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The Implementation of Curriculum Innovation: An Examination of the Factors Affecting the use of the Science 5/13 Project in Trial Schools after the Trial Period

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CONTENTS

PREFACE

I first became interested in the Science 5/13 project while working in the Advisory service in Lothian Region. It was some time later, in 1975, that I began the research that is reported in this thesis. In the meantime I had completed a B.Phil degree in Education at the University of Hull and my interest in Science 5/13 has broadened from the practical concerns associated with use of the project in schools in my authority to more general issues of curriculum innovation.

I initially registered for a PhD at the University of Hull on a part-time basis in 1975 and began work on a full time basis in 1976 at the University of Lancaster, but in 1980 my registration was transferred to the University of Stirling. The Research and the thesis has taken a long time to complete. In part this has been because it has taken longer than I anticipated to undertake the research and write it up. In part, also, though this has been because I have had two children and a short period in full time employment as a chemistry teacher.

The length of time covered by this research endeavour has created a number of problems. It is obviously difficult to sustain momentum. More critically, it means that the research can get 'out of date'. The review of the literature that provided the basis for the research design was undertaken before the fieldwork and therefore could not take account of more recent work. I have tried to monitor discussion since then but, of course, this does not overcome the basic problem. Nevertheless I believe that many of the general and particular issues looked at in this thesis are still relevant and are the subject of current academic debate.

I have benefited at Hull, Lancaster and Stirling from the guidance and advice of members of the teaching staff in education. At Hull my research was supervised by Dr W J Wilkinson, at Lancaster by Dr J B Reynolds and Dr J C Mathews and at Stirling by Mr J K Davies and Mr D I McIntyre. Their comments were always 'to the point' and constructive. In a number of instances they were able to prevent me from making serious errors, in others they were able to point me to avenues I had not considered exploring.

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CHAPTER 1

Introduction

The central focus of this research is the implementation of curriculum innovation: this is examined by looking in detail at one particular innovation, the Schools Council project, Science 5/13, and attempting to isolate factors affecting its use. The research has been undertaken in a sample of those schools who tried out the project materials in the initial trial stages. These schools were contacted a number of years after the completion of the trials[1] to examine the development of the project in the post trial period.

It was considered important to enquire into how the project progressed, both at the school level and at a more local level, during the trial period itself as developments in this period might affect the use of the Science 5/13 materials in the post trial stage. Information was sought at the school level, from headteachers and teachers, and also from support personnel such as local authority Advisers, teachers centre wardens and College of Education staff.

One of the reasons for concentrating on schools which had previously been involved in the trials of the project was an interest in examining how such schools, which received a considerable amount of help to encourage the use of the project's materials, continued the project after the end of the trials. Although there have been a number of well documented reports[2] following projects through the trial stages, there are few which have revisited trial schools several years later to examine the post-trial impact of a project. For example, a nationwide survey conducted in 1973 by H.M. Inspectorate showed how various Nuffield Foundation and Schools Council science projects were being used.[3] The sample included 1,732 secondary schools in England and Wales with all types of schools within the 11 - 18 age range represented. The survey showed the number of schools either 'using' parts of the material or 'doing' all of the project. However, it did not seek to differentiate between 'trial' and 'non-trial' schools.

It was considered unrealistic to cover the total population of 378 trial schools (spanning nineteen local education authorities in England and Wales and four local education authorities in Scotland[4]) which were used in the official trials of the Science 5/13 project, and so a sample was chosen from selected areas which illustrated a variety of different circumstances. These included geographical position (for example, urban-rural setting); school type (for example, schools based on the traditional primary-secondary system and others in a middle school system); and the structure of the local authority Advisory/Inspectorate service. In all nine areas[5] were used in the sample covering 198 schools.

The methods used in the research for collecting information were of two types: one was by a questionnaire survey of all trial schools in the sample, and the other was by a system of area visits which involved a series of unstructured interviews and a search through relevant documentation held in the areas, mainly at the teachers' centres and colleges of education. The questionnaire survey took place first and was conducted some five years after the trials ended. The questionnaire form was in two parts: Form A dealt in the main with the work of the trial teacher in the trial period itself, and Form B with developments within the trial school after the trials ended. The data from the questionnaire forms was analysed to discover which factors were correlated with the continuation of the Science 5/13 project in the trial schools sampled. Whereas the questionnaire survey was aimed at the trial schools and gained information from trial teachers, headteachers and teachers using the materials in the post-trial period, the area visits looked at the position from the point of view of the support staff in the area. Key persons in the support structure were the local authority Advisers/Inspectors and additionally (particularly in Scotland) college of education staff. They were the main focus of the interviews and the main aim of the area visits was to look at post-trial developments from the point of view of the support personnel.

The research report itself has been divided into a number of chapters. This chapter (chapter 1) introduces the research by looking at such issues as: the main focus of the research; a brief outline of the sample used; the reason for undertaking this particular research topic; an outline of the research methods used; and the structure of the research report.

The nest three chapters (chapters 2, 3 and 4) introduce three reviews of the literature: the first looks at the topic of curriculum innovation and models of change; the second examines the factors affecting the implementation of curriculum innovations; and the third describes developments in science education in Great Britain. All three chapters are deliberately broad so that they can provide a general background, but also include a number of points which are directly relevant to the implementation of a project like Science 5/13.

Chapter 5 looks at the design of the empirical research. The first part of the chapter explains how the literature reviews have been used to generate areas for research. The second part discusses the relevant points from the literature reviews and focuses upon a number of pertinent research questions. In a number of instances, as the result of research evidence discussed in earlier chapters, a relationship between factors is suggested. The final part of Chapter 5 examines the methodology used for collecting the relevant data.

Chapters 6 and 7 examine the data collected: Chapter 6 discusses the results of the questionnaire survey and Chapter 7 the outcome of the area visits.

The final chapter (chapter 8) draws the research together. First it looks at the research questions raised earlier in chapter 5 and examines them in the light of the data collected. The chapter tries to highlight those factors which have played an important role in the implementation of Science 5/13 in the sample of trial schools studied. This concluding chapter goes on to examine how the Science 5/13 project developed in terms of the various models of change, outlined in chapter 2.

The final part of chapter 8 proposes one way in which the relevant factors affecting the implementation of the Science 5/13 project might be linked together in a coherent manner.

Footnotes

1. Although the trial period stretched from 1969 until 1972 the main trials (the first,second and third sets) ended in 1971. The questionnaire survey was undertaken five years after the end of the main trials. Those schools which were involved only in the first set and/or second set of trials would have recieved the questionnaire some six years after the trials ended.

2. See for example: Shipman, M.D., Inside a Curruculum Project, Methuen & Co. Ltd., London, 1974; and Humble, S. and Simons, H., From Council to Classroom : An Evaluation of the Diffusion of the Humanities Curriculum Project, Macmillan Education, Basingstoke, 1978.

3. Booth, N., "The Impact of Science Teaching Projects on Secondary Education", in Trends, 1975, Vol. 1 pp. 25 - 32.

4. The nineteen local education authorities which took part in the trials of the Schools Council Science 5/13 project were, Anglesey, Birmingham, Bradford, Bristol, Cardiff, Carlisle, Croydon, Essex, Gloucestershire, Kent, Leicester, Liverpool, London (I.L.E.A.), Somerset, Southamption, Staffordshire, St. Helens, Teesside and West Riding. The four local education authorities involved in the trials from Scotland were, Dundee, Lanarkshire, Roxburghshire and West Lothian.

Footnotes (continued)

5. Eight of the areas used in the sample were the local education authority areas of Anglesey, Birmingham, Kent, London (I.L.E.A.), Southampton, Staffordshire, St Helens and Teesside. The ninth area was Scotland which included all four local education authorities used in the trials of Science 5/13.

CHAPTER 2

Curriculum Innovation and Models of Change

This chapter attempts to review the literature on curriculum innovation and the various models of change up to the time when the present research was started. The review thus gives an account of the thinking which underlay the design of this work.

Introduction

Any discussion of the factors affecting the implementation of curriculum innovations is difficult because of the plethora of definitions and different terms used. Three examples are given to illustrate this point: the first of these concerns the concept of the curriculum and the various definitions attributed to it; the second illustrates the different emphases placed upon the words 'change and 'innovation'; and the final example distinguishes different interpretations of the term 'curriculum innovation'.

(i) Curriculum

An international report[1] dealing with curriculum development noted the diversity of definitions of the term curriculum. Other writers[2] have made similar comments. This has led commentators to try to classify the various definitions. Some have talked about the distinction between descriptive and prescriptive definitions[3] ; others about the distinction between wide and narrow definitions[4]. The two types of classification are not mutually exclusive; this point is well illustrated by considering the definitions supplied by Kerr and Gagne. The former views the curriculum '...all the learning which is planned and guided by the school,'[5] whereas the latter equates the term with '....a sequence of content units arranged in such a way that the learning of each unit may be accomplished as a single act, provided the capabilities described by specified prior units (in the sequence) have already been mastered by the learners.'[6] If one were to compare the definitions one could term the former descriptive and the latter prescriptive or the former broad and latter narrow. Indeed this is possibly what one might expect with a descriptive definition tending to be broad and a prescriptive definition tending to be narrow.

Attempts have also been made to classify definitions according to whether or not they have a 'dynamic' quality; typically any definition with a dynamic quality conceives of the curriculum as 'an organised set of processes, procedures, programmes, and the like which are applied to learners in order to achieve certain kinds of objectives.'[7] Some of the advocates of this interpretation view the curriculum as a 'teaching strategy'[8]; a strategy to be used as an 'instrument of change'.

Other writers have tried to distinguish between different types and elements of the curriculum. Thus some writers have distinguished between the 'planned' and the 'hidden' components of the curriculum while others have drawn a comparison between the 'official', 'actual', 'formal', and 'informal' types of the curriculum.

For example, Michaelis, Grossman and Scott when considering a definition which views the curriculum as 'all learning experiences of the child under the auspices of the school'[9] argue that it is readily divisible into a 'planned' component ('the broad goals and specific objectives, content, learning activities, use of instructional media, teaching strategies, and evaluation-stated, planned, and carried out by school personnel'[10]) and a 'hidden' component ('learnings in the cognitive, affective, and psychomotor domains that are acquired concurrently with the planned curriculum but come about as a result of conditions or experiences not deliberately planned or set forth in advance'[11]).

Dreeben[12] argues that the 'hidden' curriculum is but one name for the concept 'unwritten curriculum' which he defines for the purpose of his paper as 'the prevailing social arrangements in which schooling takes place and the implication that children infer modes of thinking, social norms, and principles of conduct from their prolonged involvement in the arrangements.'[13] Whitfield[14] also uses the term but in a wider sense acknowledging that the home and the total environment of a person provide experiences through which learning occur; probably each person's environment provides a unique 'hidden' curriculum which can be marked off from the more obvious planned formal education of the school which is formulated toward some essential targets. However Whitfield's own interpretation of the term curriculum clearly emphasises the importance of the planned component; it is defined as 'all the experiences for learning which are planned and organised by the school.'[15]

The distinction has been drawn also between the 'official' curriculum (that which is outlined in an official policy statement) and the 'actual' curriculum (that which actually happens in practice).[16] Other classroom research has tended to highlight the second of these two types. Projects such as the Ford Teaching Project[17] attempt to assist teachers to assess the realities of the classroom situation; such work aims to help the practitioner not only to diagnose problem areas but also to hypothesise and test possible solutions.

The 'official' curriculum has been further subdivided into the 'formal' (all that is 'timetabled') and the 'informal' (often called 'extra-curricular'). While Kerr's definition of the curriculum emphasises its planned nature it also contains the caveat which takes account of some of the more'informal' aspects. Kerr's definition is presented below; this represents a fuller account of the definition discussed earlier[18].

> *[The curriculum is] all the learning which is planned and guided by the school, whether it is carried on in groups or individually, inside or outside the school.*[19]

(ii) Innovation and Change

Different writers emphasise different aspect of innovation and change when they draw the distinction between the two terms. For example Miles contrasts the planned nature of innovation with the possibly haphazard nature of change; his descriptions of the two terms are presented below.

> *[Change] generally implies that between time 1 and time 2 some noticeable alteration has taken place in something.*[20]

> *Innovation is a species of the genus 'change'. Generally speaking, it seems useful to define an innovation as a deliberate, novel, specific change, which is thought to be more efficious in accomplishing the goals of a system.*[21]

The description of innovation given by Miles is similar to that used in a Council of Europe report where it is defined as 'the deliberate attempt to improve practice in relation to schools.'[22]

Walton[23] in his comparison of the two terms highlights the more dynamic and challenging nature of innovation, so much so that to him innovation implies a movement across existing frontiers into new areas of development. Owen in his definition of innovation supports Walton's emphasis upon 'newness'. He states :

> *By definition, innovation is to do with something which is new rather than with the rearrangement of old constituent parts in a different pattern.*[24]

Owen concludes that because innovation (unlike change) is associated with such 'newness' 'change in education usually calls for response while innovation calls for initiative.'[25] Walton also highlights the more complex nature of innovation stressing the very many changes involved. In such a situation Walton argues that it is hardly surprising teachers resist innovations.

Many writers argue that either the existence or the lack of certain critical factors prevent a full realisation of innovation as it has been defined by Miles, Walton, Owen and others; for example Miles points out that the 'state of health of an educational organisation'[26] is particularly important in assessing how successful an innovation will be. This and other factors are discussed in more detail later. It is sufficient here to conclude that failure to take full account of such variables tends to lead innovation to be somewhat haphazard; a feature earlier attributed to change.

Gross, Giacquinta and Bernstein[27] in their discussion of the failure of innovations to have the intended effect in educational and other kinds of organisations point to the many references given in the literature on organisational change that emphasise the limited nature of our knowledge in this area[28]; one writer reported argues that the chief reason for the lack of success in planning educational improvement is 'the rampant conceptual poverty about the change process in general.'[29] Miles[30] also concludes that this is the crux of the problem, demanding that we adopt a much more systematic enquiry into the various features and consequences of the change process.

While some authors have attempted to distinguish between innovation and change, it appears that others view the terms as synonymous. This is particularly true where discussion has centred upon the 'dimensions' of change and innovation; such dimensions include rate (rapid/slow), scale (large/small), degree (fundamental/superficial), and continuity (revolutionary/cyclical).[31] Different writers[32] have used the same dimensions in describing aspects of both innovation and change.

(iii) Curriculum Innovation and Curriculum Innovations

'Curriculum innovation' as a term has been used in one of two ways. First,'a curriculum innovation' is used to refer to a set of materials (which could include ideas for teachers as well as written pupil materials), produced by agencies such as the Schools Council and the Nuffied Foundation with the aim of furthering change in the school curriculum; second it is used to refer to 'the process of curriculum innovation' suggesting a series of stages by which the 'materials' of a particular curriculum innovation come to be used by teachers in the schools.

Miles,[33] although writing more generally about educational change, drew a similar distinction between the 'content' of the desired change and the change 'process' itself. Commenting in the 1960's he observed that the dominant focus was toward the former with its emphasis upon particular innovation materials. He argued that the trend should be reversed so that critical questions such as the following might be answered.

1. *Why does a particular innovation spread rapidly or slowly?*

2. *What are the causes of resistance to change in educational systems?*

3. *Why do particular strategies of change chosen by innovators succeed or fail?* [34]

A number of innovations, especially some of the large scale enterprises arranged centrally by the federal government in U.S.A. and the Schools Council/Nuffield Foundation in Great Britain, have failed to achieve the success originally hoped for. This has led to an increased concern with the innovation 'process' and questions like those outlined above. Writers in this area have often included other fields of study in their work in addition to education; possibly the most comprehensive of such reports are those by Havelock[35] and

Rogers and Shoemaker.[36]

An examination of the literature reveals that the most common way of analysing the innovation process is to consider it as being made up of a number of phases or stages. Havelock argues that a study of adoption and diffusion curves[37] has contributed to the identification of a regular sequence of events in the process of adoption and diffusion. Ryan and Gross[38] distinguished between (1) awareness (2) conviction (3) acceptance and (4) complete adoption, of hybrid seed corn. Wilkening[39] is usually credited with the first use of the concept of stages in the process of adoption; he viewed the process as being composed of (1) learning (2) deciding and (3) acting over a period of time. Rogers and Shoemaker[40] talk of the traditional innovation-decision process which they trace back to the adoption process postulated by a committee of rural sociologists in 1955[41]. This committee isolated the following five stages : (1) awareness (2) interest (3) evaluation (4) trial and (5) adoption. Lewin[42], in his study of phases of implementing change in social behaviour and attitudes, distinguishes the three stages of : (1) unfreezing (2) moving and (3) freezing. In the field of education Mort's early studies[43] indicated that innovation in the American school system comes about through a surprisingly slow process and follows a predictable pattern, which is described as follows :

> *Between insight into a need (for example, identification of school children's health problems) and the introduction of a way of meeting the need that is destined for general acceptance (for example, health inspection by a school doctor) there is typically a lapse of half a century. Another half century is required for the diffusion of the adoption. During that half century of diffusion*

> *the practice is not recognised until it has appeared in 3 per cent of the systems of the country. By that time, fifteen years of diffusion - or independent innovation - have elapsed. Thereafter, there is a rapid twenty years of diffusion, accompanied by much fan-fare, and then a long period of slow diffusion through the last small percentage of school systems.*[44]

Havelock isolates the four stages of (1) insight into a need (2) the introduction of a way of meeting the need (3) diffusion and (4) adoption, from the above account. Miles commenting on Mort's time-span for the various stages suggests that data[45] on diffusion rates for the 1960's indicates an increase in these rates. Comparing Mort's four stages (as delineated by Havelock) with the five earlier outlined by the committee of rural sociologists, Havelock suggests that Mort's final stage of 'adoption' can be thought of as encompassing the entire five stage process described by Rogers.

As with Mort's breakdown, many descriptions of the change process include stages preceding diffusion and adoption, with the additional stages describing the preparation of an innovation for use. Miles, in his presentation of a typology of change strategies[46], formulates a series of four stages which occur prior to the actual adoption of an innovation by a target system, the first of which highlights the design stage of the innovation itself. The four stages include; (1) design (the innovation is invented, discovered, produced by research and development operations etc.), (2) awareness-interest (the potential consumers of the innovation i.e. members of the target system, come to be aware of the existance of the designed innovation, become interested in it, and seek information about its characteristics), (3) evaluation (the consumers perform a kind of mental trial of the innovation, and form an opinion about its efficacy in accomplishing system goals, its feasibility and its cost), (4) trial (where the target system engages in a (usually) small scale trial of the innovation to assess its consequences). If the trials are favourable adoption occurs. Miles comments that Roger's formulation excludes 'design' simply because most of the studies he reports on begin with the existence of an adequately designed innovation such as hybrid corn. However the other three categories are heavily dependent on the stages outlined by Rogers.

Thus the literature shows how different writers have highlighted different stages in the innovation process depending upon their particular interest and emphasis within the total process. For example Rogers is essentially concerned with diffusion whereas Miles takes a much broader look including the design stage of an innovation. Other writers have placed a particular emphasis upon the user-system so that the intial stage for such writers becomes the perception of a particular problem by the user. Overviewing the situation Havelock has identified three broad perspectives or 'schools of thought', each associated with particular characteristics in terms of the stages of the change process; these 'models of change' will be discussed in more detail in a later section.

This discussion so far has concentrated upon the problem of defining some of the key terms within the field of curriculum innovation. The three examples taken clearly show that in most cases the different definitions and terms used involve more than mere semantics; they rather involve a particular approach and philosophy. This point is made forcibly by Tanner and Tanner[47] in their review of the various definitions of the term 'curriculum' ; these authors find that the definitions given by contemporary curriculum scholars both here and in America reflect '....differences in the vantage points from which curriculum is studied, conflicting educational philosophies, changing societal influences and demands on education, and the enormous difficulty in seeking to define such a complex concept, which, like knowledge itself, is limited only by the boundaries and tools of thought.'[48] The same authors conclude that the different definitions present limitations so that each one only partially explains the full meaning of the concept, thus it can be argued that any one definition would be inadequate. In supporting this argument we find that for the purpose of future discussion it becomes unnecessary to come down in favour of one or other of the various definitions, and in holding this particular view-point it allows us to take a more eclectic view of the general field of study. Tanner and Tanner stress that profitable discussion can continue without prior general agreement on a particular definition and point in support of their argument to the field of science where they argue that the lack of a fixed definition of science has not impeded useful work from being conducted.

However because the focus of this study is upon the 'implementation' of curriculum innovations it is important for future discussion to look more closely and suggest a working definition of the term 'implementation' within the context of curriculum innovation.

'Implementation' of Curriculum Innovations

Many writers have distinguished between adoption and implementation. However both terms have been used in different ways by different writers and at times overlap. For example some writers who have used the term adoption have seen it as one of a sequence of stages while others have seen it as a process encompassing a number of different phases[49]. Thus Guba and Clark[50] argue that the 'adoption process' is made up of three stages; (1) trial (2) installation and (3) institutionalization. If the trial (or the testing of the innovation within the context of a particular situation) proves successful then installation follows. Installation aims 'to fit the characteristics of the innovation to the characteristics of the adopting unit i.e. to operationalise'[51]. The final stage of institutionalization is 'to assimilate the invention as an internal and accepted component of the system i.e. to establish'[52].

Rogers combines the use of the term adoption as a process with its use as one of a sequence of stages[53]. He delineates a five stage adoption process of which adoption itself is the final stage. As the fifth stage it is defined as the time when 'the individual decides to continue to full use of the innovation.....Adoption implies continued use of the innovation in the future.'[54] It would appear that Rogers' definition of adoption includes the element of institutionalization mentioned by Guba and Clark earlier. However, in a later piece of work (with Shoemaker)[56] the adoption process is reconstructed as a paradigm which aims to represent more realistically how adoption and rejection of innovation occur. In this paradigm adoption is no longer the last stage; it is followed by other decision making processes where receivers may well decide to discontinue with an adopted innovation. Thus Rogers' and Shoemaker's modification and extension of previous work suggests that the adoption stage cannot be considered with the same finality, in terms of the whole adoption process as it used to be; other decisions continue to be taken after an innovation is adopted which may well lead to its discontinuance.

Adoption (as a stage defined by Rogers and Shoemaker) can therefore take a different meaning to terms like institutionalization which suggests a more long term and serious committment to a particular innovation. Hoyle claims also that there is a distinction between adoption and institutionalization but accepts that in practice it is often difficult to use the terms.

> *adoption is a synonym for acceptance and simply implies that an innovation....has 'entered' the school and is being practiced....institutionisation implies not only that the innovation has been accepted, but that it has become an integral part of the school's functioning and has persisted over a period of time*.[56]

He adds that the "possible disjunction between acceptance/adoption and institutionalisation is a major problem facing the would-be innovator."[57]

Hoyle further complicates discussion when he appears to equate implementation with the trial stage of the Guba and Clark schema. Other writers do not use the term implementation in the same way. Thus, Fullan and Pomfret[58] define implementation as the 'actual use' of the innovation and Reynolds sees it as "how intended curriculum changes are translated into actual changes in the learning experience teachers provide in the average school"[59].

Gross, Giacquinta and Bernstein, take an organisational perspective of innovation in their discussion of implementation and provide further insight into the term. Like other writers they view it as a 'stage' in the process of planned organisational change where the three sequential stages involved are (1) initiation (2) attempted implementation and (3) incorporation. Initiation 'covers the period of time in which a particular innovation is selected and introduced into and organization'[60]. The second stage, 'attempted implementation' 'begins after an announcement that an innovation will be adopted and focuses on efforts to make the changes in the behaviour of organizational members specified by the innovation'[61]. If the second stage is successful, the final stage of 'incorporation' can take place; this is 'the period when a change that is implemented becomes an enduring part of the operation of the organization'.[62] Two points can be seen as important here. First, Gross et al's distinction between implementation and incorporation mirrors Hoyle's comments earlier about adoption and institutionalization; two different sets of terms apparently meaning much the same. Second, Gross et al are more vigorous about the boundary limits of implementation; they quite clearly see this particular stage as the period when organisational members attempt to come to grips with an innovation, with success leading ultimately to incorporation. The definition provided by Gross et al offers possibly the most comprehensive working definition; not only does it elaborate the term itself but it also places it within the context of other stages of the innovation process.

The value of the Gross et al definition becomes even more apparent when it is realised that it lends itself to practical measurement in terms of 'the degree of implementation'; the latter refers 'to the extent to which, at a given point in time, the organizational behaviour of members conforms to an organizational innovation...(or).. the extent to which organizational members have changed their behaviour so that it is congruent with the behaviour patterns required by the innovation'.[63]

It is possible to take the idea of 'the degree of implementation' proposed by these authors and represent it as a continuum, where any particular point (using Gross et al's terminology) will be a measure of the extent to which members have changed their behaviour to become congruent to that required by the innovation. Clearly the aims of the innovation and the expected outcomes need to be specified before the degree of implementation can be ascertained.

The use of such a continuum to measure the degree of implementation allows the researcher to distinguish between the different effects of innovations; some could be superficial while others may make a more fundamental impact on the school's curriculum However, it is important to guard against the danger of using the Gross et al continuum to attach the labels of 'success' or 'failure'; such terms are inappropriate shorthand and do little to promote greater knowledge of innovation.

