared to use the convener of the Curriculum Development Group for roles carried out elsewhere by a science adviser. They reported an intention (abandoned in view of local government reorganization) of following a year's successful operation of teacher advisers in mathematics with similar appointments in science.

When the LEA was notified about the SCISP Dissemination Conference to be held in a not too distant city, the acting convener was telephoned and asked to attend. He did so, but no other teacher had heard about the Conference and at least one young teacher had been disappointed at missing it.

The personal request over the telephone appeared to be used frequently by the LEA personnel: another teacher recalled how he had been telephoned by the LEA in 1966 and asked to attend a Nuffield O-level Physics course at the nearest University Centre.

LEA (C)

It was possible to detect a recent quickening of interest in and support for science education and curriculum development in general within this LEA. An LEA Curriculum Development Centre had been set up, with a warden appointed at a relatively high status level. At the time of interview the Warden, an Arts graduate, also had teaching commitments within the School of Education. Some two years after his appointment the first in-service work in science from the centre had been organized.

Key persons

Within the School of Education an active tutor in Biology, with a concern for the schools, had emerged. She had developed a Science News Letter covering curriculum projects, courses, new publications and other useful information. Support for chemistry was developing through a relative newcomer at the School of Education, but in physics this was less apparent.

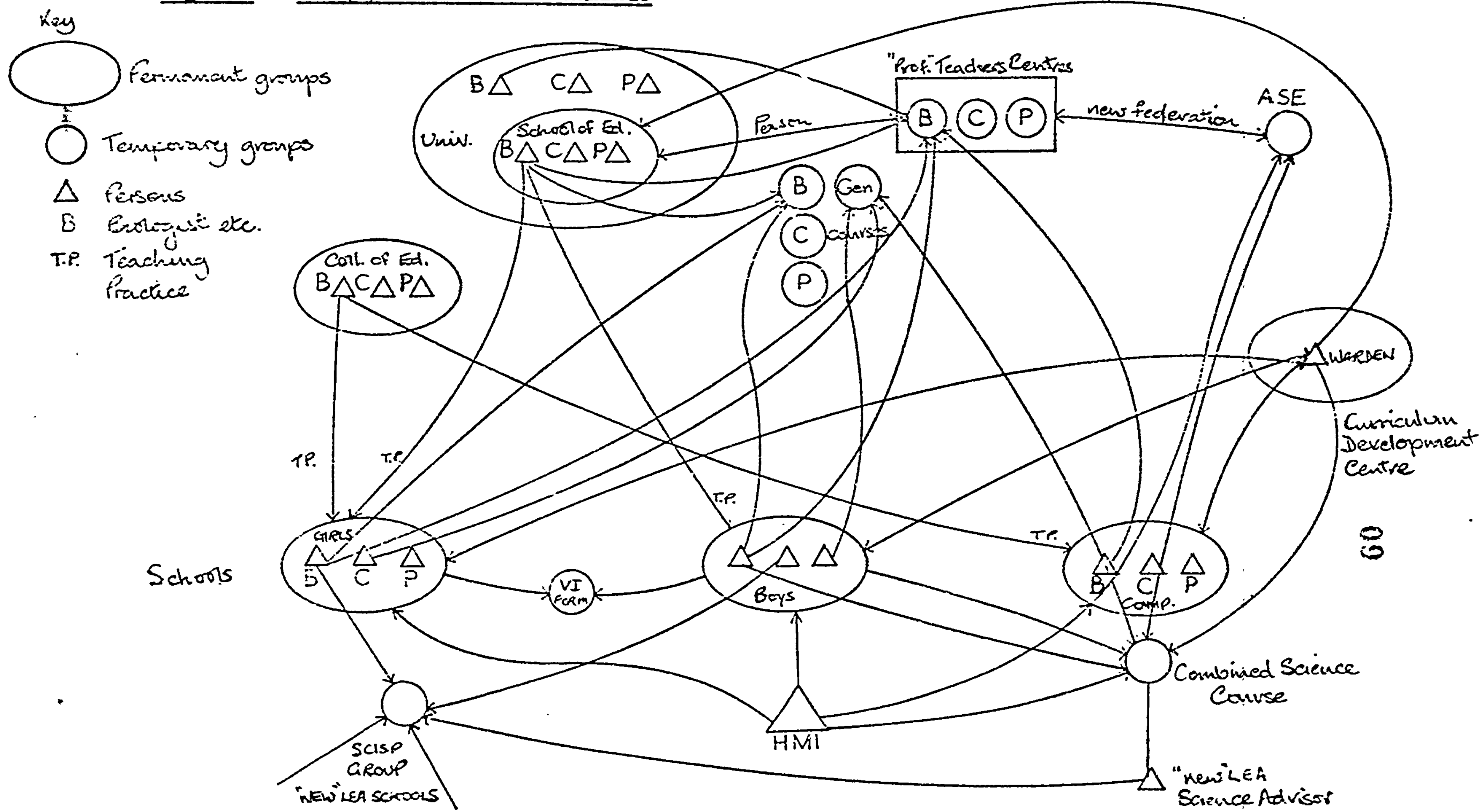
The local HMI was a biologist; an inspection of school science had been carried out in the LEA and had resulted in the recommended use of Nuffield Combined Science materials in the schools. Several heads of department spoke appreciatively of the continuing support and advice received from the HMI (a few were critical).

Support for interdisciplinary contacts in science

Figure 6 displays the presence of factors commonly supporting the separation of the science subjects: the subject identity of teachers and tutors, separate teachers' centres in biology, chemistry and physics, and separate courses relating to examination work. However, one of the aims of the recent Federation formed between the teachers' centres and the ASE (which was in contact with the School of Education through its biology tutor) was "to reflect the increasingly inter-disciplinary nature of science at both the school and the university level".