Models of Change

Any discussion of the topic of innovation ought to include a review of the various models of the change process. Havelock's work represents a significant contribution to this field. There was a brief mention of his work earlier[64]; this section deals with it in much more depth and relates it to the contributions made by other writers in this area.

Havelock identified three broad perspectives, or 'schools of thought', each of which had particular characteristics when viewed in terms of the stages involved in the process of change. The three schools of thought are: (1) research, development and diffusion (R,D & D), (2) social interaction (S-I), and (3) problem-solving (P-S). Table 2.1 highlights the major stages of each school.

(i) The R,D and D perspective

Havelock argues that this school of thought is based on five assumptions:

> *(a) a rational sequence in the evolution and application of an innovation, which includes research, development and packaging before mass dissemination takes place;*
>
> *(b) a planned process usually on a massive scale over a long time span;*
>
> *(c) division and co-ordination of labour;*
>
> *(d) a more or less passive but rational consumer who will accept and adopt the innovation if it is offered in the right place, at the right time and in the right form; and*
>
> *(e) the acceptance of high initial development costs which will be outweighed because of the long term benefits in efficiency and quality of the innovation together with its suitability for mass audience dissemination.* [65]

TABLE 2.1 Stages Typically Included in Models of Change Within Three Schools of Research

School of Research	Stages In Research	Stages In Development	Stages In Diffusion and Adoption
Social Interaction (S-I)	Research Assumed →	Development Assumed →	Some Diffusion Activity Assumed Awareness Interest Evaluation Trial Adoption
Research Development & Diffusion (R,D&D)	RESEARCH Basic Scientific Inquiry; Investigate Problems; Gather Data →	DEVELOPMENT Invent & Design Engineer & Package Test & Evaluate →	DIFFUSION Promote, Inform, Demonstrate, Train, Help Service, Nurture ADOPTION Awareness Interest Evaluation Trial Installation Adoption Institutionalization
Problem-Solver (P-S)	Basic Research Assumed ⇄	Search for Solutions Establish Goals and Priorities Weigh & Evaluate Possible Solutions Select Best Alternative Plans for Implementation →	Need → Diagnosis Establish Relationship with Outside Expert (→ Search for Solutions) Installation Evaluation Revision Institutionalization Change Relationship Terminated Possible Diffusion to Others

Source: Havelock, R.G., Planning For Innovation Center For Utilization of Scientific Knowledge Of The Institute For Social Research, The University of Michigan, Ann Arbor, Michigan, 1969, p.10.28

Research, development and diffusion looks at the process of change from the point of view of the originator of an innovation beginning with the formulation of a problem on the basis of a presumed receiver need, and followed by the developer designing and developing a potential solution. Dissemination of the solution to the receiver and promotion of adoptive behaviour in the receiver group complete the process. Stenhouse commenting on this model, argues that it represents the pattern adopted, with variations, in the first wave of curriculum development through the use of the objectives model and the emphasis on the production of classroom materials and teacher handbooks. He goes on to argue that it diverges from a research model because of the R,D & D's assumption that 'it is products embodying solutions, rather than the hypotheses or ideas behind these products, which are being tested.'[66] The main concern of innovations in this model is to get the product right and then market it.

It is generally accepted that R, D & D was the basis for projects first used both here and in America during the 1960's in an attempt to bring more effective planning for change in education. It is also generally agreed that work in these early days tended to concentrate on the initial research and development stages to the detriment of diffusion and implementation. Becher makes the following comment about the situation :

> *The early 1960s, then, taught the new agencies concerned with planned change a good deal more about the ways to develop innovations than about the ways in which, once developed, they might most effectively be implemented. The problem of implementation was in fact hardly then recognized to be a problem - it was simply assumed that successful adoption would follow logically and inevitably from successful initial development and trial, and subsequent revision and mass production.* [67]

Disillusionment with the R,D & D model in education stimulated action in two directions: first, there were attempts to rectify the problems by concentrating more closely on the diffusion/adoption process and second there were moves to consider other models which might be amalgamated with or supercede the existing R,D & D paradigm.

Before considering other models it is perhaps worth examining those aspects of Schon's work which relate to the R,D & D model as these form a base for later discussion on the alternative models. Frequently in the literature one finds the association of the R,D & D paradigm with Schon's centre-periphery (C-P) model. Schon's general concern is with social change and within this he focusses upon the diffusion of innovation in a number of spheres. The C-P model rests on three basic criteria:

> *1 - the innovation to be diffused exists, fully realized in its essentials, prior to its diffusion;*
>
> *2 - diffusion is the movement of an innovation from a centre out to its ultimate users; and*
>
> *3 - directed diffusion is a centrally managed process of dissemination, training, and provision of resources and incentives.* [68]

Pictorally diffusion of an innovation radiates outwards from a centre as if along the spokes of a wheel moving toward the wheel's periphery.

Schon, in examining how the model has worked in practice, offers some insight into the reasons for recent failures in educational innovation which have adopted a R,D & D approach. He argues that the effectiveness of the C-P system depends on the following factors : (1) the level of energy and resources at the centre; (2) the number of points at the periphery; (3) the length of the radii or spokes through which diffusion takes place; and (4) the energy required to gain a new adoption. If the system exceeds the resources or energy at the centre, overloads the capacity of the radii, or mishandles feedback from the periphery, it fails. Failure can take different forms: (1) simple ineffectiveness in diffusion; (2) distortion of the message; and (3) disintegration of the system as a whole.

In Stenhouse's review[69] of Schon's models he refers to them as models for the 'dissemination' of innovation not diffusion of innovation. Although the interchange of such words may appear trivial it is but one more example of the myriad of closely knit terms used by writers in the field of curriculum innovation. Recently there has been an increased emphasis on the distinction between diffusion and dissemination. Ruddock and Kelly see Hoyle's definition of diffusion ('Diffusion is the process whereby this new idea (i.e. an innovation) spreads through the social system' [70]) as too haphazard when one is considering more purposeful programmes. They suggest that the task and study of dissemination is as follows:

> *The task of dissemination is to ensure that investments in innovation actually influence the system and are not simply building private wisdoms among those involved in planning and development. The study of dissemination would then be concerned with the attempt to understand the difficulties of making new ideas and approaches accessible within the system.* [71]

To summarise, the R,D & D school of thought presents one view of the change process involving an orderly sequence of stages. We have noted how early curriculum projects of the 1960's centrally managed by such agencies as the School's Council in this country, tended to concentrate on the initial stages to the detriment of the diffusion phase; the latter is now receiving much more attention because of its apparent complexity. An examination of Schon's C-P model, although almost exclusively derived from agricultural studies (it is sometimes called the agricultural model) offers some insight into this difficult area of diffusion presenting possible reasons for failure in the C-P model. In Havelock's overview of writers working within the R,D & D framework, he tabulates the sequence of activities which some authors describe in the R,D & D process. These he summarises in a general fashion as research, development, diffusion and adoption, though, as he shows (see Table 2.2) few authors specifically include all the activities. Havelock notes that none of the models has become known as the R,D & D model.

(ii) The Social-Interaction Perspective

Earlier, the search for alternative models which might prove more effective in the general process of curriculum innovation was noted; Havelock's 'social-interaction' perspective is one of these alternatives. Table 2.1 shows the social - interaction (S-I) approach in relation to R,D & D in 'phase' terms. The innovation to be adopted is already in a developed form, suitable for use and readily available to the potential adopter. Thus, comapred with the R,D & D school of thought, the research and development stages, together with some diffusion activity are assumed to have occurred already. Therefore the initial stage in the S-I process is toward the end of the diffusion part of the process and essentially within the adoption phase. The five main stages within the diffusion/adoption phase are : (1) awareness, (2) interest, (3)

TABLE 2.2 Research, Development and Diffusion Change Models

<table>
<tr><td>Guba & Clark</td><td colspan="2">Research</td><td colspan="4">Development</td><td>Diffusion</td><td colspan="2">Adoption</td></tr>
<tr><td>Hopkins & Clark</td><td colspan="2">Research</td><td colspan="4">Development</td><td colspan="3">Diffusion</td></tr>
<tr><td>Havelock & Benne</td><td>Basic Research</td><td>Applied Research</td><td colspan="2">Devel-op-ment</td><td colspan="2">Engin-eering</td><td colspan="3">Distribution & Installation</td></tr>
<tr><td>Brickell</td><td colspan="2"></td><td colspan="3">Design</td><td>Evalu-ation</td><td colspan="3">Dissemination</td></tr>
<tr><td>Heathers</td><td colspan="2"></td><td>Task Anal-ysis</td><td colspan="2">Devel-opment</td><td>Test-ing</td><td colspan="3">Dissemination</td></tr>
<tr><td>Miles</td><td colspan="6">Design</td><td colspan="3">Adoption</td></tr>
<tr><td>Cailsler</td><td colspan="6">Innovation</td><td colspan="2">Dissemination</td><td>Integra-tion</td></tr>
<tr><td>Myerson & Katz</td><td colspan="6">Discovery</td><td colspan="3">Dissemination</td></tr>
</table>

Source: Havelock, R.G., Planning For Innovation, Center for Utilization of Scientific Knowledge Of The Institute for Social Research, The University of Michigan, Ann Arbor, Michigan. 1969 p. 10.50

evaluation, (4) trial, and (5) adoption.[72] Rejection by the adopter can truncate this sequence at any stage.

Advocates of the S-I school of thought place particular emphasis on the patterns by which innovations diffuse through a social system. Stenhouse, in an analysis of the model reflects that it focusses on the diffusion of ideas with the flow of messages from person to person replacing the emphasis in the R,D & D model on the marketing of products. Following a review of research associated with the school, Havelock highlights five important assumptions :

> 1. *that the user/adopter belongs to a network of social relations which largely influences his behaviour;*
>
> 2. *that his place in the network (centrality, periphery, isolation) is a good predictor of his rate of acceptance of new ideas;*
>
> 3. *that informal personal contact is a vital part of the influence and adoption process;*
>
> 4. *that group membership and reference group identification are major predictors of individual adoption; and*
>
> 5. *that the rate of diffusion through a social system follows a predictable S-curve pattern.* [73]

It must be admitted that the bulk of the evidence comes from studies in rural sociology. However there are advocates in education including Mort[74], Ross[75], and Carlson[76]. Havelock argues that the model has gained more status recently with both policy makers and practitioners.

Havelock regards Rogers' five-stage process[77] (named by Rogers as the 'adoption process' or the traditional 'innovation-decision process') as the model most widely used within the social-interaction school. Rogers defines the total 'adoption process' as 'the mental process through which an individual passes from the first knowledge of an innovation to a decision to adopt or reject and to confirmation of this decision.'[78] Criticisms of this particular conceptualization of the adoption process led Rogers and Shoemaker to propose a new set of four functions or stages:

1. *Knowledge. The individual is exposed to the innovation's existance and gains some understanding of how it functions.*

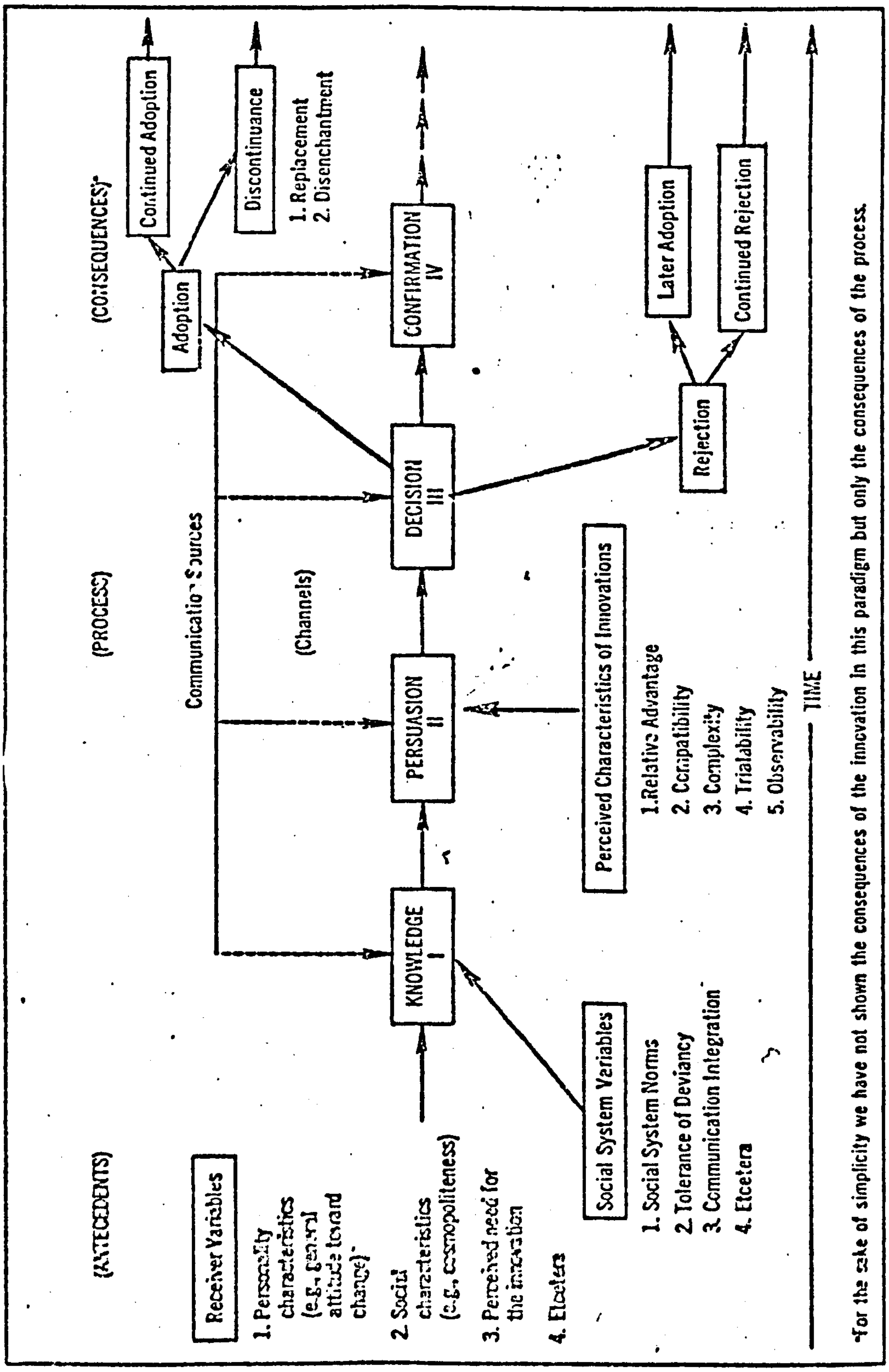
2. *Persuasion. The individual forms a favourable or unfavourable attitude toward the innovation.*

3. *Decision. The individual engages in activities which lead to a choice to adopt or reject the innovation.*

4. *Confirmation. The individual seeks reinforcement for the innovation-decision he has made, but he may reverse his previous decision if exposed to conflicting messages about the innovation.*[79]

As can be seen these new stages incorporate the idea of first rejection and second the process of seeking further information; two important modifications in the light of research findings. Rogers and Shoemaker construct a paradigm of the innovation-decision process[80] (see Figure 2.1) based on these four stages. The model contains three major divisions: (1) antecedents (2) process, and (3) consequences; a feature prominant in Bolam's model of the innovation process.[81] In summation Rogers and Shoemaker suggest that their latest model is most applicable to the case of optional decision and would need to be modified if it were to be used for collective and authority decisions. Also it is acknowledged that various stages in the model may occur in a different order or in a different way for some individuals and some innovations. Rogers and Shoemaker's extension

FIGURE 2.1 Paradigm Of The Innovation-Decision Process



Source: Rogers, E.M., Shoemaker, F.F., Communication Of Innovations, The Free Press, New York, 1971, p.102

of the basic 'adoption process' shows how the S-I model, like the R,D & D model needed changing in the light of practical experience. It also re-emphasises the complex nature of the adoption stage.

As with the R,D & D school of thought, Havelock tabulates the phases described by a number of the authors who have studied adoption from the S-I perspective (see Table 2.3). Most of the studies come from rural sociology and are concerned with the adoption of agricultural innovations. The two exceptions are those of Holmberg, who is concerned with the individual adoption of cultural change, and Coleman who studied the adoption of a new drug by physicians. Although all authors are concerned with individuals as the adopting unit, Havelock argues that the model is applicable to groups and total social systems.

Just as similarities have been drawn between the R,D & D perspective and Schon's work so also with the S-I school of thought. Stenhouse suggests that both the R,D & D and the S-I perspectives fall within the 'centre-periphery' model. Usually writers associate social-interaction more specifically with Schon's second model, the 'proliferation of centres' model (often referred to by writers as the 'periphery' model). In fact this is an elaboration of the 'centre-periphery' model. While keeping the basic C-P structure the 'proliferation of centres' model differentiates between primary and secondary centres. The primary centre supports and manages the secondary centres located at the periphery but allows the secondary centres to engage in the diffusion of innovations. The primary centre still remains the 'guardian of pre-established doctrine and methodology' with the possibility of conflict if secondary centres innovate upon the work produced at the centre. Its advantage over the C-P model is that it can multiply many-fold the reach and efficiency of the diffusion system, although the system's scope still depends on the energy and resources at the centre and the infrastructure technology. Within the S-I philosophy, points at the periphery would represent 'jumping-off points' for the spread of an innovation to other parts of the periphery.

Schon highlights four main sources of failure for the 'proliferation of centres' model. First, he points to the limits of the infrastructure, where the 'network of communications of money, men, information and materials' can become inadequate for the demands made upon it; this leads to retrenchment or complete failure of the system. Although the 'proliferation of centres' model offers far greater scope than the C-P model this depends on a more advanced infrastrcture technology which has to incorporate the need for rapid central response and the need to meet varying regional conditions. Second, Schon highlights the constraints acting on the resources at the centre; these include the differing roles which the centre (and the secondary centres) must take on as the system changes from creating networks to maintaining them. Third, he stresses the importance of the motivation of the agent of diffusion. The local or regional entrepreneur may encounter considerable difficulties when placed in an environment whose features cause clashes with central policy; such a situation will be heightened by remoteness from the centre. Schon's fourth point concerns the regional diversity and the rigidity of central doctrines;

TABLE 2.3 Social Interaction Change Models

AUTHOR	FIELD	YEAR	PHASES						
Rogers Lionberger	Agric. Agric.	1962 1960		1. Awareness	2. Interest	3. Evaluation	4. Trial	5. Adoption	
Beal, Rogers & Bohlen	Agric.	1957		1. Awareness	2. Information	3. Application (Mental trial, Decision to try)	4. Trial	5. Adoption	
Wilkening	Agric.	1953		1. Awareness	2. Obtaining Information	3. Conviction and Trial		4. Adoption	
Wilkening	Agric	1962		1. Awareness	2. Interest or Information	3. Decision Making of Application	4. Trial	5. Acceptance or Adoption	
Holmberg	Anthro.	1960	1. Availability of Information	2. Awareness	3. Interest	4. Trial	5. Evaluation	6. Adoption	7. Integration into Routine
Coleman et al	Med. Soc.	1966		1. Awareness	2. Interest	3. Evaluation (Mental Trial)	4. Trial	5. Acceptance	

Source: Havelock, R.G., Planning For Innovation, Center For Utilization Of Scientific Knowledge Of The Institute For Social Research, The University Of Michigan, Ann Arbor, Michigan, 1969, p. 10.31.

this raises the whole issue of how amenable the central message is to adaptation in the various regional settings. Concluding Schon argues that the failure of this model leads to the secondary centres becoming out of control and eventually disconnecting themselves from the centre so that the diffusion system fragments and becomes unable to maintain itself. There is no longer the diffusion of an established message, instead there is a variety of regional 'transformations'. However Schon suggests that even in 'failure' the model still behaves as a learning system, not between secondary and primary centres but between the secondary centres themselves.

Stenhouse, writing in the mid 1970's, describes the 'proliferation of centres' model probably as the closest to the situation existing in curriculum innovation in England and Wales. He argues that the Schools Council in encouraging the establishment of teachers' centres could be seen as setting up 'a nation-wide chain of secondary centres'. Stenhouse goes on to point out that compared to the Coca Cola Company (one of the examples used by Schon in illustrating this model) centrally organised curriculum projects, as primary centres, are only temporary systems with a limited life-span. Also the teachers' centres are associated more closely within the administrative framework of the local authorities than with the primary centre of the project. As a result there is a greater concentration of power in the secondary centres. Also, examining the position from the secondary centres' point of view, it is the primary centres (i.e. the centrally organised project) which proliferate and die. Consequently Stenhouse proposes that in such a situaion the secondary centre "must have a tradition which is not determined by individual and transient projects, but which is capable of responding to many primary initiatives. Such a tradition must either be on the model of a consumer association helping clients with a choice between projects as products, or it must be on the model of a research centre helping clients to work out lines of development which will become autonomous and organic."[82] While Stenhouse favours the latter, he suggests that the Schools Council appear to be adopting the former policy.

A CERI report[83] notes that in those countries where the R,D & D model has been found unsatisfactory in terms of implementation, attempts have been made to give more emphasis to the social-interaction approach. The first examples of this trend have often been in the primary schools (e.g. AAAS elementary science programme in the U.S.A.) although some secondary school projects (e.g. Project Technology in Gt. Britain) also have adopted this pattern where the central team concentrates on building up a network of co-operating teachers together with collating and disseminating the ideas they put forward. As with the R,D & D model certain limitations of the S-I paradigm have appeared in practice. Not all teachers appear sufficiently enthusiastic and creative to develop their own programmes from a set of stimulating ideas. Also the extensive communication networks built up by the central team can fragment once the team disbands, resulting 'in more localised networks which perpetuate the original innovation only in a mutated form, if at all.'[84] Even with the active involvement of enthusiastic teachers there can be duplication of effort and the production of some rather poor quality materials.

To summarise the 'social-interaction' school of thought presents another way of looking at the innovation process. It does not include all the phases of the R,D & D model but because it analyses the later stages of diffusion and adoption in much greater depth it does complement the lack of emphasis given by the R,D & D school. However just as certain limitations and failures became associated with the R,D & D perspective and the consequent turn to other models such as social interaction, so also with the S-I perspective. As one way out of these difficulties people have looked toward a third perspective based on the problem-solving model.

(iii) The Problem-Solving Perspective

Much of the criticism of the centre-periphery type models of which the R,D & D and S-I schools can be seen as examples, has been on the grounds that they imply too high a degree of centralization of ideas, and fail to take local variations and needs into account. The third of Havelock's perspectives, the'problem-solving'(P-S) model goes some way to meeting such criticism. It concentrates primarily on the problems of the client which may be defined by the client himself or diagnosed by a 'change agent'[85] who has directly studied the client's situation. An examination of Table 2.1 shows the stages within the problem-solving school as reviewed by Havelock. Basic research is assumed but in the two active stages remaining the complete reversal in philosophy of the P-S model toward receiver needs marks a sharp contrast with the R,D & D and S-I models where the receiver's role is much more passive. The receiver in the P-S model becomes actively involved in finding an innovation to fit his own particular problems. Havelock comments 'whether or not this same input could also satisfy the needs of other receivers (i.e. mass diffusion) is not generally considered.'[86] The change sequence as listed by Havelock is triggered off when the receiver (who can be an individual or a group) becomes aware of some need and therefore wishes to improve his present position. This is followed by a process involving diagnosis, searching for solutions, selecting the best alternative, planning implementation and terminating in the evaluation and revision of the innovation before institutionalization. A particular feature of the P-S model is the use of persons from outside the receiver system, for example 'change agents' who collaborate with the receiver (often called the client-system), in finding solutions to receiver problems. The use of the term 'client system' again contrasts with the word 'target system' which is often found in the literature dealing with the R,D & D and S-I schools of thought. Table 2.4 outlines how a number of authors within the P-S perspective have conceptualised the various stages involved in change. Havelock argues that many of these authors draw upon the early work of Lewin,[87] adding additional stages to each of Lewin's three main categories of (i) unfreezing, (2) moving and (3) freezing. Most of the people belonging to this school are social psychologists in the group dynamics human relations tradition.

Drawing parallels again with Schon's work, the P-S model has been linked to a 'periphery-centre' approach[88] which emphasises the identification of client needs at the periphery with the central agency taking a non-directive stance, helping the search for relevant solutions for the client-system.

Author	Field Year	Phases							
Lewin	Social Change	1. Unfreezing		2. Moving			3. Freezing		
Lippitt Watson & Westley	Social Change 1958	1. Develop a need for Change	2. Establish Change Relationship	3. Diagnosis of client problems	4. Examine Alternative Routes of Goals; Establish Goals & Inventions of Action	5. Transform Intentions Into Change Efforts	6. Generalizability & Stabilization	7. Terminate Change Relationship	
Mann & Williams	Industry 1960	1. Equilibrium before change		2. Preliminary Planning	3. Detailed Preparation	4. Installation and Testing 5. Conversion	6. Stabilization 7. Equilibrium After change		
Thelen	Educ 1967	1. Decide on Variables	3c. Set up change	2. Construct Force Field Analysis 3a Decide what needs to be done 3b Decide on first action target agent communications 4 Make first action explicit 5a Consider conditions 5b. Define roles		5c. Act 6. Revise Force Field Decide on Next Target ....Repeat cycle			
Watson	Social Change 1966	1. Felt Dissatisfaction		2. Diagnosis	3. Consider whole system 4. Creative Design 5. Force Field Analysis 6. Reduce Resistance 7. Participation 8. Temporary System 9. Leaders and Consultants	10. Adaptation Evaluation Revision			11. Spread of new ideas to others
Mackenzie	Educ 1964	1. Criticism		2. Proposals for change	3. Development & Clarification of proposals 4. Evaluate, review, reformulate proposals 5. Comparison of proposals	6. Action on proposals 7. Implementation of Decision			
Miles & Lake	Educ 1967	1. Clarify Expectations about Program 2. Collect Information		3. Formulate Goals 4a. Problem Sensing 4b. Diagnosing	c. See change target & Objectives d. Locate & Invent solutions e. Weigh cost and gain f. Decide on alternative g. Plan to Implement	5. Carry out Plans	6. Institutionalize	7. Phase out COPED	8. Assess 9. Feedback 10. Disseminate
Watson	Educ 1967	1. Sensing		2. Screening 3. Diagnosis and Force Field Analysis	4. Inventing 5. Weighing 6. Deciding	7. Introduce 8. Operate 9. Evaluate 10. Revise			
Jung & Lippett	Educ 1967	1. Identification of the concern		2. Diagnosis; Retrieve Knowledge & Derive Implication	3. Formulation of objectives 4. Feasibility Testing of Action Alternatives; Training; Evaluation	5. Adoption			5b. Diffusion

TABLE 2.4 Problem Solver Change Models

Source : Havelock, R.G., Planning for Innovation, Center For Utilization of Scientific Knowledge Of The Institute For Social Research, The University of Michigan, Ann Arbor, Michigan, 1969, p.10-56

In education the Nuffield Resources for Learning Project can be seen as working within a type of problem-solving pattern. When tried in practice the P-S approach has proved to make heavy demands upon clients. Respect for teachers' individual differences and autonomy brings with it a need for greater continuing professional development Also programmes based on an ideal P-S philosophy would prove costly because consultancy techniques are heavily labour intensive. Hence there is some need to rationalise client problems/needs so that results/solutions can be transferred to a number of clients. Writers propose that social-interaction strategies could prove useful here[89]. In addition because of the impractibility of developing individual tailor made solutions for each client it is suggested that the P-S model should make use of the wide range of products of R,D & D whilst at the same time accepting the need for local adaptation. Some hold the view therefore that successful curriculum development depends on an amalgam of all three of Havelock's models; this view is supported by Havelock himself in the development of his linkage model[90].

At the macro-level the linkage model involves the development of 'national systems' which allow any school district to 'plug in' to to sources of information; this allows districts to 'get knowledge and materials which are relevant and timely and truly cost beneficial.'[91] Although Havelock sees parts of such a national network already present one serious omission is the network of regional centres which would act as 'truly comprehensive resource linking centres with the skills and the staff to be an effective mediating mechanism between R & D on the one hand and operating school districts on the other'[92].

MacDonald and Walker comment that a proposal like Havelock's linkage model which is an amalgam of all three approaches so far discussed, is 'rather like advising the punter to back each horse in the race to make sure his money is on the winner.'[93] Stenhouse is also cautious, believing that all Havelock's models are based on solutions; he instead advocates a more research oriented approach where solutions are gradually arrived at by contstant evaluation of a particular line of development. Such an approach is seen to demand that schools have their own 'learning systems' where teachers gain the expertise for problem-solving.

In addition to the views already put forward by the various writers concerning the best way to make progress in the future on the process of change, Schon makes one further contribution. He goes beyond the centre-periphery models to present a description of a model which he believes more closely fits present day reality. Schon takes as his main examples for this description (called by him the 'movement' approach) business concerns and societal movements.

Schon reflects how the business world has changed from an essentially centre-periphery model of operation in the diffusion of innovation toward a movement approach. Earlier we discussed how developments in education have also emphasised the centre-periphery model. Thus it seems particularly relevant to discuss a model such as the 'movement approach' which could evolve within the education field as it has done in the business world. Other writers stress the importance of drawing on all available evidence from different fields of study in the search for generalisations which may help our understanding of the process of change; Rogers views such generalisations as vital in assembling a general theory of diffusion, and Havelock believes that they will assist in producing a more effective system of knowledge dissemination and utilization (D & U).

The 'movement' model (often referred to by some writers[94] as the 'shifting-centres'model) is described by Schon as showing the following features.

> 1. *It has no clearly established centre. Centres rise and fall on a shifting ad hoc basis around new issues and leaders.*
>
> 2. *There is no stable centrally established message. Instead there is a shifting and evolving doctrine - a family of related doctrines.*
>
> 3. *The system of the movement cannot be described as the diffusion of an established message from a centre to a periphery. The movement must be seen as a loosely connected, shifting and evolving whole in which centres come and go and messages emerge, rise and fall. Yet the movement transforms both itself and the institutions with which it comes into contact. The movement is a learning system in which both the primary and the secondary messages evolve rapidly, along with the organization of diffusion itself.*
>
> 4. *Its remarkable behaviour and its international scope depend upon the infrastructure technology on the basis of which it operates. The connectedness permitted by highly developed infrastrcture technology allows the movement to retain cohesiveness in the face of shifts in the centres of leadership and the central doctrine.*
>
> *95*

Schon sees the learning system of the movement as survival-prone due to its fluidity and apparent lack of structure; its ability to transform itself enables it to function as situations change around it. The scope of the 'movement' model, unlike the former models, is no longer determined by the energy or the resources at the fixed centre, nor by the capacity of the 'spokes' connecting the primary to the secondary centres. The 'movement' has to be seen as representing 'a set of overlapping and evolving innovations, rather than a set of like instances or applications of a single innovation. Its innovations bear a family resemblance to one another.'[96]

Stenhouse suggests that the movement model may be useful in the area of political and social policy but limited in its application to education. This is because the direction of the movement model is assumed and its learning is one merely of tactics; there is no systematic basis for the critical development of either the message or its practical implementation in the classroom. In fact just those features which Stenhouse sees as vital to the teacher-researcher approach are absent.

Footnotes

1. Wrigley, J., Sparrow, F. (eds), The Dissemination of Curriculum Development, N.F.E.R., Windsor, 1976, p.11.
2. See for example : Richmond, W.K., The School Curriculum, Methuen & Co Ltd., London, 1971, pp. 10-11; Beauchamp, G.A., Curriculum Theory, Kagg Press, Illinois, 1968, pp.6-7.
3. Open University, The Curriculum: Context, Design and Development- Teaching Strategies: A Systems Approach (Unit 9 - Educational Studies: A Second Level Course), Open University, Bletchley, 1972. This text provides the following definitions for descriptive and

prescriptive definitions.

> *[Descriptive definitions] endeavour to describe as adequately as possible, the way in which [a] word... is most commonly and most acceptably used, [whereas prescriptive definitions] urge the reader to think of the [subject in question] in a particular and often novel way.*

See pp. 8 - 9 for further details.

4. See for example: Kerr, J.F., <u>Changing the Curriculum</u>, University of London Press, London, 1968, p.16.
5. Ibid, p.16.
6. Gagne, R.M., 'Curriculum Research and the Promotion of Learning' in <u>Perspectives of Curriculum Evaluation</u>, A.E.R.A. Monograph Series on Curriculum Evaluation, No. 1, Rand McNally, Chicago, 1967, p.23.
7. Open University, Op Cit, p.9.
8. See Ibid, pp. 9 - 10 for further details.
9. Michaelis, J.U., Grossman, R.H., Scott, L.F., <u>New Designs for Elementary Curriculum and Instruction</u>, McGraw-Hill, New York, 1975, p.1.
10. Ibid, p.1.
11. Ibid, p.1.
12. Dreeben, R., 'The Unwritten Curriculum and Its Values', <u>Journal of Curriculum Studies</u>, 1976, Vol. 8, No.2, pp. 111 - 124.
13. Ibid, p. 112.
14. Whitfield, R. (ed), <u>Disciplines of the Curriculum</u>, McGraw-Hill, London, 1971.
15. Ibid, p.2.
16. Open University, Op Cit, (Unit 1) pp. 12 - 13.
17. For further details see: Elliott, J., 'Developing Hypotheses about Classrooms from Teachers' Practical Constructs - An Account of the Work of the Ford Teaching Project', <u>Interchange</u>, 1976 - 77, pp. 2 - 22.

18. For further details see p.8

19. Kerr, J.F., Op Cit, p.16

20. Miles, M.B., 'Educational Innovation : The Nature of the Problem' in Miles, M.B. (ed), Innovation in Education, Teachers College, Columbia University, 1964, p.13.

21. Ibid, p.14

22. Wrigley, J., Sparrow, F., Op Cit, p.11.

23. Walton, J., 'The Implications of Innovation', Forum, 1972, 14(2) pp. 38 - 42.

24. Ibid, p.38.

25. Ibid, p.38.

26. Hoyle, E., 'How Does the Curriculum Change', Journal of Curriculum Studies, 1969, 1(3), p.231.

27. Gross, N., Giacquinta, J.B., Bernstein, M., Implementing Organizational Innovations, Harper & Row, New York, 1971.

28. See for example: Bennis, W.G., Changing Organizations, McGraw-Hill New York, 1966; and, Heathers, G., 'Research on Implementing and Evaluating Cooperative Teaching' The National Elementary Principal, 1965, 44(3), pp. 27 - 33.

29. Gross, N., et al, Op Cit, p.8.

30. Miles, M.B., Op Cit p.2.

31. Open University, Op Cit, (Unit13, 1972), pp. 10 - 13.

32. Compare for example Hoyle's use of these dimensions (Ibid) with that of Kallen. For further details of the latter see : Kallen, H.M., 'Innovation', in Etzioni, A., Etzioni, E., (eds), Social Change: Sources, Patterns, and Consequences, Basic Books Inc., New York, 1973, pp. 447 - 448.

33. Miles, M.B., Op Cit, p.2.

34. Ibid, p.2

35. Havelock, R.G., Planning for Innovation through Dissemination and Utilization of Knowledge, Centre for Research on Utilization of Scientific Knowledge, Institute of Social Research, The University of Michigan, Ann Arbor, Michigan, 1969.

36. Rogers, E.M., Shoemaker, F.F., Communication of Innovations, The Free Press, New York, 1971.

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CHAPTER 3

Factors Affecting the Implementation of Curriculum Innovations

Like the previous chapter this is a review of the literature up to the time when the present research was undertaken. So far the discussion has concentrated upon the definition and elaboration of essential terms within the area of curriculum innovation and implementation. We now turn to an examination of those factors which have been highlighted in the literature as instrumental in affecting this implementation process. The analysis which follows categorises these factors into four main sections: the first section examines the factors which relate to the innovation itself; the second looks at factors which deal with the user system where a distinction has been drawn between users as individuals and users as part of an organisation; the third section studies those factors which are concerned with the effect of the various support agents and agencies surrounding users as they attempt to implement an innovation; and the fourth section suggests the possibility of interaction between these sets of factors.

1. *Factors Attributable to the Innovation Itself*

Gross et al in a study of the implementation of an educational innovation[1] isolated four main barriers to effective implementation; all four have implications for 'the innovation itself'. Gross' work indicated that barriers arise when there is a deficiency in one or more of the following areas; first, in the clarity of the innovation as seen by organisational members; second, in the necessary skills and knowledge needed by organisational members; third, in the necessary materials and resources; and fourth, in the compatibility of the innovation within organisational arrangements. In terms of the innovation itself these conclusions infer that for effective implementation an innovation should show the following four features: (1) state clearly its purpose; (2) be realistic in terms of teachers' existing skills and knowledge; (3) be realistic in terms of the amount of ancillary materials needed to operate it; and (4) be compatible with the organisational arrangements so that 'trying it out' becomes a realistic undertaking.

The same authors make two further points which are of particular interest here. The first concerns the possibility of such barriers being at least partially lowered by administrators taking appropriate counter-action. The second point warns that initial enthusiasm and acceptance of an innovation by staff is not sufficient for effective implementation; frustrations develop as barriers are met during the implementation process leading to a feeling of resistance against the innovation which can end in its abandonment.

Rogers and Shoemaker examining the position from the stand-point of diffusion research note the dangerous tendency of workers to regard all innovations as 'equivalent units'. They themselves identify five different attributes of innovations which determine the rate of adoption[2] of a particular innovation. The authors' aim is to obtain a comprehensive set of characteristics which are as mutually exclusive and as universally relevant as possible. The five characteristics are listed below.

1. *Relative Advantage - this is the degree to which an innovation is perceived as better than the idea it supercedes. This factor, as perceived by members of a social system is positively related to an innovation's*

rate of adoption.

2. *Compatibility - this is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of the receivers. This factor as perceived by members of a social system, is positively related to an innovation's rate of adoption.*

3. *Complexity - this is the degree to which an innovation is perceived as relatively difficult to understand and use. This factor, as perceived by members of a social system is negatively correlated to an innovation's rate of adoption.*

4. *Trialability - this is the degree to which an innovation may be experimented with on a limited basis. This factor, as perceived by members of a social system, is positively related to an innovation's rate of adoption.*

5. *Observability - this is the degree to which the results of an innovation are visible to others. This factor, as perceived by members of a social system is positively related to its rate of adoption.*
   3

The two characteristics of 'compatibility' and 'complexity' relate directly to the first and fourth barriers highlighted in Gross et al's research. Four further points can be made about Rogers' characteristics.

The first concerns the characteristic 'relative advantage'. Researchers such as Wilkening[4], Sutherland[5] and Bertrand[6] indicate that the relative advantage of a new idea may be emphasised by a crisis situation so leading to an increase in the rate of adoption of the innovation. Other studies[7] show that decisive events may work in the opposite direction retarding the rate of adoption. However it has been noted that as soon as the crisis is over members of a social system react in such a way as to make up for the time lost. Rogers and Shoemaker highlight also a number of sub-dimensions important in the consideration of relative advantage; these include the degree of economic profitability, low initial cost, lower perceived risk, a decrease in discomfort, a saving in time and money, and the immediacy of the reward[8].

The second point looks at the feature of 'complexity'. Whilst arriving at the generalisation given earlier, Rogers and Shoemaker accept that the research evidence is far from conclusive on this issue.

The third deals with the factor of 'trialability'. There is evidence[9] to suggest that early adopters perceive trialability as more important than later adopters. Laggards (very late adopters) move from the initial trial to full scale use more rapidly than do innovators (the first to adopt) and early adopters (the next category to adopt after innovators)[10]. Whereas the more innovative individuals (innovativeness is defined by Rogers and Shoemaker as 'the degree to which an individual is relatively earlier in adopting new ideas than other members of his system.'[11]) have no precedent to follow at the time they adopt, later adopters are surrounded by peers who have already adopted the innovation; such peers therefore act as a guide or demonstrators through their experience so that 'trialing' becomes much less significant for later adopters.

The fourth point concerns the changing perceptions of receivers to the various attributes of an innovation over the adoption process. From the limited amount of research conducted in this area it would appear that perceptions alter during the period of diffusion in part as a result of changes in the 'meaning' of an innovation and the 'use' to which an innovation is being put. Rogers and Shoemaker postulate that such changes during the adoption process result in different perceptions being held by early and late adopters. Further, different attributes of an innovation are perceived by the receivers with differing degrees of importance depending upon the stage the receiver is at in the innovation-decision process.[12] At the knowledge stage the innovation's complexity and compatibility should be more important; at the persuasion stage the innovation's relative advantage and observability; and at the decision stage the innovation's trialability should feature more prominently.

Elsewhere Rogers and Eichholz list a number of pertinent questions requiring further research. These are listed below :

> 1. *Does a given innovation cause a certain form of rejection, or are all forms of rejection common to all innovation?*
>
> 2. *What happens when a series of many innovations are available in a short period of time? Are they adopted as a cluster, Is such a cluster or complex of innovations adopted more quickly or slowly than single innovations?*
> [13]

These questions concentrate particularly on the individuality of innovations and the effect of one innovation upon another especially where a number are available together within a short period of time. Later in this section we shall see how Bolam takes the discussion further describing the way in which innovations not only compete with each other but also become planned antecedents for other more highly valued innovations. Rogers and Shoemaker, noting the general lack of research interest in this area, conclude that such neglect reflects an 'implicit and certainly false assumption... that the adoption, and the consequences of an innovation, are completely independent of all other innovations.' [14] The same authors negate any such assumption, a view based on research already conducted into the perception of receivers to a new idea in terms of its compatibility with previouslyadopted ones and the relationship between the eventual outcome of an innovation and others being tried at the same time. Thus Rogers and Shoemaker urge researchers to become more realistic, to examine in more detail 'bundles' or 'packages' of innovations rather than individual ones as if the latter exist as discreet units for analyis.

The idea of innovation complexity, a factor raised by Rogers and Shoemaker, can be related to the issue of the 'language of communication' used by the various project development teams. MacDonald and Walker[15] argue that a central team which is working closely together and with a group of teachers trying out the project's ideas inevitably builds up an 'in-group or words and phrases'; because these words and phrases become familiar to this group they do not necessarily present problems during the initial stages of a project's development but difficulties may arise later as the project undergoes wider diffusion. Philip Jackson's work[16] shows how cautious a project team must be in choosing the correct language for communication. His research highlights the simplicity of teachers' language both in the use of technical terms and in its level of conceptual complexity. Thus MacDonald and

Ruddock conclude :

> *This has implications for a curriculum project which aims at development through teacher understanding and which does not give careful thought to the uses and effects of its language of communication.*
> *17*

A project's 'language of communication' also affects other sections of the education community in addition to teachers. For example, headteachers and various local authority personnel engaged in the administration of education take important decisions about curriculum innovations. In the light of MacDonald and Ruddock's comment that no standardised method of describing curriculum projects as yet exists, this makes decision making in this area particularly hazardous.

So far we have highlighted the importance of appropriate communication. However writers like MacDonald and Walker[19] argue that 'communication problems' often become red herrings in discussions where the basic malaise may well be with the receiver who prefers not to hear about a particular innovation; one remedy suggested for the latter is to change the image of a project so that the receiver sees it in a more appealing light. This brings us to MacDonald and Walker's main thesis : they propose that as a result of discrepancies between a project's own educational convictions and the convictions of 'others' outside, which include teachers on the one hand and academic critics on the other, projects engage in a process of 'image manipulations' where each group receives a picture of the project more in tune with their particular convictions. Thus the reason why different groups receive different messages (or images) concerning a particular project is not essentially one of bad communication where the central message is being misinterpretted by each group but rather is a result of policy by a project team to meet the various diverse expectations of different groups; a strategy of negotiation which allows the project to be seen in an acceptable light by all interested groups. MacDonald and Walker's thesis is well supported by Shipman in his analysis of the Keele Integrated Studies Project[19] where he describes the process of bargaining, negotiation and horse-trading which went on during the trial stage. One further comment appears important here and concerns the amount of flexibility project teams are allowed or decide to allow so that the various views coming from outside the team can be taken into account. It needs to be recognised that such flexibility reduces the degree of standardisation of the message received; as MacDonald and Walker's work suggested it is the intrinsic differences between receivers which is the determining factor in a project's endeavours to sell its products.

Earlier in the discussion[20] 'trialability' (the degree to which an innovation may be experimented with on a limited basis) was isolated as one factor leading toward a faster rate of adoption. Work by Miles[21] shows that 'temporary systems'[22] exhibit this feature of 'trialability'. After examining three case studies concerned with temporary systems Miles concludes that such systems can accomplish fundamental change. As a result it is proposed that if an innovation lends itself to the establishment within the school setting of a temporary system, with the result that other characteristics such as 'lower risk involvement for teachers' are evolved, the process of innovation will become more effective.

In a review of numerous studies, Miles[23] concludes that as far as the innovation itself is concerned educational innovations are almost always never installed on their merits; other factors including the characteristics of the local system, of the innovating person or group, and of other relevant groups often outweigh the impact of what the innovation is. However he does suggest that some properties of the innovation itself play a part in affecting its adoption and continued use. He lists five main properties which are: (i) cost; (2) technological factors; (3) associated materials; (4) implementation supports; and (5) innovation/system congruence. Research into the first of these suggests that if large amounts of money, energy or time are required by the adopting person or group, the innovation's progress will be slow. However if the innovation is 'divisible'[24] the obstacle of cost becomes less important. Research pertinant to the second category listed indicates that in the adoption of technological innovations features such as cost, feasibility, ease of availability for efficient use, and convenience of use, have a large influence at the user level on diffusion rates. Miles concludes that the third factor of 'associated materials' supports the diffusion of educational innovations to a considerable extent if the materials are comprehensive and designed as complete units, as in the case of the Physical Science Study Committee's work. The fourth area, 'implementation supports', highlights the difficulties teachers can encounter in attempting to implement an innovation; such difficulties can cause an effective barrier to adoption and continued use. Whilst the 'complexity' of an innovation appears to have no effect on diffusion rates[25], Miles argues that innovations which are difficult to operationalise (those requiring extra administrative energy, proving disruptive to the local system, or found to be puzzling or threatening in a technical sense) will diffuse more slowly. The fifth property, 'innovation/system congruence', follows directly as a consequence of the conclusions reached with regard to the last category, and bears a close resemblance to Rogers' characteristic of 'compatibility'. In addition to the five properties outlined, Miles makes two further observations regarding the characteristics of an innovation. The first is that substantial structural innovations, for example those necessitating changes in the teachers' role diffuse at a much slower rate than technologically based ones; and the second is that innovations which are perceived as threats rather than additions to existing practice are much less likely to be accepted.

In Bolam's analysis[26] of those factors which are important to the success of an innovation he includes characteristics such as relative advantage and compatibility (re-named 'feasibility') outlined earlier in Rogers' work but also goes on to discuss the importance of the 'competitive strength' of an innovation in its struggle against other innovations and activities competing for scarce resources. The emphasis given in Bolam's analysis is clearly toward the relationship of the innovation to the 'organisational setting' compared with Rogers who concentrates more on individual values, ideas and needs. In this respect Bolam's work shows a similarity to that of Gross et al. Three other issues raised by Bolam and not covered in quite the same way by writers discussed so far include: (1) the 'magnitude' of an innovation (this involves the scale of the change to be undertaken, the degree of change and its trialability/divisibility[27]) ; (2) its 'adaptability' and (3) its 'gatewayability'. The last two factors in particular require a further elaboration. Bolam argues that 'adapability' is rarely mentioned as a factor in the literature and notes that while development agencies may deplore such a process[28] the user on the other hand may see it as one of the chief strengths of a particular innovation. As the same author points out it is when one has to decide whether an adaption is still sufficiently like the innovation to be called the same innovation that problems arise. Bolam argues that 'gatewayability' becomes important when innovations are valued for their ability to create opportunities for the introduction of other more highly valued innovations. This concept reflects the importance of Rogers' statement concerning the need for research to concentrate more upon the effect of one innovation upon another.

Havelock, based largely upon the work of Barnett[29], makes the useful distinction between intrinsic and extrinsic characteristics of knowledge and innovations[30]. It is under the heading of intrinsic factors particularly that he provides further information for discussion. In this category he includes the characteristics of 'scientific status' and 'value loading'. In connection with the first of these, Havelock suggests that despite the importance of such attributes as reliability, validity, generality, and internal consistency to scientists in assessing the scientific status of knowledge, the literature contains few attempts to assess the impact of this factor on diffusion or utilization. Factors which appear to over-shadow scientific status include the educational background of the receiver and the perceived credibility of the information source. The second property of 'value loading' is important in that it makes information more acceptable to some groups (for example their own peers with similar values) but at the same time less so with those who hold opposite views. Earlier in this section in a discussion of MacDonald and Walker's work[31] it was proposed that different groups holding different values can affect the policy and resulting strategies adopted by a project team.

2. *Factors attributable to individual users and the user system*

Writers analysing innovation from the user perspective tend to take one of two approaches; some place emphasis upon users as individuals whilst others are concerned with the wider user system within which individuals work. Growing interest in the second of these two approaches has brought with it a need to understand how the various parts of the user system interact with each other; this has led to moves for the application of systems theory[32] to the field of education.

Hoyle after reviewing the potential uses of systems theory in the social sciences in general and the field of administration in particular, suggests that it has three main uses. These are outlined below :

> *First, it can integrate into one theoretical framework data from the behavioural sciences and thus lead towards a unified theory of human behaviour,.....and it can integrate this data further with data from the natural sciences to reveal patterns of organisation common to all phenomena. ....the second use is to utilise general systems theory as a model in order to bring order to the data of the behavioural sciences and to reveal the crucial relationships in a concrete situation. ......*

> *there is no doubt about the value of general systems theory as a model for an organisation and its environment....The third use of the general systems theory lies in its power to generate hypotheses which could not otherwise have been generated by a more limited theory.* [33]

Eggleston[34] provides similar comment, remarking that the 'ordering of data' is a key contribution of the systems approach; a contribution which helps the development of three processes (1) categorisation, (2) conceptualisation, and (3) theory construction. Bolam, dealing more specifically with educational change, places great importance upon the 'organisational setting' of the school; such an emphasis leads him towards the application of general organisation theory to educational organisations such as the school. Within this area he believes there is a certain amount of concensus about the value of general systems theory (his comments largely mirror those of Hoyle).