The ATO had provided courses for integrated as well as specialist science, including a popular one entitled "Planning the Secondary School Science Curriculum" in which all the Nuffield science materials were presented and discussed.

Figure 6. LEA (C) Communication Channels



Intra-school support for science teachers

In one boys' school a Senior Teacher appointment carried responsibility for the professional development of teachers in the school. In the same school the Headmaster had time-tabled a thirty minute period for all the science staff to meet together. The use and appreciation of this had led to its extension to a one hour period.

Communication processes directly relating to Curriculum Development Projects

The LEA administrator responsible for schools was a language specialist. In the past, information relating to science projects had tended to be filed, in the absence of any structure for dissemination. Following the creation of the Curriculum Development Centre all such materials were passed direct to the Warden - further dissemination depended on his vision and efficiency. The proximity of the science HMI ensured that materials in science were not disregarded.

This structure had resulted in inter-school discussion of Combined Science at the first LEA in-service course in science (one that was staffed by practising teachers), and in two schools becoming potential trial schools for SCISP Dissemination Phase. One of these schools was the one referred to above, where the head of science was looking for a common course to co-ordinate the work of the department and to provide a mechanism for supporting inexperienced teachers, and the head of science in the other school was in close touch with the HMI, and favourably orientated to integrated science courses.

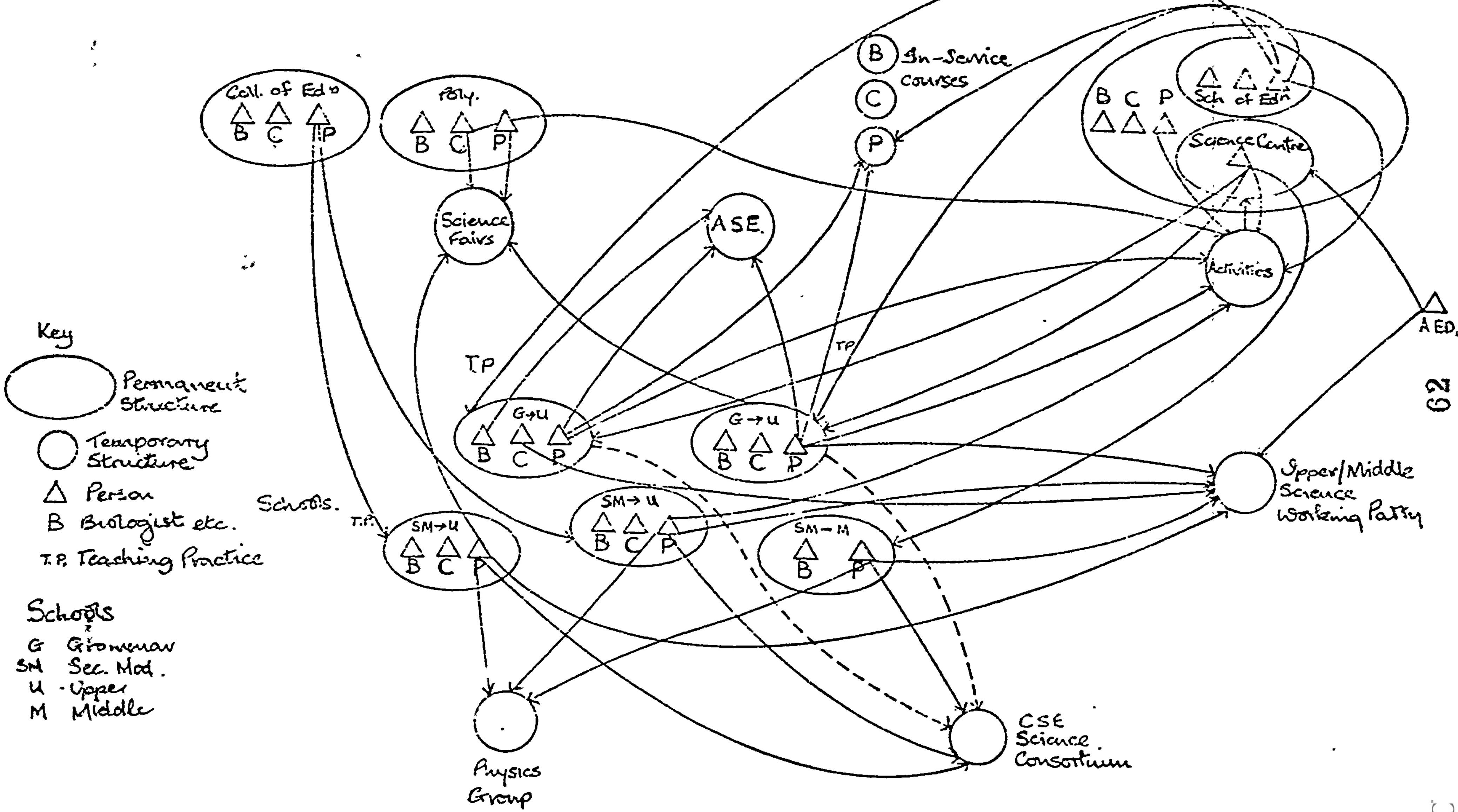
Co-ordination of the four trial schools in the new authority was to be the responsibility of the science adviser in the new LEA.

The teachers

It was reported from several different sources that the LEA had had problems in staffing the schools in mathematics and science. The interviews showed there had been unfortunate discontinuities at head of science level through illness in three schools, and that married women teachers in the girls' schools were highly mobile.