Systems theory may be crudely divided into the two categories of 'open' and 'closed'[35]. Katz and Kahn[36] examine some of the consequences of viewing organisations as open and closed systems. They conclude that traditional organisational theorists have tended to view the social organisation as a 'closed system' ; this tendency has led to a disregard of differing organisational environments and also to an over concentration of the functioning of the internal organisation. The 'open' system on the other hand, through its feedback principle, can take account of changes in the surrounding environment, so allowing for a more realistic means of development compared with the closed system. As a result many writers, particularly in education, favour open systems theory. Thus Griffiths[37] uses open systems theory in his search for a theory of administrative change; he considers administration as an open sub-system, the organisation as the system and the environment as the supra-system. In this Griffiths produces a model out of which he is able to construct a number of propositions about organisational change.

Silverman presents an alternative view to the use of systems theory when examining organisations. Whereas systems theory stresses 'the way in which the action of the parts is structured by the system's need for stability and goal-consensus, and emphasises the processes of integration and adaptation'[38] an alternative might be to analyse organisations 'in terms of the different ends of their members and of their capacity to impose these ends on others....an analysis in terms of power and authority'.[39] He suggests that these two approaches can be seen as opposite sides of the same coin. Systems theory can be seen in terms of 'society makes man' and action theory (the alternative) as 'man makes society'. Silverman argues that systems theory limits itself unnecessarily by playing down the political and status concerns of those involved and implying that both goals and actions are to a large extent conditioned by the problems of the organisation and the role-expectations defined by the formal structure. One could also argue that in its extreme form the alternative approach which looks at the action of members within an organisation is too limited because it fails to recognise the possibility of shared values. Consequently Silverman proposes that when analysing interaction one must remember that there is a 'plurality of action systems available to the individual' such that any one may be taken as the particular frame of reference for a certain action.

Some authors when comparing systems and action theory treat them as complementary; Cohen[40] is one such example. He begins by distinguishing between an 'holistic' approach (this seeks to explain the action of parts of a system in terms of the nature of the whole) and an 'atomistic approach' (this views the system as an outcome of the action of the parts), and goes on to argue that they are alternative ways of analysing the same problem, that of social order. Other writers[41] contend that action and systems explanations offer conflicting rather than complementary frames of reference because they deal with different types of problems.

Bolam argues that in the field of educational change systems theory and action theory can be brought together through the use of 'open systems theory'. He highlights three aspects of an open system for educational change: (1) the change agent (2) the innovation (3) the user (which all constitute dimension 1 of his conceptual framework for studying educational change). In this way, he says, a model can be constructed which takes account of 'the way in which individuals and groups within the systems construct their own phenomenological worlds and thus affect all aspects of the organisation, including its innovation activities'.[42]

However not all writers accept that open systems theory is as satisfactory as Bolam suggests. Jackson[43] notes that there are many variations of open systems theory. Some place considerable emphasis on the way the environment and the actor can influence the system. These run the risk of destroying the notion of system which has 'integration' and shared values as its central thesis. Others place less emphasis upon the environment and the actor and their ability to affect the system. These maintain the integrity of the system but fail to answer the central criticisms of systems theory.

Crane[44] notes the attempts made by some writers to develop a general organisational theory of educational innovation but still argues that there has been a noticeable neglect of both systems theory and organisation theory in much of the literature concerned with educational innovation. He acknowledges the emphasis by people like Miles and Griffiths in Innovation in Education[45] upon organisational theory but argues that even they give little mention of terms such as bureaucracy and names like Talcott Parson,Blau, or Webster. However Crane points to the . work of Carlson & Gallagher[46], and Thompson[47] as an indication that greater attention might start to be paid to the organisational context of the dynamics of educational innovation.

Mohr[48] agrees with Crane that there is a lack of work dealing with the organisational correlates of innovation, not only in education but also in the more general literature. The research which has been conducted 'consists of scattered projects representing different disciplines, motivated by different considerations, and employing a heterogenous selection of independent variables'.[49] Findings resulting from such work have not been sufficient to generate one unified theory but rather combine to form 'a series of suggestions, or an agglomeration of operational hypotheses upon which one must attempt to impose some common conceptual dimensions before theory building can be undertaken.'[50] Mohr states that many studies of innovation have concentrated upon individuals rather than organisations. He concludes however that individuals may well have a valuable role to play in the adoption of innovations (see Burns & Stalker[51], Mytinter[52], Eisenstadt[53] and Blau[54]). Mohr argues that 'the same factors that seem to cause farmers and doctors to innovate for themselves might also cause executives to innovate, or at least try to innovate, for their organisations.'[55]

The remainder of this section, which examines in more detail those factors affecting the degree of implementation of innovations, falls conveniently into two parts; the first concentrates on the factors writers attribute more to individuals' characteristics and the second includes those based upon a wider organisational perspective.

(i) Factors Emphasising Individual Characteristics

Rogers and Shoemaker provide a considerable amount of information about how individuals within a social system adopt an innovation. Adoption is defined as 'a decision to make full use of a new idea as the best course of action available.'[56] Therefore 'adopters' can be interpreted as those individuals who take such a decision. Thus the term 'adopter' could include both teachers who decide to try an appropriate innovation and policy-makers at the local level who may decide to finance a particular project in a number of schools in their area. Therefore in dealing with Rogers and Shoemaker's findings it should be remembered that the term 'adopter' implies more than just the 'user' category as exemplified by the classroom teacher.

In an earlier section[57] the discussion dwelt upon the importance of the adopter's 'perceived impressions' of an innovation; this represents but one of the findings arising out of Rogers and Shoemaker's work. They isolated also five main categories of 'adopters'; these were based on the criterion of 'innovativeness' ('the degree to which an individual is relatively earlier in adopting new ideas than the other members in his system, where 'relatively earlier' means 'in terms of actual time of adoption, rather than whether the individual perceives he adopted the innovation relatively earlier than others in his system'[58]). The five catergories range from 'innovators' (the first 2.5 per cent of the individuals to adopt) to 'laggards' (the last 16 per cent of the individuals to adopt).

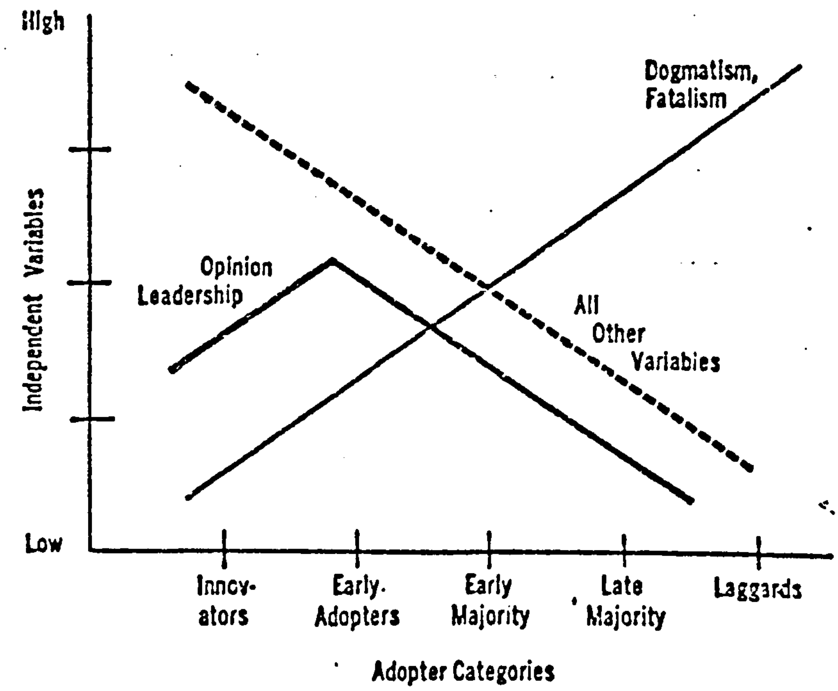
Rogers and Shoemaker state that there have been very few adequate investigations which examine the values of each of these adopter categories; as a result they have attempted to provide data by abstracting details from a variety of studies which do not as such deal specifically with the value differences of the different adopter categories. The outcome is a list of dominant characteristics for each adopter category. Taken in order the innovators (category 1) are highly 'venturesome'; early adopters (category 2) 'respectable'; the early majority (category 3) 'deliberate'; the late majority (category 4) 'skeptical'; and the laggards (category 5) 'traditional'. Obviously such limited descriptions mean very little without further amplification.

The characterisitic of 'ventursomeness' entails an eagerness to try new ideas; this takes innovations out of the local circle of peers into more cosmopolitan social relationships. Communication patterns and friendships among a clique of innovators are common even over large geographical distances. But perhaps the most important feature of innovators is their desire for 'the hazardous, the rash, the daring and the risky'. In the light of this it is not surprising that this group must be willing to accept occasional setbacks when an innovation proves unsuccessful. To combat such 'failures' innovators usually have access to finances whereby possible losses can be absorbed. Also innovators can both understand and apply complex technical knowledge to better advantage. Rogers' second category of adopters, 'early adopters' are a more integrated part of the local social system, often called 'localites'. More than any other category this group has the greatest degree of 'opinion leadership' (defined by Rogers and Showmaker as "the degree to which an individual is able to informally influence other individuals' attitudes or overt behaviour in a desired way with relative frequency'[59]). In addition to potential adopters checking out an innovation with such opinion leaders, 'change agents' (defined by Rogers and Shoemaker as 'a professional who influences innovation-decisions in a direction deemed desirable by a change agency'[60]) often use opinion leaders to assist with their strategies for diffusion and planned change. Holding a position which is seen by their peers as not too extreme (compared to the 'innovators' group) early adopters serve as a 'role model' for many other members in the social system. The third group, 'the early majority' who adopt new ideas just before the average member of a social system hold a position between the early and the relatively late adopters which makes them an important link in the diffusion process. The fourth category, 'the later majority', approach innovation with particular caution. System norms must favour a particular innovation before this group adopt; pressure of peers is vital for adoption to occur. The final group to adopt, 'the laggards', are the most localite in outlook with many showing near isolate qualities. This group prefer to use past experience for reference rather than innovators or change agents both of whom are treated with as great a suspicion as the innovation itself. Their effect on the innovation-decision process is to slow the process down.

In a further analysis Rogers and Shoemaker have isolated a number of independent variables relating to 'innovativeness'. This has allowed them to propose further generalisations about the various adopter categories. These generalisations fall under three headings: (1) socio-economic status; (2) personality variables; and (3) communication behaviour. The generalisations offered by Rogers and Shoemaker show that within the first category, although age is not a distinguishing criterion the earlier adopters are more educated, have a higher social status, have a greater degree of upward social mobility, have larger sized units (for example farms), are more likely to have a commercial economic orientation and have more specialised operations than later adopters. Personality variables seem to have received less attention in the literature, possibly Rogers argues, because of the difficulty of measuring these dimensions in field interviews. However early adopters are associated with qualities such as: greater empathy (the ability to project oneself into the role of another); less dogmatism; a greater ability to deal with abstractions; greater rationality; a more favourable attitude to change, risk, education and science; less fatalistic; a higher level of achievement motivation; and higher aspirations (i.e. for education, occupations and the like). In the third category of communication behaviour earlier adopters are believed to have the following characteristics: greater social participation; they are more highly integrated with the social system; more cosmopolitan; more change agent contact; more exposure to mass media communication channels; greater exposure to interpersonal communication channels; seek information more about innovations; greater knowledge of innovations; a higher degree of opinion leadership; and more likely to belong to systems with modern rather than traditional norms than later adopters. Figure 3.1 which indicates how the various independent variables are related to 'innovativeness', shows that most of the variables are positively related. A feature clearly highlighted is the concentration of the characteristic 'opinion leadership' in the early adopter category; a relationship discussed earlier in this section. Evidence also suggests that the degree to which 'innovativeness' and 'opinion leadership' are related depends on the norms of the system; in a modern system opinion leaders are more likely to be innovators than in traditional ones.

In conclusion Rogers and Shoemaker state that such differences existing between adopter categories might be valuably used by change

FIGURE 3.1 Abstraction Of General Direction Of Relationship Of Independent Variables With Innovativeness



Most variables, such as social status, cosmopoliteness, and the like, are positively related with innovativeness. However, a few variables, such as dogmatism and fatalism, are negatively related, and opinion leadership seems greatest for early adopters, at least in most systems.

Source : Rogers, E.M., Shoemaker, F.F., Communication Of Innovations, The Free Press, New York, 1971, p.190.

agents when they select appropriate strategies of change. In a later section of this review such strategies will be discussed in more detail.

Carlson[61] in an American study of the diffusion of modern math highlights many of the generalisations arising out of Rogers and Shoemaker's work; he deals with the general characteristics of the adopter categories and considers in detail the question of opinion leadership. Carlson traced the adoption of a particular innovation (modern math) as it was taken up by school superintendents in Allegheny County. This study therefore does not equate 'adopter' with the ultimate user, the teacher, but rather concentrates upon the decision making process occuring prior to teacher involvement where the policy makers at district level decide whether an innovation shall be tried or not. Carlson discovered that the first school superintendent to adopt (i.e. belonging to category 1 - 'innovators') was an isolate having no interpersonal communication links with other superintendents in the County. Earlier it was established that innovators are cosmopolitans so that relationships with a local circle of peers is not a strong feature of this grouping. Also in agreement with the general findings of Rogers and Shoemaker, Carlson's sample showed a concentration of opinion leadership in categories two and three. Carlson's work went on to show that opinion leadership is associated with a small number of people who form a clique of informal friendship grouping; it is this clique which plays a central role in the diffusion of the innovation. Carlson discovered that as soon as the clique adopted, especially the opinion leaders within it, the rate of adoption began to rise rapidly in the overall system. Commenting upon the role of opinion leaders, Rogers and Shoemaker suggest that

Carlson's study typifies the communication behaviour of opinion leaders. House, in a discussion of Carlson's study[62] particularly emphasises the role of the central friendship group and its importance in dissemination. He notes that the innovation of modern math did not diffuse until it reached the central friendship grouping.

Carlson not only concerned himself with the friendship pattern of the school superintendents but also took a broader perspective, analysing the superintendents general position in the social structure. This, as he acknowledged can be measured in many ways; he concerned himself particularly with 'social network involvement' and 'status'. The former, with its emphasis upon involvement was assessed in three ways: first by finding out how the superintendents rated as friendship choices (this relates directly to the friendship patterns House comments on); second by asking each superintendent for his perception of the amount of his interaction with other superintendents, as compared with that of his colleagues; and third by using a measure to evaluate the accuracy of each superintendent's perceived degree of involvemt. As the results discussed earlier indicate members who rate highly on the number of friendship choices (i.e. members of the friendship clique) were among the early adopters. When all three measures were combined to give an overall score for 'social network involvement', those scoring high in all three sections, and so receiving the highest overall scores were also found to be the people adopting the innovation first; quite simply 'social network involvement' was discovered to be directly related to the rate of adoption of modern math. Status, a second indicator of position in the social structure, also had a three-point rating system based on education, professionalism (measured by means of the superintendents' judgements of each other) and prestige (measured indirectly using the superintendent's salary as the criterion). Again the data revealed a direct relationship between a superintendent's position in the status structure and his rate of adoption of modern math. Thus Carlson's study falls in line with Rogers and Shoemaker's generalisations that (1) earlier adopters have higher social status[63] than later adopters; (2) earlier adopters have more social participation than later adopters; and (3) earlier adopters are more highly integrated with the social system than later adopters.

House[64] (looking more specifically at the question of opinion leadership) contrasts Carlson's findings from Allegheny County, (largely an urbanised area) with the adoption rates of school superintendents located in a rural area of West Virginia. In the latter the communication structure was significantly different with superintendents seeking advice from their fellow superintendents much less frequently. Opinion leaders in West Virginia were discovered to be drawn from all status levels not just the top as in the urban study, and rural superintendents relied far more on state education personnel. House, considering the diffusion data in spatial analysis terms, pictures the diffusion pattern in the rural areas as following a regular wave compared to the urbanised areas where there is an irregular 'hop-scotching' effect caused by superintendents seeking advice from those on the same 'innovativeness' level. Concluding, House talks of the 'social hierarchy' of the urban situation where seeking advice can be seen in terms of asking up the 'status ladder.

Rogers and Shoemaker emphasise the importance of human communications stressing both communication concepts and frameworks in their analysis of the diffusion process. Possibly the predominant model at the moment for mass communication flows is a 'multi-step flow' where receivers are a variable number of times removed from the message origin. Katz[65] argues that the opinion leader has a vital part to play within such a communication system; it is he who must bring the group into touch with new ideas using whatever media are appropriate. Opinion leaders therefore form an important 'linking role'. Havelock offers a typology of linking roles. As with any classification the types are somewhat 'ideal' but the author hopes that each of the major headings represent particular linking aspects. As table 3.1 indicates Havelock's work covers a wide range of sources. The typology proves useful in positioning the 'opinion leader' (labelled in the table as 'leader') within a whole spectrum of linking agents. Later discussion considers some of the other linking roles listed. While opinion leaders would seem to show features of both consultants and conveyors it is their 'insideness' which distinguishes them from these other two groups. They are seen by Havelock as the 'legitimators' of new ideas and practices. As we shall see later when discussing change agents, other writers (such as Bolam) have rather different definitions which view change agents as part of the user system; for example in Bolam's framework the head of a school could be considered a change agent.

In their analysis of the general characteristics of opinion leaders, Rogers and Shoemaker highlight most of the points already made but also include additional ones. A summary of their findings in this area

TABLE 3.1 Knowledge Linking Roles

ROLE TYPE	FUNCTION	FIELD	EXAMPLES	SAMPLE REFERENCES
A. Conveyor	To transfer knowledge from producers (scientists, experts, scholars, developers, researchers, manufacturers) to users (receivers, clients, consumers)	Agriculture	County agent (especially as seen by others)	Wilkening, Abraham,
		Agriculture	Extension Specialist	Brown and Deckens,
		Agriculture Medicine	Salesman, retailer, drug detail man.	Elliott & Couch, Anderson, Bauer & Wortzel,
		Psychology	Science reporters	Wood,
		Education	Trainers, Informers, Demonstrators } Disseminators	} Clark & Hopkins,
		Education	Teacher	
		Gov. Policy	Scientific expert	Moulin, Schilling, Sponsler, Leiserson,
		Industrial R & D	Systems engineer	Havelock & Benne,
B. Consultant	To assist users in identification of problems and resources, to assist in linkage to appropriate resources; to assist in adaptation to use: facilitator, objective observer, process analyst.	Various	Mental health consultant	Bowman, Berlin, Binderman, Kaufman, Glaser,
		Various	Change agent	Lippitt, et al.,
		Organization	Change agent	Schein & Bennis,
		Education	Change agent	Watson, &
		Agriculture	County agent (as he actually operates much of the time)	Penders, Stone,
		Urban	Expeditor	Reiff & Reissman,
		Psychiatry	Legal mediator	Torshakovec,
C. Trainer	To transfer by instilling in the user an understanding of an entire area of knowledge or practice.	All Fields	Teacher; Professor of Practice	
		Education	Trainer	Clark & Hopkins,
D. Leader	To effect linkage through power or influence in one's own group, to transfer by example or direction	Education	Administrator: superintendent, principal	Carlson, Richland, Chesler, et al.,
		Various	Gatekeeper	Lewin,
		Medicine	Opinion leader: physician	Katz,
		Agriculture	Opinion leader: "good farmer"	Blackmore, et al., Wilkening & Santopolo,
		Community (urban)	Opinion leader: informal power structure	Angell,
E. Innovator	To transfer by initiating diffusion in the user system.	Agriculture	Innovator	Rogers,
		Agriculture	Demonstrator: farmer	Blackmore, et al., Wilkening & Santopolo,
		Industry	Product champion	Schon,
		Industry	Entrepreneur	Nader,

Continued on following page

Source : Havelock, R.G., Planning For Innovation, Center For Utilization Of Scientific Knowledge Of The Institute For Social Research, The University Of Michigan, Ann Arbor, Michigan, 1969, pp. 7.4-7.4a.

TABLE 3.1 Continued

Role Type	Function	Field	Examples	Sample References
F. Defender	To sensitize the user to the pitfalls of innovations, to mobilize public opinion, public selectivity, and public demand for adequate applications of scientific knowledge	Various	Defender	Klein,
		Agriculture	County agent	Francis and Rogers,
		Education	"Quality controller"	Hencley,
G. Knowledge-builders as linkers	To transfer through gatekeeping for the knowledge storehouse and through defining the goals of knowledge utilization.	Various	Scholar: scientific leader	Znaniecki,
			General educator	
			Definers of human values	
		Various	Futurists and future planners	Wright,
	To transfer through maintenance of a dual orientation: scientific soundness and usefulness.	Industry	Applied researcher-developer	Stein,
		Education	Applied researcher-developer	Clark & Hopkins,
		Medicine	Clinical researcher	Havelock,
		Industry	R & D Manager	Krugman & Edgerton, Pelz & Andrews,
		Education	Res. coordinator	Sieber,
		Education	Res. director	Sieber,
		Education	Engineer	Anderson,
		Education	Curriculum developer	Clark,
H. Practitioner as Linker	To transfer to clients and consumers through practices and services which incorporate the latest scientific knowledge.	All		
I The User as Linker	To link by taking initiative on one's own behalf to seek out scientific knowledge and derive useful learnings there from.	Agriculture	Most advanced farmers	Havelock & Benne, Rogers,

provides a fitting conclusion to the topic of opinion leadership. They state that opinion leaders, as compared with their followers (or non-leaders) 'have greater mass media exposure, more cosmopoliteness, greater change agent contact, greater social participation, higher social status and more innovativeness. Opinion leaders conform more closely to a system's norms than do their followers. When the system's norms favour change, opinion leaders are innovative; but when the norms are more traditional leaders are not especially innovative.'[66]

The discussion so far has concentrated upon critical factors relating to individuals within the 'adopter category' where the latter has been interpreted using Rogers' definition which is somewhat wider than the term 'user category', a category normally relating to school personnel who are more directly involved in the implementation of an innovation. American research findings in this area have tended to highlight the influence of the school superintendent upon the rate of diffusion of innovations within a school district; such work involves more the analysis of the effect of policy making personnel than the analysis of the effect of heads of schools. This emphasis within the American research literature can be explained by the fact that the headteacher in North America does not share the same degree of power and autonomy as heads receive in this country. However before turning to factors which concetnrate more closely upon headteachers and the members of staff within schools several writers provide yet more information about the effectiveness of the school superintendent in the process of educational innovation. House argues that the migration, mobility and career patterns of school superintendents are important features. 'Career-bound superintendents' are those 'who move from district to district carrying new ideas and innovations with them. Although they ordinarily move only short distances within state boundaries, their very entry into a school district unfreezes the district social structure for a period of time thus allowing new coalitions to form and some change to occur. It is also in the career interests of the superintendents to promote change in order to build their reputations'.[67] House emphasises the unique position of the superintendent like other chief executives in having access, unlike teachers, to outside information. He therefore functions as a 'carrier, catalyst and gatekeeper' for new innovations. Carlson's research seriously attacks the notion held by Mort that the school superintendent is merely a victim of the local school budget. In fact Carlson discovered a negative correlation between finance and adoption. Mort also suggested that the superintendent was a powerless office holder, finding himself subordinate to the school board. Data collected by Carlson on the relationship between social structure variables and adoption parallels similar findings in agriculture and medicine. Thus Carlson argues it is likely that superintendents are like farmers and physicians in not finding themselves subordinate to their organisational structures.

Turning now to an examination of factors associated with school personnel, we begin by looking at the role of the headteacher. In an article based upon their experiences in developing and diffusing the Humanities Curriculum Project in this country, MacDonald and Ruddock[68] observe that the head is a key figure in curriculum innovation; curriculum developers require not only his goodwill but also his understanding. His task is to make the appropriate choices in terms of staff, material resources and organisation, and in addition be sensitive to the tensions that invariably arise during the process of innovation; such sensitivity should show itself actively in the provision of support which does not involve too much dominance by the head. The writers stress that the project team itself must accept their particular responsibility which is to help the head make the most effective decisions by providing him with any relevant details about the project; these may include the amount of support the project itself can provide. But perhaps a more important part of a project's strategy is the 'realisation' of the important role of the head within the school.

MacDonald and Ruddock, recognise that the headteacher is a key figure within the innovation process, emphasising his managerial function within the organisation of the school. This is reflected by other writers such as Hoyle[69], Gross et al[70], Dickinson[71], and Walton[72]. It seems inevitable that the head's role will be seen by many in this light as more writers begin to concentrate upon the organisational aspects of the school. Discussion of this topic along with other organisational factors relating to the user system are to be found in the following section.