There was little sense of involvement in the community or of personal career drive. One "traditional" teacher from the grammar school was potentially influential in his high level AMA contacts in Joint Four/N.U.T. and Schools Council Committees, but there was no evidence from the interviews that he had any influence at the local level.

Figure 7. LEA (D) Communication Channels



LEA (D)

At the time of visits to the schools the communication channels involving the teachers were in a fluid state as the organization of schooling was changing from separate grammar and "modern" secondary schools, each group with its associated communication system, to upper and middle schools, again with different needs and resources, giving rise to different communication systems.

Active groups

The Physics Group shown in Figure 7 had already ceased to exist, but two teachers referred to its support in the past. It had been convened by the head of science (since retired) of one of the larger secondary modern schools and members had been other physicists from the modern and technical schools. They had discussed common problems and invited guest speakers, at times, to their meetings. One of these teachers had successfully introduced the Nuffield O-level Physics course for the boys in his (mixed) school.

The local branch of the ASE was reported by several teachers to be active, and had been a useful communication channel for grammar (and independent) school teachers.

A working party of the branch had recently produced a Safety Booklet. This had been followed by a further group working with the local Radio station to explore the possibility of making programmes for schools based on local industrial topics.

The Polytechnic had been the site of an annual Science Fair for the past three years. The chemistry department appeared to be particularly active and an RIC Chemistry Teachers' Centre had been formed there in 1970.

Key persons

In the middle 1960s a chemistry teacher (since moved from the area) in one of the grammar schools had obviously been an active communicator: he was referred to by name, in his old school and two others, as the source of much information about, and enthusiasm for, Nuffield O-level Chemistry.

One Assistant Education Officer (of relatively recent appointment) had been influential in setting up a Centre for School Science and Technology at the University. He had also convened, and acted as chairman of, a working party on Middle School Science made up of heads of science of middle and upper schools. Meetings of this group had been discontinued and a science headmaster reported that satisfactory communication channels had not yet been established between upper and middle schools.

The Science and Technology Centre had developed because of the vision and availability of the man on secondment at the University, who had acted as secretary of the Institute of Physics Centre, when it had been established in the University in 1969. This latter centre and the RIC Chemistry Teachers' Centre had merged with the newly-formed Centre, and separate Biology, Chemistry and Physics panels had been formed to help plan its programmes. The tutor was appointed full-time to the Centre, but engaged in some teaching within the University.

He had produced the first of a regular Newsletter, 1,500 copies of which went to local schools. This gave information about the activities and resources of the Centre and other institutions, surplus apparatus available, competitions open to school children in science, etc.

The Centre also provided a repair service for pieces of apparatus. This provided a further personal contact between the tutor and teachers, one of whom reported that "if you haven't shown up at the Centre recently, he'll come to the school to see if you've anything to mend!"

One of the 'secondary modern-to-upper' school headmasters had been Chairman of the Regional Board Science Panel and it was largely his influence that had established an active CSE Science Consortium in the city. This had been one of the most useful communication channels for secondary modern science teachers, but now those whose schools were becoming middle schools were dropping out, while the teachers from upper schools formed from grammar schools were finding the group useful.

Other institutions

The University Delegacy for Educational Studies included in its programmes courses and meetings for science teachers. Those for secondary stage had mostly been in the separate sciences for GCE work. Three of the teachers in the sample had attended its courses for A-level work.

In the absence of a Science Adviser (and there still was to be none in the reorganized LEA), the AEO played a part in initiating structures, but was too occupied with other business to maintain personal contacts. The Science Centre tutor was co-ordinating many different activities, but, as with the high schools in LEA (A), the middle schools, largely without formal structures of examining and the need to keep in touch with developing science, were largely excluded from much communication activity.

Some conclusions

These studies indicate the variety of institutions and their relationships which are involved in the diffusion of curriculum innovations. In particular they point to the important roles of temporary groups and of key people related to them.

Communication structures and activities within the schools are shown to be important influences on whether specialist or integrated course innovations are used and whether the use of an innovation by one teacher will influence others also to be innovators.

The differences in communication between the four LEAs can be described by using four inter-related parameters

(i) Whether they are confined (with relatively few communication channels) or diffuse (with several communication channels).

(ii) Whether the communication activities are co-ordinated (by, for example, an institution or a key person) or unco-ordinated.

(iii) Whether key people assume a leadership role in fostering communication activities or not.

(iv) Whether there is high or low teacher involvement in communication.

The communication channels in LEA (A) were more diffuse than in the others, although a variety of channels existed, or were developing, in all four areas.

In LEA (A) the activities were co-ordinated both by an institution and, discretely, by the Science Adviser. The Science Centre in (D) and the 'Federation' in (C) were recent attempts to co-ordinate activities in their respective areas. With two separate University Centres on its borders and no science adviser, co-ordination in (B) was low.

Early leadership had developed from groups and individual teachers of biology and physics in LEA (A) and of chemistry in LEA (D), resulting in high use of the corresponding Nuffield O-level projects in these areas. Continued leadership within the School of Education in (A) had reinforced the use of separate science projects but had provided little support for integrated science courses. On the other hand communication activities concerned with the Nuffield project in Combined Science had developed in both LEAs (B) and (C): in the former, these were related to emergent leadership from a head of a science department in a school within existing LEA structures, but, in the latter, leadership of a more authoritarian nature had come from the local HMI.

LEAs (C) and (D) were both county boroughs and similar in many ways. One important difference, related to the use of projects, was in the stability of the science staffing of schools and the involvement of the teachers in communication activities. This was low in LEA (C) where there was also a low use of projects.