However, whilst accepting the increasing tendency of the literature to highlight the organisational role of the headteacher, other references concerning the effectiveness of the head in curriculum innovation have been made. Shipman, in his evaluation of the Keele Integrated Studies Project (K.I.S.P.)[73] also looks at the effect of heads together with other 'high-level manpower' when they participate more closely with classroom teachers during the trial period of a project. In the Shipman study the data showed that the involvement of heads, deputies and heads of departments working within teams of teachers, caused a negative, zero and positive effect respectively upon the impact of the project. Shipman concludes that the tendency for heads to reduce the impact of an innovation like K.I.S.P. seems to be positively correlated with a general desire by some enthusiastic heads to pressgang uncommitted staff into trying out the project's materials. Thus over enthusiastic heads tended to exert a detrimental effect upon the innovation's progress. However even where staff themselves were enthusiastic a head's participation in a team was still found to exert a negative effect; teachers argued that it was difficult to take the initiative when the head was present.

Writers generally support the assertion that the headteacher is a key figure in the process of curriculum innovation[74]. Dickinson is one such example. In a study looking particularly at the role of the head as an innovator within one school district in the North of England, he concludes that heads often judged the 'success' of an innovation in terms of whether it had been 'introduced' into the school or not.

> *All headteachers spoke of all the innovations as highly successful, indeed, in one sense, successful introduction of the innovation was frequently seen as a measure of success of the innovation itself, and success in these terms appeared to be a major goal of the school....."*
> *75*

Turning more specifically to the general teaching staff within a school, Shipman in his evaluation of K.I.S.P., concludes that the demands made by a project can force teachers into using up a considerable amount of time and energy. Not only did the Keele project provide its own particular demands involving teachers in the use of new skills but it also increased the strain on teachers because of their very involvement in 'an innovation'. Shipman concludes that 'the part had to be learnt, then played under public scrutiny.'[76] Innovating teachers often found themselves visited by various outside personnel including project directors, co-ordinators, H.M.I.s, local authority Advisers/Inspectors and researchers engaged in evaluation. One example of the extra time and energy 'put in' by teachers arose because of the need for team meetings in individual schools and other meetings and conferences where teachers from the various schools involved would meet together. In some schools meetings were held within timetabled hours but in most they were arranged at break times or after school. Shipman outlines the varius difficulties involved in arranging meetings: these included the problem of timetabling so that all staff could be free at the same time for a meeting; the absence of teachers' centres for more general meetings; and the fact that 'teachers seemed unwilling or unable to spare the time'[77] resulting in a poor attendence at some meetings. Shipman suggests that teachers were more concerned with the immediate problems of the classroom; problems of discipline and standards, so that the main ideas behind the project '(the) principles of integration, the niceties of team teaching, and the commitment to feed back experiences to the project were often ignored.'[78] It is argued that this failure to supply feedback information prevented a more active involvement of teachers in the project's development. Shipman makes the following conclusion as to the reasons for feed-back failure.

> *Again it seemed to be the effort required in providing feedback combined with reluctance to publicize problems that stopped this active participation.* 79

> *The difficulties over feedback were partly caused by the private nature of conventional classroom teaching that makes teachers reluctant to expose their problems to the public.* 80

Many of the factors reported here arising from Shipman's evaluation have also been made by other writers commenting upon other curriculum projects. MacDonald and Ruddock in discussing the Humanities Curriculum Project (H.C.P.) emphasise the particular demands made by this project in terms of new skills to be learnt. They talk of the un-learning of existing teaching habits, a task which can all too often lead to diffidence in the early stages. These writers also stress the importance of sufficient time being made available to enable teachers to become familiar with new teaching methods; they make the following observation.

> *In practice teachers generally are so concerned with system maintenance that their energy is spent in running to keep up with the status quo. Innovation needs time: time for teachers to familiarise themselves with any new teaching materials time to reflect individually and with colleagues on new experiences.* 81

Brown in an article[82] discussing the impact of the Scottish Integrated Science course upon secondary schools, argues similarly emphasising that 'time (should be) set aside in the timetable for teachers to discuss with each other and to demonstrate the material that is to be used.'[83]

In another publication[84], MacDonald (again reflecting upon H.C.P.) isolates other critical factors relating to teachers. In addition to the increase in work-load he includes three other factors: first, the undermining of confidence and competence which initially occurs (referred to as the 'negative Hawthorne effect' by Ruben); second, the fact that teachers appear to become unpopular with their colleagues who become suspicious of the innovators' motivations, resent the usually favourable allocation of resources innovating teachers receive and also feel threatened by the innovating ideas; and third the possible career risk to innovating teachers particularly if the innovation departs from a specialised subject structure (for example K.I.S.P, Man-A Course of Study, the Scottish Integrated Science Project and H.C.P.) on which promotion is normally based, embodies values alien to the organisation or involves teachers extensively with pupils of limited ability.

Another factor arising out of Shipman's evaluation was the effect of 'critical but involved teachers' in often producing more lasting effects within their schools. Shipman concludes that the failures were in those schools which either welcomed innovation or just accepted it rather than using it as an opportunity 'to work at creating change.' Gross et al more or less make the same point arguing that initial enthusiasm is not a sufficient pre-requisite for an innovation's successful implementation; the process is much more complex with barriers to implementation presenting a constant challenge. However it should be noted that several studies[85] highlight the importance of certain antecedent conditions for an innovation's success. One such antecedent is the degree to which organisational members have already worked within an atmosphere of innovation and general change, with the data indicating that the greater the past history of change, the greater the chance the innovation will be implemented.

Shipman also mentions the effect of staff turnover upon an innovation's progress in the trial stages. Although several schools participating in K.I.S.P. suffered through loss of teachers (in one school all seven of the team who joined in 1969 had left by 1972) with the possible consequence of failure to complete the trial period or failure to effect change in the anticipated direction, the result was not all loss. As Shipman points out, several of these teachers began integrated studies courses in their new schools so assisting the process of diffusion. Smith[86] in a follow-up study of the Schools Council Primary Science Project discovered that 'teacher emigration' had severely affected five of the original eight schools. He concludes that the migration of those teachers who had played an active role in the trial period (referred to by their colleagues as 'the real activists') could be responsible for the resulting decrease in teachers pursuing primary science in the post-trial period. However Smith also argues that because the original pool of 'activists' was small, the development of primary science in the geographical area studied, was particularly vulnerable to teacher migration. Like Shipman, Smith discovered that teacher movement had led to the diffusion of the innovation within new schools.

In 1973 the Curriculum Diffusion Research Project[87] conducted a questionnaire survey of science teachers to examine some of the variables influencing the dissemination and adoption of new curriculum projects (in this particular case, science innovations). The data showed a number of intersting features. First high adoption was found to be positively correlated with teacher appointment level (i.e. the 'high adoption group' contained more heads of departments than assistant teachers). Second, a curvilinear relationship was identified with the number of years of teaching experience such that teachers at the beginning and end of their careers were associated with lower adoption scores. Third, high adoption was negatively associated with initial professional training so that there were fewer teachers with a degree in the high adopter category. However Nicodemus in his analysis of the data[88] warns that 'generalizations from these simple associations are.....difficult to draw because of the complex inter-relations between the above data with school selectivity coupled with subject specialism.'[89] In a detailed discussion of these two factors (school selectivity and subject specialism) Nicodemus reports that the former was discovered to be related both to the relevance of the projects for the ability range of pupils and to the characteristics of teachers found in the different types of schools. These results not only highlight the possible importance of certain teacher characteristics, such as appointment level, number of years experience and subject specialsim, but also suggest that different types of schools with varying aims react in different ways to educational innovations; the latter forms a fitting introduction to the following section which examines those factors emphasising the organisational characteristics of the user-system.

The work of Ponder and Doyle[85] also highlights the important role of the classroom teacher in the process of curriculum implementation. They conclude that 'curriculum implementation is determined in large measure by teacher reaction to change proposals and by the ways teachers use innovations in the classroom.'[90] They add that 'user reaction derives from the destructive ecology of the classroom, an ecological system whose characteristics are set essentially by the often conflicting tasks of managing and instructing relatively large groups of non-volunteer students during comparatively long periods of time.'[91] The authors consider that one way teachers respond to this situation is to be sceptical about changes in their routine, and so teachers tend to examine change proposals in terms of how 'practical' they would be. Change proposals viewed as 'practical' are those which teachers will try to incorporate into their classroom procedures whereas those which are viewed as impractical 'have little chance of being tried unless control mechanisms, such as those which frequently accompany innovation projects, make teacher decision-making superfluous.'[92]

(ii) Factors Emphasising Organisational Characteristics

Gross et al argue that Rogers' model[93] of why individuals do or do not adopt innovations is of little help in understanding the innovation process within the school setting; their reasons are outlined below.

> *We believe, however, that this model has little use in explaining the success or failure of the implementation of innovations in schools or other types of organizations. Its lack of utility is due to certain of its assumptions which are not applicable to the implementation of organizational innovations. One of its basic assumptions is that during any of the intermediate stages between awareness and use, the individual is free to decide him-*

> *self whether the innovation shall be tried, and if tried, whether it should be continued. If the innovation does not interest him, he is free to reject it. If he is not pleased with his evaluation of it, he can discontinue his use of the innovation. This assumption does not apply to major educational innovations in most school situations, for example, those in which teachers are asked to redefine their roles by their superordinates, or in the cases where compensatory programs for lower-class urban schools have been designed by top administrators and teachers must carry them out. Moreover, the adoption of a particular program by administrators does not necessarily mean that it will be instituted or implemented at the school level......*
>
> *The Rogers model is concerned with the adoption of simple technological innovations by individuals, and it assumes that they can try out innovations on a small scale without the help or support of other persons. It also assumes that persons can undertake trials in an either/or fashion and that short trials are sufficient to render an effective evaluation.* 94

The authors go on to suggest that the current schools situation means that many innovations can neither be tried out on such a small scale nor implemented without the cooperation and support of fellow colleagues. Gross et al conclude that while the model may help one to understand adoption of 'single innovations among aggregates of individuals', it has little value in the organisational setting

Gross et al raise many interesting issues. First they suggest that teachers are not free-agents within the innovation process because important decisions are taken elsewhere by their superordinates or administrators outside the school. We have already outlined the role of the school superintendents in the United States of America as key personnel at the decision stage of educational innovation and pointed out that in this country similar power is found more at the headteacher level. In the next section dealing with support agents and agencies the various functions of personnel such as local authority Advisers will be discussed; it will be seen that the latter can play a large part not only in assisting the innovation once it is introduced but also in deciding which innovations are most appropriate in their area. Second, Gross et al infer that although an innovation may be introduced by administrators, in reality teachers may well not implement it at the school level. This raises the whole question of consultation between the various personnel involved in the innovation process. MacDonald and Ruddock argue that the headteacher has a central part to play here linking the ideas of the project team with the organisational setting of the school because his is the only person with a comprehensive view of the organisation. Thus he will be the only person able to anticipate the possible effects of an innovation upon the different sectors of the school and marshall the resources necessary to effect implementation for that particular innovation. Hoyle[95], in a discussion of the role of the head in innovation concludes that innovation requires: first, positive leadership; second, the use of persuasion rather than the issuing of instructions; and third, the existance of administrative procedures which emphasise flexibility rather than bureaucratic control. The third point to note from Gross et al's conclusions concerns the view that trying out innovations is a complex undertaking because teachers are limited by organisational constraints, such as the need for support from colleagues. If one looks at any of the major Schools Council projects one can find supporting evidence; cooperation is needed not only at the school level between fellow teachers but also between teachers and outside personnel such as Advisers, Inspectors, and project team workers.

It is not surprising that writers taking an organisational perspective highlight the need for effective strategies of management. Gross et al in their discussion of the four main barriers[96] to implementation of an innovation conclude that these present serious management implications; such barriers demand efficient strategy for feedback between the initiators of change and the implementers. Also, effective handling of these barriers can only take place if problem-solving mechanisms are in operation to deal with unanticipated as well as anticipated difficulties. Evidently such strategies involve both user and the user-system, and re-emphasise Stenhouse's plea for schools to see themselves as 'research and development' institutions, rather than the clients of research and development agencies.

Several writers have commented on the lack of effective strategies for curriculum innovation. Kelly, following his work with the Curriculum Diffusion Research Project, concludes that the lack of organised strategies for dissemination within both schools and local authorities generally is to a great extent caused by the non-specificity of role definition among the key personnel involved.

> *Their [the schools and local authorities] 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 L.E.A. personnel and headteachers considered they should play in diffusion.*
>
> *We were able to detect few examples of dissemination strategies that might be more widely applied.* [97]

Dickinson[98] makes similar comments. In his study he discovered that heads concentrated on successfully introducing innovations into the school rather than the evaluation of learning outcomes.

In an endeavour to improve the managerial aspects of innovation writers have isolated various factors which they see as crucial. For example, Walton[99] emphasises the importance of the time-table within a school. He argues that the time-table can be one of the most powerful constraints functioning within schools, largely because of its unchanging nature even in the face of an innovation. While accepting that some modifications have taken place, he argues that these have been piecemeal. Warwick[100] believes that the aims and objectives of the curriculum must be made explicit in the formal organisation of the school, with sufficient emphasis upon 'planning' to meet these aims.[101] Shipman, in his evaluation of K.I.S.P. highlights the general lack of consultation between heads and innovating teachers, reflecting the important role of the decision-making process existing within a school.

Looking more generally at the organisation, several writers emphasise the 'organisational character'[102] of a school and its relationship with the innovation. Miles uses the concept 'organisational health' to describe 'the school system's ability not only to function effectively, but to develop and grow into a more fully functioning system.'[103] He delineates criteria essential for such organisational health, including such items as: clear goals; adequate communication; high morale; innovativeness; autonomy; cohesiveness; optimum equalisation of power; optimum use of resources; adaptiveness to change and adequate procedures for resolving internal problems. Hoyle, commenting upon the concept, shares Miles concern that 'the metaphor of 'organisational health' creates some problems, for example, the tendency to treat an organization like some kind of gigantic person, and the danger of distorting reality by seeing all schools as conforming to, or deviating from this model.'[104] However, in spite of such problems, Hoyle concludes that such a concept at least allows one to visualise the type of school which is likely to be innovative.

Griffiths[105] in his attempt to isolate those factors which not only bring change but also sustain it within the school's organisational setting, arrives at two important conclusions. The first is that change in organisations is assisted by the appointment of outsiders rather than insiders as the chief administrators. It is argued that they introduce change either because they do not know the system or because they have different ideas about how it should run. The second conclusion concerns the structure of the school, and states that change is modified by the hierarchial nature of organisations. A hierarchial structure makes innovation from the grass roots virtually impossible. Reference has already been made to one aspect of this second conclusion in the discussion on decision making processes within the school. It might be worthwhile, therefore concentrating attention at this point on Griffiths' first conclusion. It might be suggested, in this connection, that the appointment of top management personnel represents a most important part of the planning procedure for educational change. Glatter, in his more general discussions about management development for the education profession, argues that 'resources are urgently needed for the creation of new learning situations and teaching materials in the context of British educational administration, developed co-operatively by the institutions providing programmes and local authorities, schools, colleges and national agencies.'[106]

3. *Factors Attributable to Supporting Agents and Agencies*

This section concentrates upon the various support services which exist to offer a back-up service for teachers engaged in curriculum innovation. In the previous section, the supportive role of the head within the school was outlined and note was taken of the type of help which the project teams ought to provide. We now turn to look in more detail at the general provision of support both at the local and national level, continuing as we do so, to isolate those factors which appear critical in the innovation process. The discussion ends with an analysis of one particular change strategy, the use of 'change agents', highlighting how in certain fields this can be a promising way of assisting the planning of change.

(i) Local and National Support

Shipman, in his evaluation of K.I.S.P. points to the differing aims of the local authority on the one hand and the national project team on the other; this led, he concludes to support being 'unsynchronised' and sometimes 'conflicting'. Whereas the project was concerned ultimately with the spread of integrated studies across the whole country, and as a result tended to look beyond the school, the local authority's emphasis appeared to be primarily on the general quality of work within trial schools (not just with integrated studies). It was difficult to assess the effect of local authority support because of the variety of methods used by different authorities. For example, different authorities set about selecting trial schools using different criteria. Even after this initial selection there were great differences between the various policies adopted. In one authority each school was credited a small capital sum and officials took an active part in checking the trial's progress, but in others the project received no direct support at all, although some schools did receive extra money after making requests for specific items. Where there was a lack of active support these authorities argued that such support was the role of the project team. From his experience with this particular project Shipman concludes that as a general strategy for curriculum change there needs to be much more support at the grass roots level rather than a concentration of resources at the centre. In defending this statement he claims that, taking an area within a fifty mile radius of the project, those schools on the periphery felt a distinct lack of contact not only with the centre at Keele but also with other schools. Such 'horizontal communication' between schools is seen as vital, not only as a means of sharing information about the trial, but also because it is a way of obtaining support and recognition. One could label one of the functions of horizontal communication as essential 'morale' boosting. Unfortunately with K.I.S.P. this type of communication was hampered by the late establishment of teachers' centres which made local meetings more difficult to arrange.

Like Shipman, Humble and Ruddock[107] (through their experience with the Schools Council project, the Humanities Curriculum Project (H.C.P.)) reflect on the differences between local authorities. They make the following comment about the effect of such differences on the diffusion of innovations.

> *The response of each local authority to innovation will differ according to its peculiar blend of innate features (size; geographical location; history; basic income) and its acquired characteristics (experience; resources; personalities). The innate features provide a framework of advantages and disadvantages in which the acquired features operate. The result is a set of highly individual patterns of role structure, and projects need to plan in terms of variety of local situation.* [108]

Experience with the H.C.P. showed that four factors, in particular, played a significant role in the project's progress. These were : (1) size of local authority; (2) policy for the allocation of money for innovation; (3) number of support staff; and (4) the location and use of the teachers' centre.[109] Looking at the first of these, it was discovered that in a compact county borough, innovating teachers could not only meet readily but also there was a greater chance of a coherent pattern of follow-up meetings being sustained. Urban areas were found to be not as dynamic and self sufficient as the team had been led to believe they would be. The compactness of the county borough appeared to create a uniformity which called for the establishment of other links outside the area so that new stimulus could relieve the development of this parochial view. The project team discovered that in a county there may well be more diverse experience but that this breadth of experience will not be used fully because of difficulties of bringing the teachers together. The greater distances involved in country areas brought organisational problems, so that the siting of institutions like teachers' centres came to have crucial importance.

Humble and Ruddock, commenting upon the second factor, argue that the availability of resources is important at all the various stages of innovation, and that the speed at which money can be made available is of crucial importance. It is suggested that where local authorities hold a central sum, budgeting is often used as a way of committing and controlling sums for future expenditure; a policy of this nature makes effective response in a time of rapid educational change more difficult.

The third factor, 'support staff', raises the whole issue of the changing role of the local authorities, particularly the Advisory service. Humble and Ruddock identify a shift from a 'quasi-authoritarian' stance to one which sees the support relationship with the teachers as more important. Viewed as a possible anomoly within this shift is the function of the newly created role of curriculum development officers who function primarily to co-ordinate and promote their particular scheme of curriculum development; such a function may well make him see national projects as competitors. However, the very appointment of such people is viewed as an acknowledgment of the growing importance of innovation and curriculum development. Various Schools Council projects have linked with local authorities through the use of co-ordinators/area organisers (e.g. K.I.S.P., Science 5/13 etc.). Humble and Ruddock see the establishment of local authority contacts as one of the most important steps in a project's plan; they are the main communication links. In H.C.P. where there was no consultation between the project team and the contact/co-ordinator to ensure how much the latter knew about the project, there developed a wide range of contact types in terms of status, power, experience and commitment to the project's aims; the implications for the diffusion of H.C.P. are obvious. In Science 5/13 the area organisers, first established in the trial period, were composed of an H.M.I., head-teachers, local authority Advisers and Inspectors, teachers' centre wardens and teachers. H.C.P. included a similar mix with the addition of an assistant education officer, a Schools Council project adviser and a curriculum development officer. Humble and Ruddock note the variety of response from local authority contacts; some acted in a prescriptive role, others in a facilitating one.

Humble and Ruddock's fourth factor involves the location and use of the teachers' centres. Earlier in the discussion we mentioned the importance of the siting of the teachers' centres within local authority county areas. The authors go on to isolate two factors concerning teachers' centres which are crucial in the dissemination of a national project. These are, first, the status and role of the teachers' centre warden and second, the investment in and the use of centre resources. Experience with the H.C.P. showed that considerable variation in both factors might be expected from one authority to another.

Other writers have also commented on the important role of teachers' centres; Crossland (in a review of the Nuffield Junior Science Project)[110], Shipman and Stenhouse are good examples. Stenhouse argues that their potential for stimulating effective curriculum development lies in their ability to encourage and support local research and development units. The same writer also discusses the possible conflict between local authority Advisers and teachers' centre wardens. Stenhouse shows how this conflict might be played out.

> *When tensions occur, advisers will often capitalise on their closeness to decision-making and real power: wardens will respond by playing their closeness to teachers.*
> *111*

Looking at the two categories of local Advisory staff and teachers' centre wardens together, Stenhouse suggests that they often hold the important role of 'gate-keeper' in the communication of information between projects and teachers in the locality and as such are key people in innovation. After a consideration of the evidence available he concludes that 'it is through the local authority and its advisory services that the opportunities open to schools and teachers are created, defined and negotiated.' [112]

Humble and Ruddock adopt a more general view when looking at differences in support provision between local authorities. First, because no detailed diffusion model exists which takes account of differences in values, policy and experience, they present a complex challenge to projects concerned with diffusion. One solution to the challenge is for projects to clarify goals and outline difficulties associated with diffusion, making clear the range of temporary and long term external support available to schools, and leave the local authorities to respond in a way appropriate to their particular setting. The second point refers to the attitude taken by different local authorities; this is closely related to the role assumed by the authority. The writers argue that the role of the local authority should be one of communicator and facilitator rather than promoter or censor. However in practice the latter appears to be more the case when decisions taken at the local authority level are essentially about rejection or adoption of a project. It appears difficult for authorities to commit themselves to more than one project in the same curriculum area which (against the Schools Council ideal) limits teacher choice. However, Humble and Ruddock argue that the rejection of a project by a local authority on the grounds of its controversial nature is an even more serious cause for concern. In summary the writers conclude that the existence of such a relationship between the Schools Council and the local authorities seems somewhat at odds with the fact that the former's finance and committee representatives are highly dependent on the local authorities.

Owen[113], himself a deputy education officer, points to the general lack of expertise at the local authority level in matters of the curriculum, a situation which not surprisingly has given rise to a form of curriculum development that is 'slow, jerky and not highly organized in its local management.'[114] The two main factors contributing to the situation are first, inexperience, and second the relatively low rating of curriculum development, in-service training and teachers' centres within the local authority budget system. This situation allows the authority to side-step the issue on the grounds of insufficient resources. The result is that curriculum development is limited to becoming either a 'local extension and interpretation of national projects (or possibly allowing) local initiatives to have enough encouragement to allow some brief flowering before they are ended or before they are developed more broadly.'[115] Owen reflects that this picture has altered slightly because of the influx of money via projects from such bodies as the Nuffield Foundation, the establishment of single-purpose teachers' centres and impetus from the Area Training Organisations who together with H.M. Inspectorate arranged joint in-service training courses.

Kelly, in a study of the extent to which schools use or reject project materials,[116] concentrated largely upon the communication and decision making processes by which local authority personnel become aware of innovations leading to their subsequent use or rejection. He concludes that the decentralised nature of education in England and Wales throws up 'a formidable array of structures and processes'. There was also a significant shortage of data on diffusion in L.E.A.s, a situation which led the team to suggest the introduction of a monitoring system to provide more information about types of courses and curriculum materials available in each authority; not only would this be of value to researchers but also to the authority itself. In addition it would allow diffusion research to be concentrated more constructively and effectively on local studies. Kelly also notes that within the sample of his study both local authorities and schools 'rarely used organized strategies of dissemination'. a finding that has already been discussed in some detail.

Most of the section so far has concentrated upon those factors relating to support at the local authority and national project level. However several other agents and agencies are also involved in a supportive role to curriculum innovation. Ruddock and Kelly,[117] in listing the various agencies important in the dissemination of information, also include the work of H.M. Inspectorate, subject associations (for example the work of the Association for Science Education in promoting new curriculur ideas in the sciences), teachers' professional associations, examination boards and publishers. Also within the overall innovation process reference ought to be made to the effect of central government in curricular decisions especially in the light of the government interest which culminated in the 'national debate'. Undoubtedly the main issues in that debate (the core curriculum, teacher training, the 16-19 age grouping and evaluation) have implications for the future direction of education so affecting future decisions about innovation.

To summarise it would appear that a substantial amount of imbalance exists between local authorities in their provision of support. As Humble and Ruddock suggest such imbalance leaves national project teams a formidable task in planning innovation strategies in different authorities. The general lack of coordination and strategies within the local authorities themselves provides curriculum planners with little information on which to base and implement support provision. The next section dealing with the use of 'change agents' suggests one strategy which may come some way to rectify the situation.