Superimposed on these influences of communication structures and activities were other significant influences on the use of projects, such as the availability of resources, school organization (including recent changes) and personal characteristics of teachers.

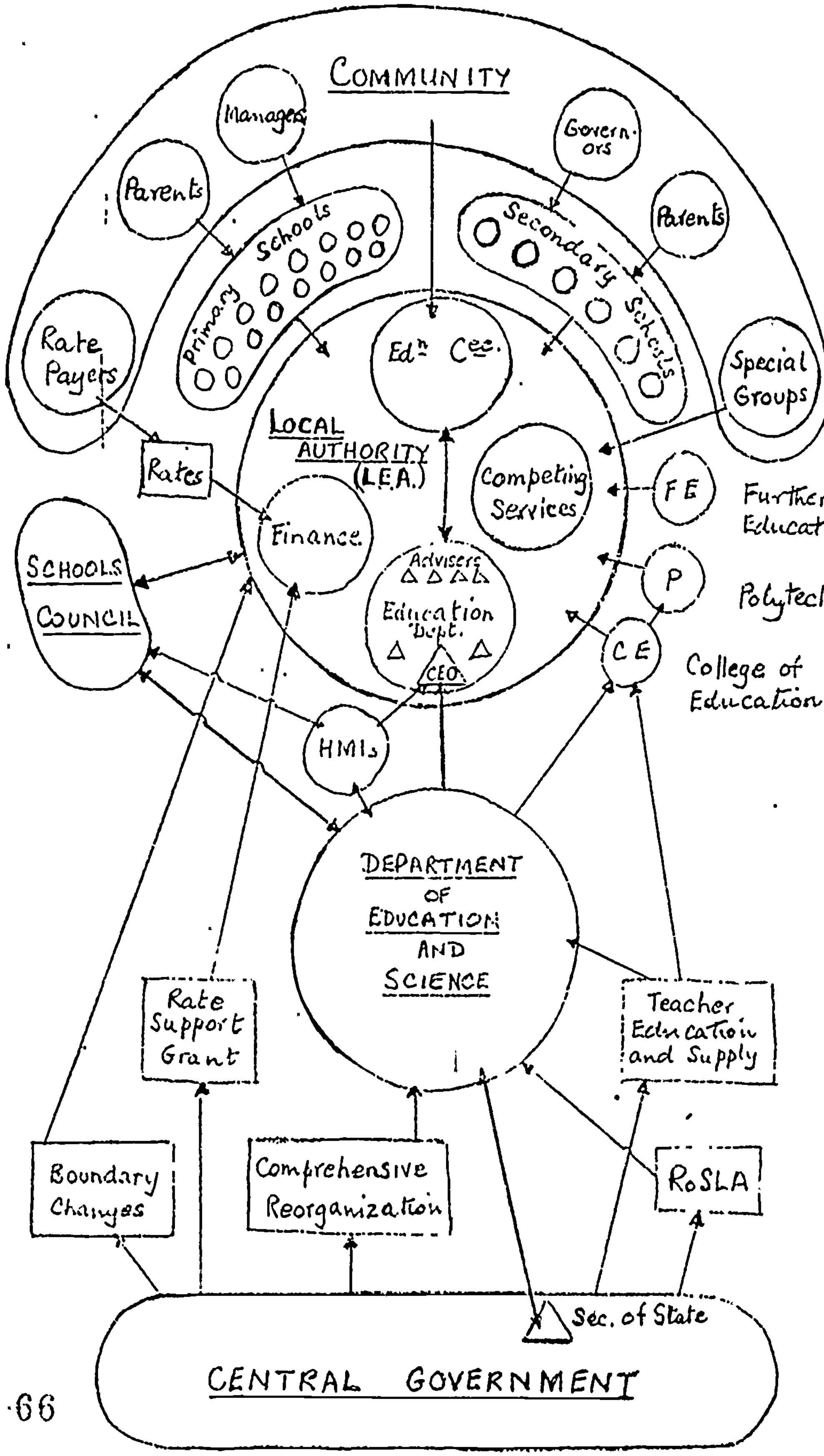
Decision-making

Analyses of decision-making were undertaken at both the LEA and school level. This involved descriptions of the pressures and administrative strategies which influence decision-making. (See Figs. 8 and 9.) The general conclusion we drew from this was that decisions concerned with the use of curriculum innovations within the LEAs and schools had most commonly taken place, not so much through well-organized strategies directed towards identifiable goals, but as 'piece-meal' responses to a variety of pressures. The following account illustrates this. It refers to teachers within schools.

The interviews with teachers suggested that their decision-making related to the use or rejection of an innovation consisted essentially of a process of matching their perceptions of the innovation to those aspects of their perceived 'world' which they considered significant. The matching process may be part conscious, part intuitive; for some it may be a 'Gestalt'-type activity, for others a series of carefully argued steps.

A model of this matching process is shown in Figure 10. It is conceived to have four dimensions DISSATISFACTION, ACCEPTABILITY, RELEVANCE and FEASIBILITY. The first describes an internal state of

Figure 8. Pressures acting on the LEA in decision making.



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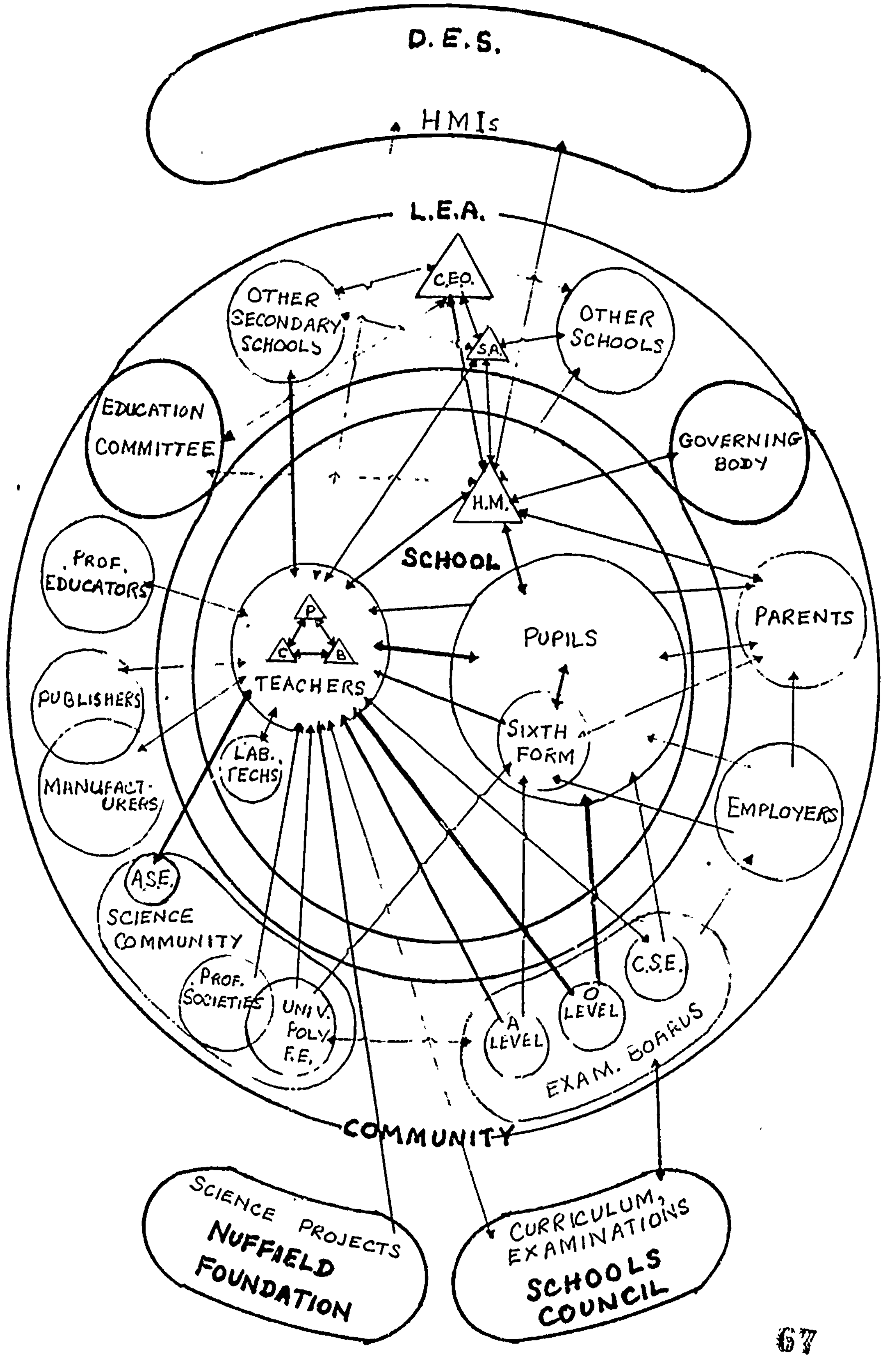
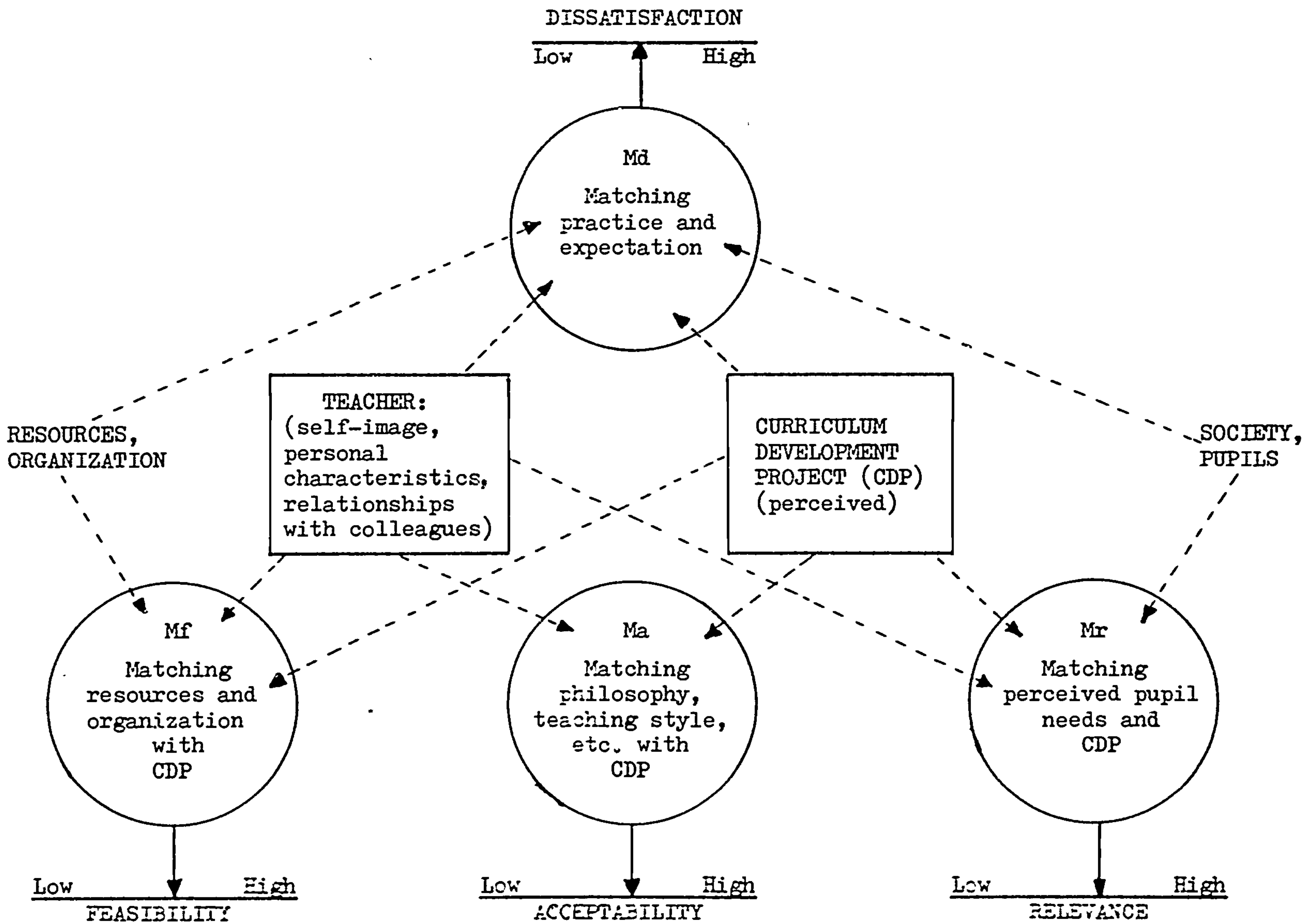