(ii) Change Agents

In an earlier part of the review the discussion briefly looked at the typology of linking agents proposed by Havelock. Perhaps the most popularised of these linking agents, particularly in educational innovation, is that of the change agent. As table 3.1 shows change agents appear in the category of 'consultants' whose functions can include the following: 'to assist users in the identification of problems and resources; to assist in linkage to appropriate resources; to assist in adaptation to use; facilitator; objective observer; (and) process analyst.'[118] Evidently the effect of change agents upon the implementation of an innovation depends upon the exact interpretation placed upon his function. Consultation can merely involve 'a very passive, impotent, almost bystander role,'[119] although recent developments have tended to alter this image. Staff at the National Training Laboratory (see Lippitt et al[120]) have developed a concept of the change agent which emphasises the need for client self-diagnosis and problem definition but nevertheless allows a certain degree of flexibility as to how much the change agent himself contributes in this strategy. He may provide the client with skills in problem formulation and problem solving and he may even make the client aware of change strategies. Thus, the change agent/consultant concept so developed can involve him as an active participant, a collaborator and a conveyor of knowledge about the process of change itself.

Rogers and Shoemaker define the change-agent as a 'professional who influences innovation decisions in a direction desirable by a change agency.'[121] They maintain that he is set off from the clients by the nature of his professional status (i.e. employment by a change agency) rather than because he lives in or out (or considers himself a member) of a particular system. Lippitt[122] emphasises the professional nature of the change agent's job and the particular training such a job requires. Rogers and Shoemaker itemise seven functions of change-agents where-by they assist the client in the various phases of planned change. These functions are: (1) he develops a need for change on the part of clients, (2) establishes a change relationship with them, (3) diagnoses their problems, (4) creates intent to change in clients, (5) translates this intent into action, (6) stabilises change and prevents discontinuances, and (7) achieves a terminal relationship with his clients.[123] In the final role it is the change agents' function to shift the client from a point of reliance on them to self reliance, so that the clients ultimately become their own change agents. These seven roles, which form a sequence of events, are adapted from the work of Lippitt[124] and Rogers and Svenning.[125] These roles are closely dove-tailed with the four functions of Rogers and Shoemaker's innovation-decision process.[126] Hoyle, reflecting on the novelty of the change agent concept in Britain considers intermediate roles which have less radical implications for the power structure existing in British schools; such intermediate roles might provide opportunities for experiments in consultancy. The roles he suggests are listed in table 3.2.

Rogers and Shoemaker suggest a number of reasons why some change agents are more successful in introducing innovations than others. Numerous researchers suggest that 'change-agent success' is positively related to

TABLE 3.2 Function Of The Change Agent And Other Intermediate Roles

Role	Potential incumbent	Function	Relationship to change process
Researcher	(a)	Evaluation of curriculum, teaching methods, technological innovations, and form of organisation	No direct relationship. Any change occurs through the operation of the Hawthorne effect
Catalyst	(b) (c)	Trials of curriculum or methods innovation (with or without evaluation) involving full-time or part-time participation in the school	No direct relationship. Change occurs via stimulation of interest, informal persuasion, demonstration of effectiveness of an innovation and Hawthorne effect
Resource	(b) (c) (d) (e) (f)	Makes systematic knowledge of curriculum or social science knowledge available to school on an *ad hoc* basis or through regular visits	No direct relationship. Influence on change variable and dependent upon persuasion or access to the power–coercive sanctions available to some roles
Counsellor	(b) (c) (d) (e) (f)	Makes systematic knowledge of curriculum or social science knowledge available to school with respect to specific problem. Perhaps carries out research or other form of analysis at the request of the school. Proposes solutions	Propose change but does not participate in change process
Change agent	(b) (c) (f)	Provides a basis of theory, analysis, research, and support functions related to change in staff perspectives, staff relationships, school organisation and curriculum.	Direct relationship. Collaborates with staff in identifying problems, evolving solutions and achieving change

(a) Research worker from university or research foundation
(b) Lecturer in college or university with curriculum knowledge
(c) Curriculum development specialist, e.g. centre leader, field officer[5]
(d) Local education authority's inspector or adviser
(e) H.M. Inspector[6]
(f) Social scientist from university, polytechnic or other organisation

Source: Hoyle, E., 'Planned Organixational Change In Education', in Harris, A, et al, Curriculum Innovation, Croom Helm, London, 1975, p.299.

the extent of change-agent effort. Other factors positively related to success are: (1) the existence of a client orientation rather than a change agent orientation; (2) compatibility of the change-agent's programme with client needs; (3) empathy of the change-agent with the client; (4) the change-agent's homophily (i.e. 'the degree to which pairs of individuals who interact are similar in certain attributes');[127] (5) the extent to which the change agent works through opinion leaders ; (6) the change-agent's credibility in the eyes of clients; and (7) a change-agent's efforts to increase his clients ability to evaluate innovations.[128]

Studies have shown that the degree of contact between change-agents and clients is positively related to certain features in the client population. These features include, high social status, high standards of education and literacy, and cosmopolitaness.[129] Rogers and Shoemaker conclude that although change-agents possess qualities allowing them to act as stimulators and initiators of collective innovation-decisions[130] they seldom act as legitimisers of collective decisions because they lack the necessary seniority, high status, social power and established credibility within the social system that a power holder must possess to sanction new ideas.

The change-agent's position can be seen to be essentially that of a 'marginal man' with a foot in at least two social systems. His success in linking the change agency (the social system 1) with the client system (system 2) lies at the heart of the process of planned change. Jenkins[131] would contend that as a marginal man he joins forces with the trial teacher and the project team worker.

Havelock looks outside the change agent role to linking roles in general and identifies several problems relating to them. The two main ones are, first, 'overloading', where the linker simply finds that he has too much to do, and second, (a factor discussed already) that of 'marginality'. It has been argued that one cause of marginality is 'recency' where a particular role has just been created and developed. In education, where the linking role is of fairly recent origin, Havelock forecasts greater difficulties with the problem of marginality than say in agriculture where the county agent has a well established linking function

4. *Interaction of Sets of Factors*

The chapter so far has discussed those factors which have been highlighted in the literature as important for the implementation of curriculum innovations. They have been divided into three discrete categories (factors attributable to the innovation itself, factors attributable to supporting agents and agencies). It is clear , though that while these three categories can affect the implementation of an innovation they may interact with each other. This has been recognised by writers in a number of instances. For example, Shipman, in his evaluation of the Keele Integrated Studies Project[132] highlighted the way in which factors attributable to the user system (in this case school size) and those factors attributable to the innovation itself (in this case its emphasis upon team teaching and the need for team meetings) could affect the use of the project. However, he also pointed to the relationship between the two factors. The quotation below reflects this relationship.

> *In eleven of the thirty-eight schools team meetings were scheduled within timetabled hours. In another twenty-three schools meetings were held in coffee or lunch breaks or after school. It is difficult to over-estimate the importance of these team meetings. The discussion of content and organization by different subject specialists was possibly the most stimulating part of the innovation to the visitor. But in the majority of schools it meant sacrificing free time. This was not necessarily lack of effort to provide planning time within school hours. In small schools it was impossible to release a team of six or more teachers simultaneously for a planning meeting.*
> 133

Thus it is clear then that this research must not only take account of the association between the three discrete categories of factors, listed earlier in this section, and the continuation of the Science 5/13 project in the trial schools, but that it must also take account of the possibility of interaction between them.

Footnotes

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3. Ibid, pp. 167 - 168.
4. For further details see: Ibid, p.138.
5. For further details see: Ibid, p.139.
6. For further details see: Ibid, p.139.
7. For further details see: Ibid, p.139.

8. Ibid, p.139.
9. For further information see: Ibid, p.155
10. For a fuller account of the various adopter categories see p.67
11. Roger, E.M., Shoemaker, F.F., Op Cit, p.27.
12. The term 'innovation-decision process' refers to the paradigm presented in Rogers, E.M., Shoemaker, F.F., Op Cit, pp. 101 - 128.
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19. Shipman, M.D., Inside A Curriculum Project, Methuen & Co Ltd., London, 1974.
20. For further details see p.52
21. Miles, M.B., 'On Temporary Systems', in Miles, M.B., (ed), Op Cit, pp. 437 - 492.
22. For a discussion of the characteristic features of 'temporary systems' see: Ibid.

23. Miles, M.B., in Miles, M.B., (ed.), Op Cit, pp. 631 - 662.

24. Miles defines 'divisible' as the ability to be adopted on a patial, flexible basis.

25. For further details see: Mort, P.R., 'Studies in Educational Innovation', in Miles, M.B., (ed), Op Cit.

26. Bolam, R.,'The Management of Educational Change : Towards a Conceptual Framework', in Harris, A., et al, Op Cit, pp. 273 - 290.

27. Defined as 'the extent to which it can be experimented with on a limited basis'.

28. See for example: MacDonald, B., Ruddock, J., Op Cit, where they comment about the possible dilution and distortion that can occur.

29. Barnett, H.G., Innovation : The Basis of Social Change, McGraw-Hill, New York, 1953.

30. Intrinsic factors are defined as 'those which are inherent in an innovation', and extrinsic factors as 'those which have meaning only in the context of specified audiences or adoption settings', Havelock, R.G. Planning for Innovation Through Dissemination and Utilization of Knowledge, Centre for Research on Utilization of Scientific Knowledge, Institute of Social Research, The University of Michigan, Ann Arbor, Michigan, 1969, p. 18 - 38.

31. For further details see p.55

32. For further details see: Griffiths, D.E., 'Administrative Theory and Change in Organizations', in Miles M.B., Op Cit., pp. 428 - 430.

33. Hoyle, E., 'Organisational Theory and Educational Administration' in Baron, G., Taylor, W., Educational Administration and the Social Sciences, Athlone Press, London, 1969, pp. 43 - 44.

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58. Rogers, E.M. Shoemaker, F.F., Op Cit, p. 27.

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97. Kelly, P.J., Final Report of the Curriculum Diffusion Research Project, Chelsea College, University of London, 1975, p. 70.

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99. Walton, J., 'Structure and the Curriculum', in Walton, J., (ed.) Curriculum Organisation and Design, Ward Lock Educational, London, 1971.

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102. For further details see : Open University, Op Cit, (Unit 13), p.27.

103. Hoyle, E., 'How Does the Curriculum Change', Journal of Curriculum Studies, 1969, Vol 1, No 3, p. 231.

104. Open University, Op Cit, p. 28.

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CHAPTER 4

Developments in Science Education in Great Britain with particular reference to the Science 5/13 Project

Introduction

There are two main aims for this chapter. The first is to examine recent developments in science education so that the context in which the Science 5/13 project was developed can be explored. In this context the work of a number of important bodies which had a major influence on the development of science education is considered. These bodies include, the Association for Science Education (A.S.E.), the Nuffield Foundation, the Schools Council, the Department of Education and Science, the Scottish Education Department and Her Majesty's Inspectorate (England, Wales and Scotland). Although the review of the work of these bodies is not confined to their interest in the five to thirteen age group, this interest is given particular emphasis. The second aim of this chapter is to look directly at the Science 5/13 project : its aims and its development.

Major Influences on the Development of Science Education

1. The Association for Science Education

Any attempt to trace recent developments in school science must include the contribution made by the Association for Science Education (A.S.E.). This professional body has had an important impact upon science at all levels of the primary and secondary school. The Association has not only had a direct effect upon individual teachers through its membership and literature, but also indirectly and possibly more importantly through its many working parties which have offered valuable suggestions for future policy to the government of the day and bodies such as the Nuffield Foundation, who by their subsequent recommendations and projects have greatly influenced the type of science we see in the schools today.

One of the main influences stimulating change in the early 60s was the Policy Statement, 'Science and Education'[1], issued by the S.M.A. and A.W.S.T.[2] in 1961. The main aim of the Policy document and the accompanying syllabus recommendations was to review the science curricuulum at the secondary level with a particular emphasis on the science taught in grammar schools. Science was to be seen in much broader terms, more suited to the needs of the present rather than the past, where both the specialist and the non-specialist would be adequately catered for. Not only would this necessitate changes to include more science appropriate for the non-specialist but it would also involve removing some of the then existing material which was viewed, either too difficult or too out-dated. This would then allow space for more relevant topics to be introduced. Also, there was a need, it was felt, for students to fully appreciate the 'methods of scientific investigation'.

It would be incorrect to suggest that previous reports had not mentioned the need to make science more relevant to the environment in which the child was living, or had notemphasised the contribution made by science through its approach to problem solving. As early as the 1920s and 1930s both the Hadow[3] and the Spens Reports,[4] in their combined review of the curriculum for pupils aged eleven to sixteen years, stressed each of these points. For example the Hadow Report which looked at elementary education spoke of the need for children to see 'the practical application of science to everyday life.. by reference to the environment (e.g. gardens, or local industries, or local geology and geography), or by a course of housecraft for girls.'[5] The Spens Report, published some years later, stated that if science was to be a living subject it must deal with the pupil's own experience. The report additionally emphasised the utility of science, not only in the evolution of present day civilisation but also for developments much further away in the future. The need for science to appear relevant to the child and the importantce of the 'process of science' were to develop as distinctive features of later reports. They will be referred to later in the chapter.

There was concern too by the Association to assist in the implementation process. It was felt that there was a particular need for effective in-service training for teachers. Also, in the longer term, it was hoped to establish a permanent institute which would undertake further research into science education. While realising these needs it became clear that additional help would be required to put these ideas into practice. Waring[6] in her review of developements at this time reports that little assistance was given to curriculum innovation by central government. Sir Alexander Todd, Chairman of the Advisory Council on Scientific Policy indicated that the British government would be unlikely, in the prevailing economic climate, to offer the kind of support for curriculum development given by the U.S. government. He suggested that the Associations might approach the Nuffield Foundation for assistance. This approach was made and as Clark[7] reports, together with action from other pressure groups like The Royal Society and the Institute of Physics, resulted in financial aid which led to the setting up of the Nuffield Foundation Science Teaching Project. The initial task of this project was to develop new materials in the three main sciences for the 'O' level examination. Nuffield Junior Science, the forerunner of Science 5/13, was one of a number of projects included under the umbrella of the Nuffield Foundation Science Teaching Project. Details of the work of the Nuffield Foundation in science education, particularly for the five to thirteen age grouping will be discussed later in this chapter.

The Association for Science Education, did not simply express its interest in science education through its links with the Nuffield Foundation, but developed its own work. During the 1970s the Primary Science Sub-Committee of the A.S.E. had issued several publications; these reflected an underlying philosophy in keeping with the Association's earlier work in the 1960s. They stressed the importance of the scientific process rather than a set content. In addition, they argued that science should arise out of the children's interests and the basis for this work should be the immediate environment of the child. It was suggested that the best way of presenting science would be alongside other subjects using an integrated approach. Following a review of existing science provision in primary schools in the early 1970s, the Committee made these comments;

> *(i) There are still too many primary schools where experience designed to help children to form scientific ideas is inadequate or lacking;*
>
> *(ii) too many Head Teachers are insufficiently concerned about the lack of science teaching in their schools;*
>
> *(iii) many class teachers are still fearful of tackling appropriate work in science because they have failed to realise that what is required in primary schools under this name is within the power of any teacher to develop.*
> [8]

They concluded that insufficient thought had been given to the role of the headteacher in relation to science work. The head was considered important because he was in a position to provide the necessary leadership for good team work within a school. Also they felt that general guidance on organisation was needed; for example, on how to deal with problem situations and how to manage resources so that they were used effectively. This concern resulted in the publication of two further papers[9]. Those publications have since been supplemented by a number of audio-visual aids suitable for a variety of in-service work at the local level. A consultative document entitled 'Alternatives for Science Education'[10] stressed the importance of in-service work if either the Nuffield Junior Science Scheme or the Schools' Council's project Science 5/13 were to be used for the first time in a school. In summary it would appear that the Association had become aware of the important role to be played by senior staff in the primary school. This includes their leadership role and also the important part they play in the effective management of resources.

2. The Nuffield Foundation

Waring,[11] in her analysis of the factors responsible for the increased interest in science education in the early 1960s by bodies like the Nuffield Foundation, concluded that the most important stimulus for development was the advances being made in science and technology during this period. However there also appear to have been a number of agencies here and in the USA which influenced the policy finally adopted by the Foundation. In the following quotation, Farrar Brown, Director of the Foundation, lists a number of these.

> *The Nuffield Foundation has for some time been interested in helping to improve the teaching of science in schools. It has had in view not only the new proposals for G.C.E. examination syllabuses drawn up in 1961 by the Science Masters Association and the Association of Women Science Teachers, and the work on curriculum reform initiated in the same year by the Scottish Education Department, but also the science teaching projects conducted in America under the National Science Foundation, the series of conferences on the teaching of science organised by O.E.C.D. and many similar ventures in Britain and overseas.*[12]

Clark[13] in his biography of the Nuffield Foundation also mentions the influecne of organisations like the S.M.A. and A.W.S.T.. In addition he describes how individuals like John Lewis, who as Senior Science Master at Malvern College pioneered new ways of science teaching and after studying science education in Germany and Russia made a number of suggestions for changes to the British system. It was in the light of discussions with people like John

Lewis that the Foundation appeared to move away from an earlier idea of setting up a National Institute towards the idea of assisting 'carefully selected individuals to work full-time for a year or two on the problems of providing new text books, teachers' guides and classroom demonstration equipment, all in relation to the new O-level syllabus'.[14] This was the beginning of the Nuffield Science Teaching Project (N.S.T.P.).

In December 1961, the Trustees of the Foundation contributed £250,000 towards the scheme. It was to be a comprehensive long-term programme to look into the science curriculum in Britain. The basic philosophy of the project was outlined in the following statement.

> *The central objective is 'science for all' - not merely for the future specialist but for the future citizen in the latter half of the twentieth century.*
> *15*

A progress report for 1964 not only expanded on the necessity of 'science for all', but also described the type of science which the programme was aiming to stimulate.

> *Education in science [is] an essential ingredient in a humane education as well as an indispensible foundation for adult life and work in a world in which science and technology are rapidly increasing in influence. The programme's aim is to give children a well-grounded understanding of science or a branch of science, not a knowledge of disconnected facts. Even at school it is not too early for young poeple to think about scientific things in the way that practicing scientists do. Thus the objective throughout the Science Teaching Project is to encourage children to think freely and courageously about science. In the long run this will make for better scientists, better technologists, and more liberally educated people. An essential part of the philosophy guiding the Science Teaching Project is the belief that the best way to awaken original thinking in children studying science is to engage them in experiment and practical enquiry.*
> *16*

As expected the first task of the N.S.T.P. was to follow up the recommendations made by the S.M.A. and A.W.S.T. for revisions in the 'O' level syllabuses for Biology, Chemistry and Physics. Table 4.1 gives brief details of these and later projects which formed part of the Science Teaching Project. Originally the idea had been to organise the projects along lines similar to their American counterparts with eminent scientists taking the lead, but this idea was later modified to bring in organisers who had an interest in both science and science education. It was appreciated from a very early date that there would be a need for good liason between projects like the original 'O' level schemes and bodies like the Examination Boards. Later projects of the N.S.T.P. were to look at other aspects of the secondary science curriculum including the 'A' level projects, (which produced teacher and pupil materials for courses in Biology,Biological Science, Physics, Physical Science and Chemistry), the Nuffield Combined Science Scheme and the Secondary Science Project.

This research has a particular interest in the Nuffield Junior Science Scheme as it was the forerunner of Science 5/13. Although, like Science 5/13 it aimed to meet the needs of the five to thriteen age group, it tended to concentrate on the junior years within the primary school looking mainly at the seven to eleven year olds. The project began in 1964 and published materials in 1967. The materials were all teachers' materials with none specifically for pupil use. This was so that a flexible approach could be taken by primary science teachers which would meet the varied interests and abilities of the pupils. A project which saw science 'primarily as a way of working

TABLE 4.1 The Various Projects included in the Nuffield Foundation Science Teaching Project

Title	Duration (Years)	Age Range	Ability Range	Begun	Material Published
O-Level (Physics, Chemistry, Biology)	5	11-16	Above	1962	1966-67
Junior Science	8	5-13 (mainly 7-11)	All	1964	1967
A-Level (Physics, Chemistry, Biological Science, Physical Science)	2	16-18	Sixth Forms	1964	1970-2
Combined Science	2	11-13	All	1965	1970
Secondary Science	3	13-16	Not likely to take O-levels in science subjects	1965	1971

Source: Schools Council, Curriculum Bulletin 3 - Changes in School Science Teaching, (Evans/Methuen Educational, London, 1970), p.11.

with the accumulation of knowledge as an important though secondary consideration'[17] would clearly find pupil kits and/or workcards unsuitable. Instead there was guidance to teachers on how they might start work in science and develop it to meet pupil interests and needs. A considerable amount of the teachers' materials dealt with the organisation of suitable resources.

The whole ethos of the course was child centred and based upon Piagetian theory. The result was that science at the primary level was designed to offer children a wide range of practical experience which would involve them actively in problem solving situations. Only in this way could problems arise out of children's own interests. It was believed that the child's world was an integrated whole rather than a series of isolated subjects. Arising out of this approach the teacher's role was basically three-fold. First, the teacher was responsible for providing a suitable, well-equipped, environment, in which the child would encounter a wide range of practical experience. Second, as the following quotation indicates, it was necessary for the teacher to create an atmosphere conducive for enquiry so that children would become accustomed to asking questions.

> *It is usually necessary for the teacher to move amongst the children and discuss with them the materials they are examining. It is then that the ideas begin to flow and the questions to be asked.* [18]

Very much interwoven with these functions was the third role of 'guiding' the children along their route of discovery. An important part of such guidance was the proper use of discussion between child and teacher; discussion was seen as vital to the process of developing scientific enquiry, so enabling the teacher to discover if the child's ideas needed further refinement. Guided discovery in these terms placed the emphasis away from the more formal type of class teaching, and if teaching as such was required, the Junior Science Project team argued that it 'may be only a brief session, just sufficient to satisfy the immediate need for help and start the children going again.'[19]

Several attempts have been made to evaluate the effect of individual projects within the N.S.T.P.. Most of these have been carried out after the projects have been in the schools for several years. The independent evaluation carried out by Crossland, with the help of finance from the D.E.S., examined the progress of the Junior Science Project during the period 1966 to 1967 when in fact the project team was still working together.

In an article[20] outlining the main findings of his research Crossland made several interesting points. One of these centred on the 'approach' of Nuffield Junior Science, as seen by those teachers who previously had laid greater stress on the more formal approach to teaching. Although it appeared that most of these teachers took the project seriously, some were worried by the apparent lack of structure and knowledge content; this concern was most prevalent amongst those who dealt with the older nine to eleven age-range. Conventional teachers of this type were seen to suffer from a twin-handicap of having to deal, not only with new subject material, but also with a new approach based on 'child centred' activity. In addition these teachers found the preparation courses inadequate.

> *Right from the start, many of these teachers felt that they had been inadequately prepared. Some described the orientation courses as shock treatment and found them woolly and frustrating. Putting adults in discovery situations similar to those envisaged for their pupils was not acceptable to all teachers as the best way of training teachers in Nuffield methods.*
>
> *21*

The Nuffield Mathematics Project, which was introduced at roughly the same time as the Junior Science Project, was considered by conventional teachers to offer a more acceptable approach with material which was more workable and structured.

Crossland's report did indicate, though, that teachers and children alike required a certain amount of time to adjust from the formal to the more informal approach. Some of the teachers visited during their fifth term of using the Nuffield material appeared far happier than they had done after three terms.

In contrast, it would appear from the report that the more progressive teacher saw nothing radically different in the approach, except that it demanded a greater extension into scientific areas. However, the report showed that such teachers varied in the degree of freedom they allowed the child in initiating investigations.

One area which received a certain amount of attention in the report was the inadequacy of the teacher's background knowledge in science; although some teachers found their lack of scientific knowledge a positive advantage, many found it a handicap.

> *Many teachers have found their lack of scientific knowledge a handicap: they started with a feeling of inadequacy and lack of confidence; with time they became frustrated, insecure, and unable to venture. The following disadvantages were noted:*
>
> *(a) Sometimes unable to recognize lines of enquiry which might be fruitful.*
>
> *(b) No knowledge of what materials to make available*
>
> *(c) Recording of progress more difficult - not based on tests and examinations*
> *22*

Burstall in her evaluation of the Primary French project[23] reported similar staffing difficulties in some of the trial schools. There was a problem in these schools of maintaining a sufficient number of trained french teachers. When the role of teachers' centres was examined by Crossland, the report was more favourable, it was suggested that the centres provided useful courses on the Nuffield material, though it was noted that many teachers felt that more fundamental changes were necessary to the content of initial training courses if the problems they had faced were to be overcome.

One other area of concern raised in the research report was the use of the project in the secondary school. It was clear that the author felt that the Nuffield approach was not applicable at that time in the secondary school. A list of reasons was given including: one, a rigid timetable based on subjects which clearly worked against an approach based on interest and enquiry; two, the specialist training of the teachers meant that an interdisciplinary approach was almost entirely new to them; three, the existing structure of laboratories with their equipment meant that children's interests could easily be caught without reference to the environment. These types of comments highlight the considerable difference in approach between the primary and secondary sectors of education and suggests that any project which tries to cross these boundaries is likely to encounter major problems.