Figure 9. Pressures acting on the school in decision making.

Figure 10. A model of the processes of teacher decision-making with respect to a curriculum development project.



the teacher, while the other three reveal the teacher's perception of the characteristics of the innovation in relation to their philosophy and situation. For each dimension a teacher's level of matching will be located along a continuum from high agreement to complete disagreement. If the matched position is high on each dimension then a teacher is likely to use a project. If there is a low agreement on any dimension this may block or modify their use of a project.

This model of the decision-making process involved in the use or rejection of curriculum innovations was developed from the early case studies and applied to subsequent analyses. The following brief account refers to the decision-making processes in three schools concerned with the use of the Schools Council Integrated Science Project (SCISP). In it no attempt is made to quantify the levels of matching but the influence of various pressures on matching levels and the relation of the level of matching to decisions are illustrated.

At the time of the case studies the materials of SCISP were just becoming available for dissemination. The innovation appeared to be at a disadvantage in each dimension of the matching process. The common expectation in schools was that O-level courses were in specialist sciences not integrated science as was SCISP. This traditional structure had been earlier supported by the Nuffield O-level projects in biology, chemistry and physics and other comparable innovations and thus it was unlikely that there would be extensive dissatisfaction. Neither was it likely that SCISP would be perceived as highly relevant or acceptable for similar reasons. The organization of school science in separate subjects and the previous allocation, in a considerable number of schools, of special funds for Nuffield science courses, made further LEA support unlikely and was likely to reduce feasibility.

In School A the head of science had heard about the SCISP project on two occasions, but it had not assumed significance for him. However, when the LEA approached him, offering financial support if the school took part in the dissemination phase of the project, it did. Here was a two-fold pressure: the increased resources and the status and recognition of a trial school (he had experienced both in the Nuffield chemistry trials in a previous school). This disturbed his state of satisfaction (Md increased) and he and his colleagues went to considerable lengths to find out more about SCISP and declared that they liked what they found (Ma high).

However, at the same time, the situation in the science department was changing as the result of secondary reorganization. It had to accommodate extra pupils of lower, but unknown (to the school) ability into Year 3, which was the year into which the teacher would have to introduce SCISP. The project's materials were not developed for the whole ability range, and their interpretation of the social needs of the new Year 3 pupils made the science staff reluctant to stream them on entry. The project thus had limited relevance (Mr) although it was feasible (Mf) to the extent that he had the offer of financial support and a colleague was willing to organize the course. At first they were prepared to modify the course for their use but found that some of the later parts of the course were not then available (low Mf). So, in the event, the head of science, in consultation with his colleagues, did not take up SCISP. It was clearly necessary for all four matching levels to be high.

School B had recently expanded and restructured its organization. This had resulted in the appointment of a new head of the science faculty and now heads of biology and physical science. A unique opportunity arose to create new practice (Ma). The curriculum committee had mooted a 'foundation course' in science for Year 4 and an integrated course appeared to be relevant (Mr). The 'philosophy' and 'style' of all three senior teachers matched that of SCISP (Ma) and no great distances separated the laboratories (Mf). They had, perhaps, not yet experienced parental pressures for pupils to gain O-level passes in the separate sciences, but the deputy headmaster was aware of them (Mr depressed). The actual use of the course was delayed by illness of an assistant teacher, requiring the head of science to take over his teaching load, the non-availability of Year 4 materials of SCISP and the head of science's desire to assess his pupils' range of abilities. The first two can be related to the availability of resources (Mf) and the last to the need for more data to assess the needs of pupils (Mr).

The head of science in School C was dissatisfied with the way the energies of his department were fragmented over several unconnected courses and he was concerned by the lack of support offered to probationary teachers in this context (high Md). The headmaster had recently cut the time available for separate science courses (low Mf for current courses). The social orientation of SCISP matched with the philosophy of the head of science (Ma) and he saw it to be more relevant to the needs of his pupils (Mr). Financial support had been offered and time for departmental meetings included on the timetable (leading to high Mf for an integrated course). The local HMI and Warden of the Curriculum Development Centre approved of SCISP (Md). The resulting high position on each matching dimension led to the use of SCISP.