The Crossland investigation included a limited follow-up study: this was based on a sample of children, who as juniors had taken part in the 1965-66 trials, but at the time of the follow-up were in the first year of secondary school. Out of the schools chosen for the study, three reported that no differences could be found between 'Nuffield' and 'non-Nuffield' children's approach to science. Of the two who discovered certain differences, one reported that the results were 'perhaps too over-whelmingly in favour of the Nuffield project',[24] and the second found that although the Nuffield children were generally more lively and interested, their examination results were not particularly favourable. If one watned to interpret these results further, one would need to know a great deal more about the type of science teaching involved in both the primary and secondary schools concerned.

However limited the Crossland study may have been it did attempt to carry the evaluation conducted by the Nuffield Junior Science Project one step further and to construct a follow-up study of children after they had experienced the Nuffield approach. The Organizer of the project, when reviewing the independent enquiry, spoke of the need for an even more extended evaluation procedure.

> *The study was carried out in a very restricted time, on a severely limited number of teachers, and was an attempt to assess the effectiveness of the trial publications. Obviously any valid assessment must examine the much more extensive final publications, and would need to follow children through the whole of their school careers, or at least over a number of years.*
> 25

The trials of the Science 5/13 project not only included schools from the primary sector but also secondary schools where there was considerably more competition from existing science schemes. It is important, therefore, to examine a number of the Nuffield Science projects which were available for the eleven to sixteen age group and which competed with Science 5/13 in the trial and post trial periods. Middle schools, particularly those covering the nine to thirteen age range, attempting as they did to introduce science to pupils in their last two years, tended to have a similar range of 'competitive' materials at their disposal.

A nationwide survey conducted in 1973 by H.M. Inspectorate[26] produced results indicating very broadly how schools were using the various projects. The sample included 1,732 secondary schools with all types of schools within the 11 - 18 age range represented. Table 4.2 lists all the Nuffield science projects included in the survey except the A-level schemes. The figures given in the table indicate the number of schools either 'using' parts of the material or 'doing' all of the project. These figures tend to highlight the fact that a larger

TABLE 4.2 Science Courses Studied in Secondary Schools in England and Wales in 1973

Results based upon answers to a questionnaire sent to 1,732 schools (boys, girls, mixed)

Project	Eligible Schools	'Doing'		'Using'	
		Number	Percentage	Number	Percentage
N. O-level Biol. First two years only	1600	89	5.6	136	8.5
N. O-level Chem. First two years only	1600	94	5.9	137	8.6
N. O-level Phys. First two years only	1600	93	5.8	131	8.2
N. O-level Biol. All five years or years 3,4 and 5	1669	161	9.7	567	34.0
N. O-level Chem. All five years or years 3,4, and 5	1669	196	11.7	549	32.9
N. O-level Phys. All five years or years 3, 4 and 5	1669	203	13.0	563	33.7
N. Sec. Science (not including grammar and sixth form college, 1300)	1659	130	7.9	429	25.9
N. Combined Science	1639	500	30.5	381	23.2

There were 170 nil returns (9.8 percent)

Source: Booth, N., 'The Impact of Science Teaching Projects on Secondary Education', *Trends*, 1975, Vol. 1, p.29.

number of schools were 'using' parts of a project rather than teaching all the package. However, while this is true for most projects, it is not the case with the Nuffield Combined Science scheme. Booth[27] argued that the overall popularity of this project could be attributed to the way in which it fitted into the existing organisation of the majority of schools. Nuffield Secondary Science reflected the opposite trend where schools selected only parts of the material. The reasons appears to be the amount of material contained in the scheme; there is so much that parts had to be selected out. Booth suggested that in the case of the Nuffield O - level schemes, the reason for the higher number of schools 'using' parts of the course was that either the style or content of these projects was not seen to meet all their needs and preferences, or that there were difficulties in acquiring the necessary resources.

Booth outlined two areas in which mis-match can occur between a project's philosophy and the setting in which it is to be used: one arises out of the type of internal organisations existing in the school and the second arises from the type of teaching style in use. Booth argued that while it may be necessary for projects to fit in with the existing organisation of a school, there is more room for manoeuvre when it comes to changing teaching styles. Both initial and in-service training can make an important contribution in fostering new teaching styles which aim to meet present day needs where the emphasis is upon individual and small group learning.

In his concluding remarks, Booth argued that the basic principle of the Nuffield Science Teaching Project, 'I understand when I do' can cause serious problems both at the school and local authority level. In the classroom it involves the teacher in more practical work. If assistance is not available for preparation of materials the burden eventually may become so great that the teacher finds it difficult to follow the scheme as it was originally intended. Carter[28] voiced similar concern in his analysis of the Nuffield Combined Science Scheme. Booth also argued that the Nuffield projects can involve heavy expenditure at the local authority level. Therefore local authorities should have the right to demand some justification for money well spent. Finally Booth questioned the basic Nuffield principle, 'I understand when I do'. He argued that when pupils leave school many will be forced into the situation of trying 'to understand science without doing'.

A second survey, also conducted in 1973, this time as part of the Curriculum Diffusion Research Project (C.D.R.P.)[29], enquired into the use teachers made of several science projects including those of the Nuffield Science Teaching Project. The results are shown in table 4.3. The findings for the Nuffield A-level projects have not been included. Teachers' use of the individual projects is measured on a 5-point scale ranging from 'no response' to 'use of all or most of the materials'. A comparison of those schools 'doing' the various projects (D.E.S., survey) against those teachers 'using all or most of the material'. (C.D.R.P. Survey) is shown in table 4.4. Both surveys highlight the popularity of the Combined Science Scheme.

TABLE 4.3 Teacher use of materials or ideas from a number of Nuffield Foundation Science projects.*

	Percentage of teachers				
	No response or not using	Using ideas	Using less than ¼ of materials	Using less than ¾ of materials	Using all or most of materials
Nuffield Projects					
O-level Biology	60	12	12	9	7
O-level Chemistry	59	11	8	12	10
O-level Physics	57	11	14	8	10
Combined Science	51	12	8	9	20
Secondary Science	59	19	11	6	6

Source : Nicodemus, R.B., 'Why Science Teachers Adopt New Curriculum Projects', Educational Research, 1977, Vol. 19, No.2, p.84.

* In total 17 science curriculum projects were examined

TABLE 4.4 A comparison of the D.E.S. and C.D.R.P. Surveys

	D.E.S. Survey % 'doing'	C.D.R.P. Survey %'using all or most of materials'
Nuffield Projects		
O-level Biology	9.7)	7
O-level Chemistry	11.7)*	10
O-level Physics	13.0)	10
Combined Science	30.5	20
Secondary Science	7.9	6

* These results include schools using the course for years 3, 4 and 5 only.

However, Shayer in his research into the suitability of the materials of Nuffield Combined Science for pupils concluded that 'at the most 20 per cent of a representative sample of comprehensive school pupils will have made enough penetration into the basic concepts so that, retrospectively, they will have interpreted the teaching sequences which were designed to lead to them'.[30] He went on to argue that the main problem was that no model was available at the time projects like Nuffield Combined Science were developed of the likelihood of children of different ages and abilities understanding the material: consequently the developers had used their own experiences of teaching.

Shayer analysed a number of other Nuffield Science projects; he looked at the concepts involved in the schemes in terms of Piagetian stages of development and tried to ascertain from this how suitable such concepts are for the children who use them. His research in this area started with an examination of the Nuffield O-level projects. In his work with the Nuffield O-level Biology Scheme[31] he put forward two reasons why he considered the course unsuitable for average selective school pupils; first, the level of thinking was at least a year too early at all points, and second, more needed to be done to help pupils organise their knowledge of biology. He went on to outline ways in which the course has been improved. He pointed to the work of Reid and Booth[32] who had succeeded in adapting much of Year 1 to suit the complete range of first-year entry in comprehensive schools. Also the Resources for Learning Project[33] had attempted to provide individualized learning in five key areas for third year comprehensive forms. Kelly and Monger[34] in their evaluation of the course materials for the Nuffield O-level Biology Scheme referred also to concepts which appeared too difficult, but hoped that revisions to the content of the course would help overcome these problems. They highlighted other problem areas which include, for example, that experiments were too often unsuccessful, that the language in some sections was at an inappropriate level, and that some objectives were not adequately dealt with. At a more general level it was found that the course was largely dictated by the content of the students' texts with the teachers' guides used infrequently. While in the early stages of adoption a closely structured course was appreciated by teachers, it was thought that with experience of the course more flexibility was needed to adapt the materials to the individual circumstances of different schools. It could be argued that this contrasts sharply with Science 5/13 which although structured by the use of aims and objectives, attempted, by the use of teachers' materials, to help teachers meet the particular interests and ability needs of their pupils.

Although Shayer[35] found more awareness on the part of the authors of the Nuffield O-level Physics Scheme of the need to meet the conceptual level of pupils he concluded that the 5-year scheme produced by the project was accessible at all points only to those pupils in the I.Q. range of 105+. However, he acknowledged that much of the work for years 1 and 11 was accessible to a much wider range of the school population and that it was only in the third year that difficulties occurred.

In their analysis of the Nuffield O-level Chemistry course, Ingle and Shayer[36] concluded that only a bright public school boy beginning the course at 13 years of age might find little difficulty dealing with the concepts in the course. The normal grammar school child might be expected to have difficulty with much of stage 2 up to nearly the beginning of the fifth year.

Two of the surveys discussed earlier in the chapter[37] highlighted the popularity of the Nuffield Combined Science Scheme. It attempted to use the material of the previous O-level projects and present a unified approach to science for children aged eleven to thirteen years. The scheme considered ten topics which linked together the material of the three separate courses and formed a bsis for later stages of the O-level schemes. The topics were presented as pupil activities and aimed to meet a much wider ability range than the previous projects. Thus there was an attempt to meet the needs of more mixed ability classes. It was mentioned also, earlier in the discussion, that there was considerably more competition in secondary than in primary schools from other science projects like the Nuffield O-level projects and Nuffield Combined Science. The degree of popularity of Nuffield Combined Science in the middle schools, particularly those catering for the nine to thirteen age group with their emphasis upon secondary type work for the eleven to thirteen age group, is an important concern of this research as the sample population included areas containing middle schools. Therefore it is of interest to discover if, and how, Nuffield Combined Science competed with Science 5/13, particularly in the post trial period.

3. The Schools Council

The Schools Council came into being in 1964. A quotation from the first annual report describes the origins of the Council and its main areas of concern.

> *The Schools Council for the Curriculum and Examination... [usually referred to as the Schools Council]...grew out of a recognition by all branches of the education service that co-operative machinery was needed to organise a more rapid, and more effective, response to change... The problem was remitted in July, 1963, to a working party widely representative of the education service... the outcome was the Lockwood Report, recommending the establishment of what is now the Schools Council.... the Secretary of State for Education and Science was asked to appoint the first chairman of the Schools Council and to take the other steps necessary to bring the new body into being...*
>
> *The Council met for the first time in October, 1964, under the chairmanship of Sir John Maud....Its first tasks were to complete its constitution and membership following the guidelines laid down in the Lockwood Report; to assume responsibility for most of the curriculum and examinations work previously carried out by the former Secondary Schools Examinations Council and by the Curriculum Study Group of the Department of Education and Science and to decide on its initial programmes of activity.* [38]

The 'initial programmes of activity' fell into one of two categories. They were concerned either to assist projects already initiated by other bodies, or to involve work in completely new areas of the curriculum. The material previously under development by the Nuffield Foundation in the fields of science, mathematics and foreign languages fell into this first grouping.

The co-operative arrangement which existed between the School Council and the Nuffield Foundation raised the question of the respective roles of the two bodies. An early Schools-Council Report[39] gave a clear answer to this question. The responsibilities of the Nuffield Foundation, it said, lay in, the development of the teaching materials, with the provision of support services, such as the organisation and evaluation of trials assigned to the Schools Council. The Schools Council was seen as one of several agencies to which the Foundation could turn for advice. Liaison between the two bodies was made a good deal easier because many former members of the Curriculum Study Group, who had experience of working with the Foundation, joined the Council's staff when it was established.

The second category of activities involved the Council in organising its own projects which by 1976 had reached over 160. The Council attempted to standardise the procedure by outlining the pattern by which curriculum projects might develop. The pattern drawn up consisted of five main stages: the first involved a preliminary investigation of the particular area of the curriculum concerned; the second, which would only come into operation if further development was needed, required the Council to appoint a project team of teachers, who with the assistance of professional researchers, designers and film-makers, would produce the necessary materials; the third consisted of trying out the new material in an attempt to evaluate its worth and make the necessary modifications before publication (such a procedure would involve the Council both in liaison with L.E.A.s to choose the necessary 'trial' schools, and in making the appropriate arrangements towards preparation courses for the teachers and local representatives concerned); the fourth was concerned with the 'diffusion' or 'passing-on' of the project's ideas by those who have been involved in the previous development work, through a machinery of courses organised by such bodies as L.E.A.s, University Institutes of Education, Colleges of Education, professional associations, and the Department of Education and Science, which, whenever possible would present alongside the Schools Council material any other available in the same area, so that teachers could examine a number of different approaches to the same problem; the fifth and final stage was to attempt an overall evaluation which might well be written up as a report and published.

This pattern was very similar to that followed by the Nuffield Foundation with the Science Teaching Project and typifies the Research Development and Diffusion model (R.D. & D.) which was later to come under such strong attack. Critics argued that its centralised approach left the teachers as passive recipients of curriculum packages[40]. Later projects such as 'Geography for the Young School Leaver' reflected a change in emphasis with more attention paid to the creation of local curriculum development groups. These were established to promote a co-operative framework for those teachers wishing to take part in the project. In this way some of the Schools Council's projects have become more decentralised. Over the years there has also been a growing awareness of the importance of the later stages of a project's development. This includes the stages of dissemination, adoption and implementation. The result has been more emphasis upon the 'after care' of projects. There has also been more general research into this area: for example, a research project was undertaken on the 'Impact and Take-up of Schools Council Projects[41]'.

Table 4.5 gives brief details of the science projects with which the Council was concerned from 1964 - 1976. The list clearly indicates the trend toward more localised development which the Council hoped would result in the production of ideas suitable for a wider coverage. The three most recent projects listed were Independent Learning in Science, the Swindon Mixed Ability Exercise in Science and Science for the Less Able Child, and are all of this type. All three attempted to find a solution to two important questions: first, how to cope effectively with mixed ability classes; and second how to find a meaningful course for those children of less than average ability who were in their final years at secondary school.

The types of materials produced varied but included those specially written for teachers and pupils working in the classroom; pre-service and in-service guidelines for Colleges, University Departments and teachers' centres; reports; films; and pupil tests. In the primary sector the emphasis at the classroom level clearly was upon teacher materials and more recently pupil materials to assist discovery learning in science. The activities suggested, reflected a total adherence to the Piagetian theory of child development. The underlying philosophy was in keeping with a child-centred approach which attempted to take full account of the environment of the child; its origins can be traced to Plowden and other similar reports. The Primary Programme began with the Science 5/13 project, a continuation

TABLE 4.5 Schools Council Projects In Science Begun During or Before 1976

PROJECT NAME	AGE-RANGE	DURATION	TYPE(S) OF MATERIAL PRODUCED
Science 5/13	5-13	1967-73	T
Children Explore Thier Environment	9-13	1969-71	F
Educational Use of Living Organisms	9-18	1969-72	T/R
Progress in Learning Science	5-13	1973-76	T/R
Development of Scientific and Mathematical Concepts	7-11	1968-73	R/X
Nuffield Combined Science	11-13	1965-69	T/P
Project Technology	11-18	1967-72	T/P/R
Independent Learning in Science	11-18	1975-76	T/P/L
Swindon Area Mixed Ability Exercise in Science	11-14	1975-77	T/P/L
Nuffield Secondary Science	13-16	1965-70	T/P
Integrated Science Project	13-16	1969-75	T/P/X
Measurement of Understanding of pupils in Learning Science	14-16	1966-69	R/X
Attitude to Science Scales	14-16	1966-69	R/X
Evaluation of Science Teaching Methods	14-16	1970-75	R
Science for the Less Able Child	14-16	1975-77	T/P/L
Modular Courses in Technology	14-16	1976-78	T/P/L
Nuffield A-level Biological Science	16-18	1965-70	T/P
Nuffield A-level Physical Science	16-18	1965-69	T/P
Nuffield A-level Cehmistry	16-18	1965-72	T/P
Nuffield A-level Physics	16-18	1966-71	T/P
Reduced Science Courses	16-18	1969-72	R
Engineering Science	16-18	1970-73	T/P

Key
- T Teacher material
- P Pupil material
- R Report
- F Film
- X Tests for pupils
- L Projects that are local in operation (although have wider importance)

Source : Schools Council, School Council Report 1975-76, Evans/Methuen Educational, London, 1976.

of the Nuffield Junior Science project. Science 5/13 became the forerunner of two further projects; 'Progress in Learning Science', which provided pre-service and in-service materials for teachers to help match pupil activities to pupil needs and 'Learning Through Science' which began work at Goldsmiths' College to produce pupil materials for the 5 - 13 age range and look more closely at the general dissemination of Science 5/13.

4. The Department of Education and Science and H.M. Inspectorate

The Schools Council for England and Wales represents just one way in which the Secretary of State for Education and Science can help to promote research into various aspects of the curriculum. This section examines other ways in which the central government has been involved with science education and some of the more general questions it has considered which have had consequences for the type of science taught in schools.

A survey carried out in the 1970s by H.M. Inspectorate[42] concluded that the position of science at the primary level was less than satisfactory. It suggested that the considerable efforts at national and local level to stimulate primary science using new curriclum development projects appeared to have had only limited impact in the majority of schools. While many teachers had tried to present children with opportunities for stimulating enquiry by using a nature or interest table and taking them on visits to areas of local interest, there seemed to have been little systematic work in the development of enquiry skills linked with other key 'scientific notions'.

In about two-fifths of the classes looked at in the survey the television was used to support and stimulate science work. While assignment cards and books formed another useful resource, especially for starting points and general reference, it was argued that these resources could have been used to even greater effect if they had been used as an aid to science being undertaken at first hand. Generally there was a lack of appropriate equipment even of the basic kind; the situation did not improve as the children moved up the primary school. In classes where an effort had been made to introduce children to the content and method of science, the greatest emphasis had been placed upon work relating to plants and animals; this situation was probably the result of the particular expertise of the teacher.

The report argued that the greatest obstacle to the improvement of science in the primary school was the primary teacher who lacked 'a working knowledge of elementary science' and therefore, as a result, either excluded science from the curriculum altogether or provided only a superficial coverage. The report recommended that those teachers who had a background in science should be used more effectively. It also suggested that those teachers who had special responsibilities in science should receive on-going help in the form of general support and in-service courses and that more attention should be paid to the acquisition and efficient use of resources. Finally the report advised that much greater attention should be paid to providing more science in pre-service courses.

An earlier report issued in the 1960s by the D.E.S. described how science could be linked in quite naturally with other 'environmental subjects'.

> *....The pursuit of science....is no more than a natural extension of a process already developed in other environmental subjects and is in keeping with children's interests.....It can be grouped quite naturally with, and indeed will overlap, other informative subjects such as history and geography, and like them, it will make good use of the tools of speaking, reading, writing and mathematics. It will knit well with the child's whole education.* [43]

Other parts of the same report had emphasised the importance of the 'scientific method' and the need for including a wider science content which went beyond a study of animals and plants.

These views were later reflected in the Plowden Report.[44] The basic philosophy of this Report was a child-centred approach with the teacher providing a full and stimulating environment. In this way children would come to enquire and enter into problem solving situations; as children became older this would involve greater precision and a higher degree of generalisation. It was envisaged that science of this type would not only enhance development of the '3 Rs' but also find an easy association with other areas of the curriculum. The result would be an integrated approach organised to meet the developmental level and interest of the particular child.

At a more general level the question of the transition between the primary and secondary sectors of education has been mentioned in a number of the Department's reports. These discussions have led to suggestions about the type of science which should be taught at the primary and secondary interphase. The Plowden Report with its recommendation for middle schools brought the whole subject into focus. A D.E.S. pamphlet[45] issued later in 1970 drew a sharp distinction between the average primary school with its flexible approach and the majority of secondary schools with their rigid and fragmented curriculum, which relied heavily on specialisation. It was argued that, even for the eleven year old, full specialisation within this restricting framework, was undesirable. As early as 1939 the Spens Report[46] had argued against the desire of secondary schools to assume the traditional grammar school type of curriculum. The report had suggested that activity and experience were no less important in the secondary sphere than in the primary school. Similar comments about the adaptation of the curriculum to the needs of the individual child were made in other later reports, including, for example, the Norwood report[47].

Perhaps the most important document to be issued concerning the middle schools is a publication by the D.E.S., entitled 'Towards the Middle School'.[48] While recognising that middle schools were still in their infancy, it presented some ideas about the type of education best suited for children of ages 8 - 13. The pamphlet began by examining some of the difficulties which the middle schools have met because of the influence of the existing primary and secondary schools.

> *And since many middle schools will be established in former secondary schools, already provided with specialist rooms and often inheriting teachers who*

have previously taught along these lines, there will be a tendency for conventional subject-teaching in specialist hands to persist - and indeed to be extended to younger children.

Such an arrangement is unlikely to be satisfactory, despite the excessive load which class teachers of older juniors carry - a load which would become intolerable if a single teacher continued to have all-round responsibility for the education of children of all levels of ability in the final years of the middle school.

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With regard to the question of the appropriate age for introducing more specialised teaching the document had the following to say.

To introduce full specialist teaching at 8 or 9 would be a disaster; to develop it at 10 or 11 would be largely to forfeit the advantages that one hopes to obtain in the middle school.

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The suggestion was that specialisation should play a major role in the curriculum towards the upper end of the middle school only. However, there were indications that specialist teachers who were sensitive to the needs of younger children could fill a valuable role in the middle years.

For the youngest children there is certainly much to be said for the flexibility towards which primary schools are moving. At this age, there are some undoubted advantages in the class teacher having responsibility for most of the curriculum, including French, Music and Physical Education. But none of these are likely to suffer gravely - and indeed they may gain - if they are handed over to experts who are also sensitive to the needs of young children. As children become older, a great measure of differentiation in the curriculum becomes suitable. Even before they are 8 they will distinguish physical education, music and some aspects of mathematics from their other learning..... In other work a unifying goal - constructing and using a bird-table or simple weather station....overshadows curricular distinctions. But teachers should plan and assess specific content and skills in such work, even though they are also quick to take advantage of spontaneous developments. By the time children near the end of the middle schools, some

> *will certainly be ready for a more elaborate framework round which to organise their knowledge, and will recognise discrete elements in that framework. The developments need to be gradual, and to avoid, as far as possible, a marked change at 11 which might perpetuate a primary-secondary break within the new schools.*
> 51

The pamphlet made a number of recommendations about possible subject groupings which would fit in with this line of thought. One suggestion placed science along with geography and history under the heading of 'environmental studies': work in this area was seen to emphasise elements which we have mentioned earlier as part of the scientific method. Although it was realised that some 'short-cuts' might be necessary in order to equip children with sufficient knowledge to cope with their surroundings, it was emphasised that most general scientific statements arrived at during the middle years should arise out of direct experience. Investigation and continued investigation were seen as the best ways of bring children into contact with the scientific method. In addition 'environmental studies' would incorporate mathematics, art, and language as basic tool subjects. An alternative arrangement saw science linked more directly with mathematics. It was suggested that they often shared common ground work and that the same teachers might be competent in both areas.

When organisational needs were examined it was argued that a time-table using 'blocks of time' would be most appropriate for areas, like science, which were based on the empirical approach; this would ensure that the necessary flexibility could be made available. Still dealing with the internal organisation of the middle school, the question of co-operative teaching was raised. It was suggested that even with the youngest age-groupings a certain amount of co-operative teaching was necessary, particularly in areas such as the use of available resources. By the second and third year, co-operative work would begin to involve the assistance of teachers in different subject areas. The following quotation shows how team teaching was seen as one particular technique which could be used if a year group were working, more of less, in an individual manner.

> *By the second and third years, teachers who may be covering the bulk of the curriculum with their classes would probably benefit from some support from a year group leader or a consultant teacher working beside them in the classroom. On occasions when the bulk of a year-group are working individually, two or three teachers might be moving amongst them, giving assistance according to their particular strengths. At such times the help of a supernumerary art and crafts teacher might be available to children (singly, in small groups, or in whole classes) who need skilled help in recording and displaying the results of their enquiries. Such specialists could also be invaluable by giving guidance on techniques.*
>
> 52

Another point also concerned with the question of organisation involved the type of specialised equipment and facilities appropriate for science in the middle years. The following quotation indicates the changing needs of the children as they pass through their middle years of education.

> *The building has to allow for different ways of working as the children pass through the school....Groups of the youngest children are likely to spend most of their time with one teacher, whereas the oldest will meet more teachers and need easier access to more advanced equipment and facilities, at least in science....*
>
> 53

In conclusion, it would appear to have been argued that the middle school should attempt to provide a more flexible and continuous curriculum for the 8 to 13 year olds than existed previously in the traditional primary-secondary type of organisation. However, it could be argued that certain factors might work against this type of philosophy. For example many 8 - 12 middle schools which develop out of existing primary schools will contain staff who have been 'primary trained'. Thus it may be difficult, especially if physical conditions are unfavourable, for those teachers to change their teaching style, especially with the older age groups, to favour a slightly more specialised approach.