Whilst pressures from LEA personnel, head teachers and others no doubt affected teachers' decision-making through their influence on 'matching', personal characteristics of the teacher also played a strong - at times stronger - role. Among these we particularly identified the qualities of 'receptivity to communication', 'openness to change', 'independence and initiative' and 'leadership'.

DISSEMINATION OF RESEARCH FINDINGS

This report attempts to provide some sense of the philosophy behind the Curriculum Diffusion Research Project, an outline of its work and some of the results obtained during the period in which it was supported by the Social Science Research Council. More detailed accounts are in preparation and will appear elsewhere.

The central publication of the project will be a book which, it is anticipated, will be completed in 1975 and published in 1976. It is aimed at a general audience in schools and higher education, administrators and the broad range of people concerned with curriculum development. The aim of the book is to use the findings of this research as the basis for a discussion of the issues involved in curriculum diffusion.

In parallel with this an extended article - commissioned by the journal 'Studies in Science Education' for publication in 1976 - is being prepared. This reviews the project's work in relation to other research in the field with an emphasis on the methodological issues involved. It is aimed at the people with a research interest in the field.

A parallel article outlining the findings of the research will be submitted for publication in the 'School Science Review'. It is intended to be for practising science teachers, college lecturers and science advisers.

Members of the research team are also preparing publications based on the more specific details of their own work. These are aimed mainly at specialist audiences.

Some of the preliminary work of the project is contained in Dr. Nicodemus' Ph.D thesis (see p.1) and Mrs. J. M. Harding is submitting a Ph.D thesis to London University in August 1975 which covers her contribution to the project and is titled 'Communication and Support for Changes in School Science Education'. Mrs. M. Waring's contribution is to be found in more detail in her Ph.D thesis (London University) to be submitted in August 1975 and titled 'Aspects of the Dynamics of Curriculum Reform in Secondary School Science'.

Members of the research group have lectured in Universities and Colleges, contributed to a number of seminars and conferences of research workers, LEA advisers and teachers, and acted as consultants to a number of curriculum development projects. The director and Dr. Nicodemus contributed to the Schools Council Working Party on Curriculum Dissemination. The work of the project has been mentioned in the British Council's Newsletter and other overseas publications and has attracted interest from overseas. The director lectured on the research in New Zealand in 1974 and Dr. Nicodemus conducted seminars at the Institute of Educational Research at the University of Nijmegen, Netherlands, and took part in discussions on diffusion research in other universities and the National Organization for Educational Research also in the Netherlands. The director contributed to a Trend Report on Curriculum Dissemination prepared for the Council of Europe.

The seminar of researchers in curriculum diffusion initiated in Phase 1 was repeated in 1974 at the University of East Anglia. It is anticipated that this, as with other activities of this nature, will continue.

A copy of the computer tape containing the questionnaire survey data together with other materials will be deposited with the Survey Archive of the University of Essex.

SOME LESSONS LEARNT

1. The decentralised nature of the education system of England and Wales, particularly in relation to curriculum matters, presents a formidable array of structures and processes to the researcher concerned with diffusion. It is inevitable that the scope of an individual research project has to be restricted but, at the same time, it is also necessary to gain some appreciation of the context of any specific topic because of the close interrelationships of so many aspects of the system as a whole. The right choice of topic, carefully defined both in itself and in its broader social context is thus particularly important. However, there has been (and there still is) relatively little research on the diffusion of curriculum innovations or in the general field of communication within the education system of this country and, so, there is little, other than general experience, on which to base a choice. For this

reason the decision of the project to have an exploratory phase and to probe a range of issues was, in our opinion, fully justified.

This is a point that bears on the form of research proposals. When the original proposal for this work was submitted there was comment on the absence of well-defined hypotheses and experimental design. In view of these comments an attempt was made to produce better definitions but, in the work itself, it became quite clear that this resulted in restrictions which affected the quality of the research. There is need, in a field such as this, to accept an open approach within which definition can result from research and to avoid the pitfalls of research being pre-determined by definition.

The adoption of an open approach also requires flexibility in the funding of research. We are most grateful that extra funds were given by the Social Science Research Council to support Mrs. Harding for an extra period which enabled us to pursue the case studies to advantage.

There are, of course, limits to an open approach. Finance and logistics are obvious ones but, in addition, we found that it was very necessary to confine the scope of investigations towards the end of Phase 1 to avoid data collection becoming too arbitrary and yielding insufficient useful information. The discipline of ending Phase 1 was as important as having it.

2. The lack of available data on diffusion in LEAs (with only a few exceptions) was a limiting factor on this research and we would strongly recommend the establishment of monitoring services which could provide such basic information as the types of courses and curriculum materials used in schools. This would, of course, be of value to LEAs as well as researchers. If such services were available it would allow diffusion research to be concentrated on local studies to greater advantage.

3. This project was focussed on a one-off survey of diffusion. However, both the National Diffusion Patterns Study and the Case Studies indicated the importance of the time element in diffusion. Different patterns of influences affect early and late diffusion, and changes in social climate, both nationally and locally, affect diffusion over time. Also there is the difficulty of obtaining information about past events. For future work we would recommend investigations in which individuals and organizations are sampled at intervals of time. If possible, diffusion research should proceed at the same time as innovative processes, not retrospectively.

4. The use of collected rather than observed data in diffusion research raises issues about the perspectives of respondents. When a question is asked, what is the mental frame of reference that governs the reply? To what extent is it influenced by expectation, unchallenged assumptions and immediate events? To what extent is the frame of reference of the researcher, and hence the questionning, at variance with that of the respondents? Our experience suggests that such issues need resolving before research

strategies are firmly developed; and points to the importance of exploratory study. We were able to give the matter some consideration, but other investigations specifically concerned with the variation of perceptions of a single innovation by different groups over time and more thorough analysis of the perceived roles of LEA personnel, head teachers and teachers in the diffusion process would be most valuable.

5. Discussions on the methodology of diffusion research has tended to polarise between advocates of survey (questionnaire) studies and those supporting the value of case studies. Our view would be that these are complementary, not alternative modes of research.

The Phase 1 studies indicated some of the deficiencies of both questionnaire surveys and case studies (see pp. 8, 9). A combined approach such as we adopted helps to limit these deficiencies. However we would not wish to underestimate the difficulties of combining the methods in a coherent research strategy and, certainly, this project would have been improved if this aspect had been more thoroughly considered or we had had the benefits of hindsight. There is a need for theoretical and practical studies of research strategies combining a variety of procedures.

6. The validity of data and interpretations obtained from case studies gave us considerable concern. In case studies the researcher is acting both as a data collector and interpreter. The data can be diffuse, incomplete and misleading and thus considerable probing through several respondents is necessary if a valid interpretation is to be obtained. However, when do you know when it is valid? How do you balance out alternative views of the same phenomenon? What is the value of a consensus of views from a group of respondents? Such questions are not unknown to the anthropologist or other social scientists but they have rarely been asked in relation to curriculum diffusion.

Case studies of diffusion in progress should obtain more valid data than retrospective studies. The use of behavioural indicators to validate responses which we experimented with in the Phase 1 studies may have possibilities. However much more experience in the development of case study procedures in diffusion research is needed. This could be obtained through small in-depth research activities in single institutions or with small groups, and the development of appropriate training procedures. An integral aspect of this work would be a consideration of the ethics and personal relations of case study procedures.[1]

7. The findings of this research suggest that generalised explanations of diffusion are rare. The factors that discriminated between high and low users of the innovations and those having high and low familiarity with them were few in number and varied with the sample studied. Heads and teachers, teachers of

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1. The research of B. MacDonald and others at the Centre for Applied Research in Education, University of East Anglia, is very relevant to this matter.

different subjects, teachers and heads from different types of schools or different areas were, for example, associated with different patterns of discriminating factors.

Unique patterns of factors perceived in a variety of forms and linked to unique processes of communicationg and decision-making have contributed to a variety of responses to the advent of curriculum development projects in education. It is possible to describe national patterns of familiarity with and use of innovations but there is little evidence of generalised national patterns of their determinants.

8. Within our sample, LEAs and schools rarely used organized strategies for dissemination. Their institutional responses to the curriculum development projects varied considerably and were characterised by ad hoc activities at the tactical level. The lack of strategic responses appeared to result mainly from ambivalent attitudes about the roles that LEA personnel and head teachers considered they should play in diffusion.

We were able to detect few examples of dissemination strategies that might be more widely applied.[1] However, the data we obtained on the diffusion processes can be used to develop theoretical models of dissemination strategies which might form the basis of future activities.

9. Temporary groups and 'unofficial' leadership e.g. from teachers' organisations, or colleges and university departments of education and individual enthusiastic teachers, played a significant part in the diffusion processes. In some areas their influence was greater than official change agents such as LEA advisers. This suggests that a key element in an effective dissemination strategy would be the detection of potential growth points and initiatives within schools and among personnel so as to support fuller participation in an area. It would require a flexible and responsive form of administration without undue structure. Change agents would be seen as informal and short-term rather than official and permanent. It could involve a reappraisal of the roles of advisers.

10. Although the LEA Communication and Support System Study was limited by the data we were able to obtain, the analysis was most valuable in providing an understanding of the social context of diffusion and we would certainly advocate its use as a basis for future research. It particularly revealed inadequacies in communication and the considerable variation in the form of support given for curriculum diffusion and the factors affecting the diffusion processes. It also pointed to imbalances in support: an example, in some areas, being the concentration of LEA support on curriculum development not related to GCE examinations other than, of course, financial provision for books and equipment in the schools. Other institutions tended to provide in-service training etc. for this sector of the curriculum. Within such LEAs several communication-support systems affecting curriculum diffusion could be located.

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1. These include LEAs not included in our sample.

Some, such as the Association for Science Education, being regional or national in scope. The systems tended to be interrelated to some measure but, nevertheless, usually were significantly exclusive. They would repay further study through the guidance that would be obtained for future policies on dissemination.

11. The term adoption has a variety of meanings in the literature of diffusion research. It is, for example, used both to describe the process by which an innovation is established in a new location and the outcome once it is there. When applied to curriculum diffusion the term adoption has a limited meaning, for rarely (if ever) is a curriculum innovation diffused without being altered in the process and rarely can the end-point of diffusion be described in simple terms (see p.7). We have found it convenient to make the term adoption redundant and to use terms such as 'use' and 'familiarity', 'decision-making' and 'communication' with more specific meanings (see pp. 4-8). Irrespective of any virtues of our practice there is a clear need to establish a more concise and utilitarian terminology for studies of curriculum diffusion.

12. This research has shown that curriculum diffusion in this country is a complex of linked processes; a composite not a unitary entity. It is also variable in its nature. We are currently attempting to formulate a typology of the processes involved but, at this stage, it is worth pointing out that it is based on the contexts of diffusion and the agents involved. It considers diffusion as involving a web of relationships rather than a one-to-one arrangement and conceived as a cyclical rather than a linear phenomenon.