5. The Scottish Education Department and H.M. Inspectorate

The work of the Scottish Education Department shows many similarities with its English and Welsh counterpart, and it faced similar problems. In the primary field the Primary Memorandum[54] of the mid 1960s echoed the sentiments of D.E.S. reports. It contrasted the more traditional approach of nature study with the newer development towards environmental studies where science was included along-side history and geography. In the early years (5-9 years) an integrated approach through 'centres of interest' was advocated with emphasis at all times upon 'observation, investigation, discussion and recording' of aspects of the child's environment. The concepts of quantity, space and time were highlighted as particularly important at this stage. Later work (9 - 12 years) might profitably involve more systematic subject studies: however this did not imply a total separation into subjects. In a section which dealt more specifically with the aims of science, the teachers were advised not to use any form of rigid syllabus in their endeavour to prepare children for secondary work.

It was also argued that it would be wrong for teachers to insist on children memorising factual knowledge; it was believed that children would be much better employed attempting to find answers to problem situations. Further, the primary level was not thought an appropriate point to begin using elaborate equipment; the involvement of the children themselves in making their own apparatus was seen as a valuable part of the learning process.

The S.E.D. was also involved in the Schools Council's primary science project, Science 5/13, contributing over £10,000 to the cost and taking an active part in the trials of the project. Later, H.M. Inspectorate compiled a report entitled Environmental Education[55] which considered ways in which schools could help children explore the environment around them. The approach is an integrated one with science included as just one of the subjects to be considered.

At the secondary level the S.E.D. was responsible in the early 1960s for organising new alternative courses for pupils taking 'O' and 'H' level examinations in science. In the mid '60s the Secretary of State for Scotland set up the Consultative Committee on the Curriculum (C.C.C.) which was to play an important part in later developments at the secondary stage. The aim of this Committee was to give the Secretary of State specialist advice on the school curriculum. It is responsible for a number of committees and curriculum development centres which promote development in particular subjects and areas of school education. Like the Schools Council it has neither power over, nor responsibility for, the content or management of the school curriculum. What is taught in schools is determined by education authorities and headteachers in the light of guidance which might be issued by the Secretary of State for Scotland. Members of the C.C.C. are appointed by the Secretary of State in a personal capacity and do not represent particular organisations or sectors of education. Members come from a variety of backgrounds including schools, Universities, Colleges of Education, further education, education authorities, H.M. Inspectorate, the Scottish Certificate of Education Examination Board and the Scottish Council for Research in Education. Both the Chairman and the committee secretariat are members of the Scottish Education Department. The structure outlined has led to a close knit relationship between the various sectors of education and it could be argued that as a result the C.C.C. has more influence over curriculum development in Scotland than the Schools Council in England and Wales.

One of the most important initiatives of the Consultative Committee on the Curriculum in science came with Curriculum Paper 7 (C.P.7.)[56]. This document which was issued in the late 1960s dealt with two distinct areas; first, an integrated science scheme proposed for all children in the first two years of secondary school (12 - 14 years) and second, a course of study suitable for those children (aged 14 years and upwards) who would not be sitting the Scottish 'O' Grade examination in science. Accompanying this document were a number of pupil worksheets (often referred to as the Heinemann sheets after their publisher) which attempted to encourage a discovery approach in science for the first two years. It soon became apparent that modifications were needed to meet a wider range of abilities than had previously been appreciated. The need was particularly acute in mixed ability classes where materials were urgently needed to allow teachers a more individualised approach. The result was that a working party was set up under the auspicies of the C.C.C.. This produced sets of new worksheets and teachers' guides. These worksheets contain 'core' material for all children so that the basic concepts of the course are covered with extra work to consolidate ideas for the least able and extension sheets to stretch the more able. Research conducted at the University of Stirling and financed by the S.E.D. attempted to evaluate the implementation of the Scottish Integrated Science Scheme. This included the original Heinemann worksheets and the new versions as they became available and were tried out in the schools. Brown in her study of the Scheme's implementation[57] isolated a number of problem areas. One of the main issues to arise was the vague way in which key terms such as 'integration' and 'guided discovery' were defined and discussed in C.P.7. The result was that in the schools teachers had implemented the course in their own way depending upon their particular interpretation. An examination of the type of objectives teachers were working towards revealed that in the main these were content objectives; objectives concerned more with the 'method' of science received much less attention.

Later work which looked more closely at the new worksheets took more of an 'action research' approach. This involved teachers and researchers making hypotheses about why difficulties had arisen with suggestions for possible solutions which could be tried out. One of the main difficulties encountered concerned the need for teachers to differentiate between the various abilities of pupils and then match these abilities with suitable activities. The guidelines offered in the materials produced by the Central Working Party appeared insufficient when teachers attempted to use the new worksheets in a mixed ability setting. The following conclusion was made by the research workers.

> *It is our view that success is possible only if teachers themselves articulate the attainment criteria that concern them, develop internal assessment procedures which they can see to be sensible and practical, and devise their own strategies for deciding what tasks pupils should undertake and for organising their classrooms. On the other hand, the kind of mixed-ability teaching that is being proposed clearly implies new ways of pedagogical thinking and the development of radically different teaching procedures from those to which the majority of teachers are accustomed, and it would seem unreasonable and over-optimistic to expect teachers to introduce such changes without any external help.* [58]

At a more general level, Brown[59] argued that much more needed to be done to adequately define the purpose of newly created posts such as assistant heads which could have considerable impact upon curriculum development within schools.

In 'Science - A Curriculum Model for the 1980s'[60] the Scottish Central Committee on Science, under the auspices of the C.C.C., provided a possible pattern for future developments in science education for the early secondary years. Like the revisions which took place in 1962 with the introduction of the new syllabuses, the Committee recommended that certain revisions should be made so that the syllabuses remained up-to-date but the emphasis was clearly toward 'a common core' for S1 to SIV (12 - 16 year olds).

The Science 5/13 Project

The Science 5/13 project was sponsored by the Schools Council (its chief sponsor), the Nuffield Foundation, the Scottish Education Department and the Plastics Institute. Table 4.6 lists the financial contributions made by these bodies. The project, set up to consolidate and extend the work of an earlier primary science project, Nuffield Junior Science, began in 1967 and was based at the University of Bristol, School of Education. The project director was Len Ennever. The project team are listed in Appendix A. The main part of the project ended in 1973 although some activity took place after that date with the setting up of an After-Care committee to oversee further dissemination of the project after the trials ended.

The new Schools Council project team were keen that their work should be used not only in the primary school but also in the first two years of the secondary school. A number of possible names were suggested for the project such as 'Introductory Science Study', 'Elementary Science Teaching Project', and 'Early Science Education Study'. 'Science 5/13' was chosen as the title because it gave a clear indication of the age range the project was aimed at.

TABLE 4.6 Financial Contributions to Science 5/13

INSTITUTION	FINANCE GIVEN
1. Schools Council	£137,200
2. Nuffield Foundation	£ 18,000
3. Scottish Education Department	£ 10,340
4. Plastics Institute	£ 2,000

Source: Elliott, J., 'Science 5 - 13' in Stenhouse, L., (Ed.), Curriculum Research and Development in Action, Heinemann Educational Books, London, 1980, p 96

The broad terms of reference initially laid down for the continuation project were given in a Council memorandum. The relevant paragraphs are reported below.

> *The main direction for the work of such a project is seen as extending the lines of development initiated by the current Nuffield Project while paying particular attention to the needs of older junior pupils, and pupils in the early years of the secondary schools. The existing Nuffield team necessarily concentrated their efforts on the needs of Infants and younger Juniors; the needs of older pupils are now therefore the main concern....*
>
> *The principal aim of the project is seen as the identification and development, at appropriate levels, of topics or areas of science related to a framework of concepts apprapriate to the age of the pupils. The aim of the development would be to assist teachers to help children, through discovery methods, to gain experience and understanding of the environment, and to develop their powers of thinking effectively about it.*
>
> *Account will naturally have to be taken of the different needs of children of varied ability, according to their interests and aptitudes. Similarly,the question of supplementing, to some degree, the content of different environments for children in rural and town schools is one which will need attention.*
>
> *This is likely to highlight another area of study, namely the best way of increasing the average primary school teacher's knowledge of modern science. The secondment of teachers for additional training, in present supply conditions, does not seem likely to be a remedy. The team will be encouraged to stimulate local experiment-ation to meet this need, perhaps through courses based in the teacher centres already set up in some areas. The team may also be able to consider how to advise colleges of education about the content of curriculum and general education courses which would equip teachers better to tackle science teaching in the primary school.*
>
> *61*

The second section in the quotation refers to 'a framework of concepts appropriate to the age of the pupil'. In a leaflet, issued at the beginning of the project, Len Ennever explained the difficulties in locating such a framework.

> *The project team and their advisers could find no statement in the literature of a framework of concepts appropriate to the ages of the children and related to science: to establish a valid one would entail long fundamental research too extensive for this project to undertake, necessary as it is. An attempt was made to postulate such a framework as a first approximation, but the result proved insufficient as a reliable guide to the work of the project.*
> 62

However the need to state 'objectives' was still considered important and after discussions with teachers and others, the original idea of a framework of concepts became a statement of operational objectives. In the first newsletter issued by the Science 5/13 project it was clearly stated that this statement of objectives was not'in any way definitive, but rather a personal statement - one of many such statements that could be equally valid and that could serve as indications to teachers of what might emerge if they set themselves the task of putting into words their own objectives for children.' [63]

The broad terms of reference also highlighted the need 'to assist teachers to help pupils, through discovery methods'. This emphasis upon the teachers as the people responsible for deciding what was most appropriate for their classrooms meant that the project moved away from using a prescriptive approach. In 'With Objectives in Mind' [64], the teachers guide to the philosophy behind Science 5/13, it was made clear that the statements of objectives 'indicate the outcome, but do not prescribe the means of reaching it'. [65]

Diagram 4.1 shows the relationship between the main aim of the project ('developing an enquiring mind and a scientific approach to problems') and the eight broad aims. Each of the broad aims was then broken down further into the statements of objectives which were discussed earlier.

The project based its ideas of child development upon the work of Piaget. However the project team decided to construct their own three stages of development which in part overlaped with those of Piaget: these are described below.

Stage 1 - This stage of development includes some pre-operational and some concrete operational thought but includes, in the main, the transition between the two.

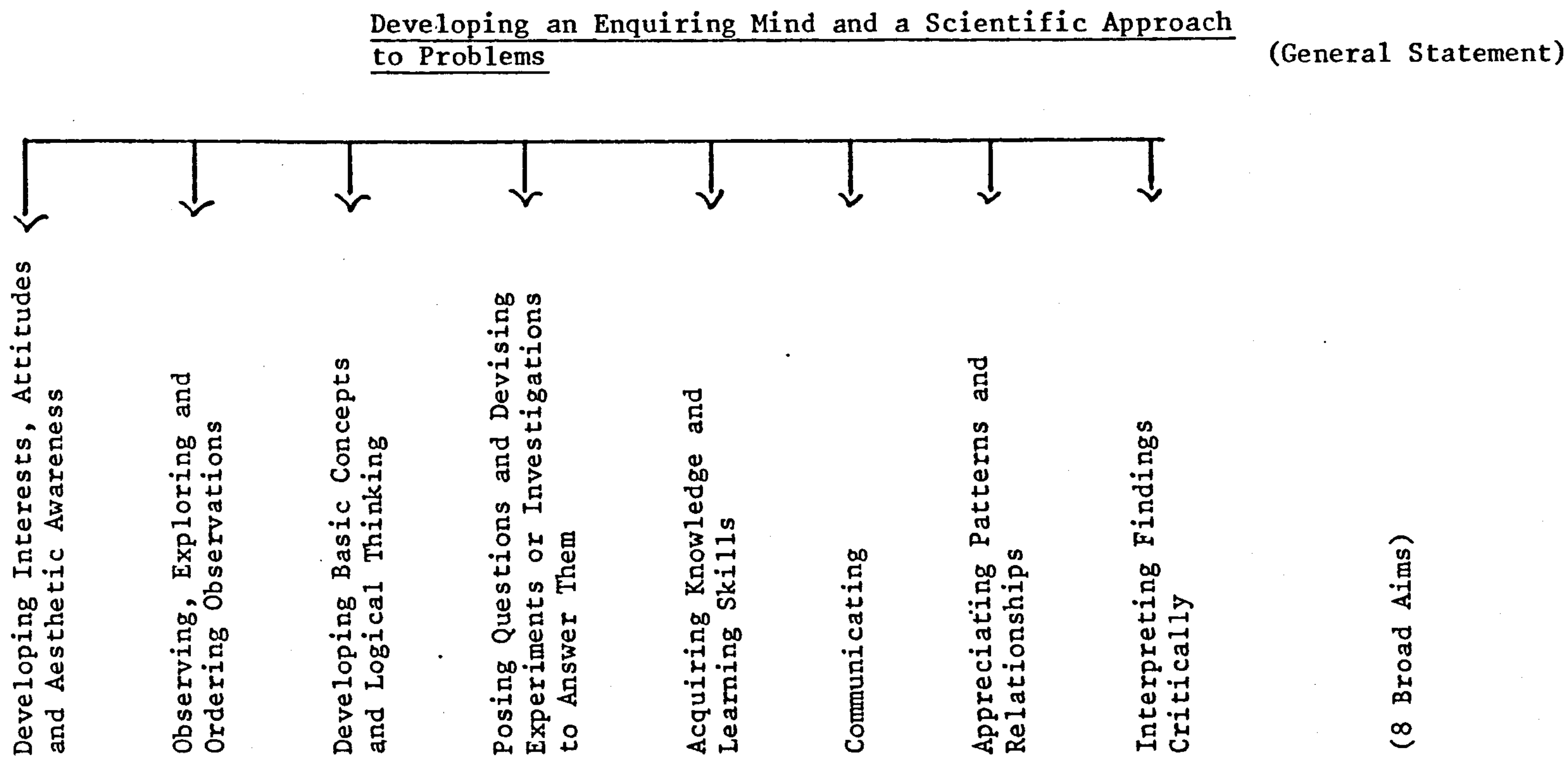
Stage 2 - This stage of development includes concrete operational thought.

Stage 3 - This stage of development includes the transition from concrete operational thought to formal operational thought.

The Project team believed that each of their stages, like Piaget's, was built upon the one before, so that children pass at individual rates through the stages in the same order from stage 1, through stage 2 to stage 3, and that age is no guide to which stage of development a child will be at.

The broad aims, then, were broken down into the behavioural objectives appropriate for each of the three stages of development. Diagram 4.2 shows, for example, how the broad aim, 'developing basic concepts and logical thinking' was broken down into objectives for stages 1 to 3.

DIAGRAM 4.1 Broad Aims Arising out of the General Statement



Source : Schools Council - Science 5/13, With Objectives in Mind, Guide to Science 5-13, (Macdonald Educational, London, 1974), p.59.

Diagram 4.2 The Objectives Appropriate at Stages 1 to 3 for the Broad Aim 'Developing Basic Concepts and Logical Thinking'

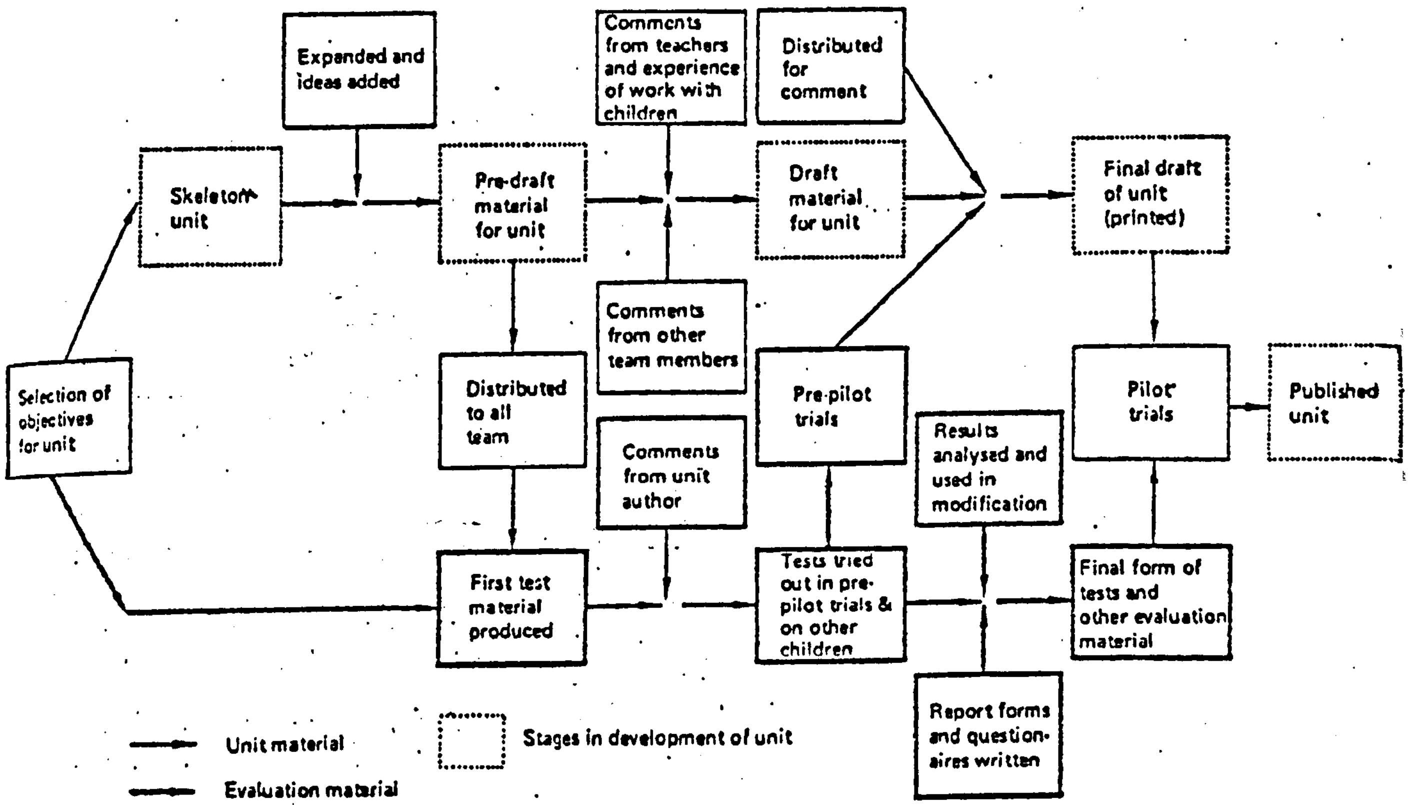
	Developing basic concepts and logical thinking	
Stage 1 Transition from intuition to concrete operations. Infants generally.	1.31	Awareness of the meaning of words which describe various types of quantity.
	1.32	Appreciation that things which are different may have features in common.
Concrete operations. Early stage	1.33	Ability to predict the effect of certain changes through observation of similar changes.
	1.34	Formation of the notions of the horizontal and the vertical.
	1.35	Development of concepts of conservation of length and substance.
	1.36	Awareness of the meaning of speed and of its relation to distance covered.
Stage 2 Concrete operations. Later stage.	2.31	Appreciation of measurement as division into regular parts and repeated comparison with a unit.
	2.32	Appreciation that comparisons can be made indirectly by use of an intermediary.
	2.34	Appreciation of weight as a downward force.
	2.35	Understanding of the speed, time, distance relation.
Stage 3 Transition to stage of abstract thinking	3.31	Familiarity with relationships involving velocity, distance, time, acceleration.
	3.32	Ability to separate, exclude or combine variables in approaching problems.
	3.33	Ability to formulate hypotheses not dependent upon direct observation
	3.34	Ability to extend reasoning beyond the actual to the possible.
	3.35	Ability to distinguish a logically sound proof from others less sound.

Source : Schools Council - Science 5/13, With Objectives in Mind, Guide to Science 5 - 13, (Macdonald Educational, London, 1974), p.62

The project team produced twenty-four teachers books, called units, which examined different topic areas, such as wood, metals and time. These are listed in Appendix B. All the units were for teachers, some providing background information for teachers about topics such as 'time', others giving advice about the type of behavioural objectives to be achieved and possible ways of achieving these as illustrated from classrooms visited during the trials. Earlier units dealt with fairly specific topics such as wood and metals. Later ones looked at more general areas, such as the unit entitled 'Change' and a series of units by Margaret Collis which examined the environment. Towards the end of the project an additional unit entitled 'Understanding Science 5/13' was prepared to help teachers assess the value of the project to them, whatever their knowledge of science. It was intended for group of individual study by teachers or students.

The project team decided to use a 'formative type' of evaluation where initial drafts of the units were tried out in schools and as a result of feedback from teachers, together with test results indicating pupil performance in terms of the objectives achieved, the draft copies were revised and published. The evaluator, Wynne Harlen joined the project team at the beginning of the project, and although she was not concerned directly with the writing of the units, the process of on-going evaluation meant that she had to keep in fairly close touch with the team. Diagram 4.3 (the lower part deals more specifically with the evaluation procedures) indicates this fairly close relationship which existed between the work of the evaluator

DIAGRAM 4.3 Development Of Unit Material And Evaluation Material



Source: Schools Council, Evaluation in Curriculum Development: Twelve Case Studies, Schools Council Research Studies, (Macmillan, London, 1973), p.20.

and the remainder of the team. In all there were four sets of trials, stretching from 1969 up to 1972 which, involved nineteen local education authorities in England and Wales and four local education authorities in Scotland and in total involved 378 trial schools.[66]

The way in which the Science 5/13 project developed fits in with the trends in science education which were discussed earlier in this chapter. For example, the publications of the Primary Science Sub-Committee of the A.S.E. in the early 1970s emphasised the importance of the scientific process at the primary level rather than a set content. This was the approach taken up the the Science 5/13 project team where scientific skills such as 'observing, exploring and ordering observations' were the basis for the materials produced. In 'With Objectives in Mind' it was stated that 'the content area must be new to children; that is (a) it engages their attention; (b) it gives them opportunity to do something, to construct, to collect, to explore and find out; (c) it stimulates them to think for themselves and causes spontaneous discussion'.[67] Also in the same unit it was made clear that 'these units do not in any way constitute a course or even part of a course. They are illustrations of ways in which a teacher might go about helping children to achieve objectives she has in mind for them.'[68] The Plowden Report[69] expressed the need for a child-centred approach which would take account of different developmental levels and interest. This approach was built into the basic philosophy of the Science 5/13 project with its emphasis upon the work of Piaget and the belief that 'in general children work best when trying to find answers to problems that they have themselves chosen to investigate.'[70] The emphasis upon 'discovery learning' contained in the Nuffield Junior Science Project was continued in Science 5/13 but differed in that it attempted to give teachers more help to understand discovery learning situations and the types of behavioural objectives which could be achieved.

The argument being put forward is not that Science 5/13 has no distinctive features, for clearly this is not the case. However, Science 5/13 was developed around a number of approaches that were used at the time in science education more generally and as such the project can best be viewed in that context.

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CHAPTER 5

Design of the Empirical Research

Using the literature review to generate areas for research

Chapters 2, 3 and 4 were organised around literature reviews: the second chapter examined curriculum innovation and models of change; the third, factors affecting innovation; and the fourth looked more specifically at developments in science education. It is the aim of this chapter to highlight material which might help isolate those factors which affected the use of the Schools Council's Science 5/13 project in the trial schools after the end of the trials.

One of the main problems faced in isolating these factors was judging which material in the reviews was relevant to the case of the Science 5/13 project. Also it was necessary to restrict the amount of material used in an attempt to make the overall research study 'manageable' in terms of the number of questions to be asked and the amount of time available.

If one looks in more detail at the first problem outlined, that of judging which material in the reviews was most relevant then it is clear some was more and some less directly relevant. For example, some of the research looked at considered other Schools Council or science based projects with the result that clear parallels could be seen between this work and the research to be undertaken on Science 5/13. On the other hand, although much of the research undertaken in the United States of America had relevance, on occasions it was too closely linked to the educational system of that country with its distinct organisational structure for it to be easily related to the British setting.

Examples that might be quoted to illustrate this latter point include those from the research undertaken by Griffiths into the role of administrators in schools[1], and the work of writers such as Rogers and Shoemaker when they examined the particular role of change agents.[2] Also, some of the research work listed (again like that by Rogers and Shoemaker[3]) was based on findings in areas outside education and much of it was of a more general nature and could be related to education a few parts were too specific, for example, to the agricultural setting, for it to be directly relevant. Similarly, while some of the research conducted by Kelly and Nicodemus into the uptake of science projects in the secondary school included some factors which were of a more general nature, others reflected the type of setting specific to secondary school science with its use of specialist science teachers and a fairly rigid timetable[4].

In fact, in the first instance eleven areas of study were extracted from the literature reviews in chapters 2, 3 and 4 and considered useful starting points: these are reviewed briefly below and reference is made to the material covered in chapters 2, 3 and 4 upon which they are based. In some cases these areas of study closely follow the ideas or research of one particular writer, while in other cases they are developed from the work of a number of different writers on related topics and material.

Defining the research questions

1. Many writers including Booth[5], Gross et al[6], Rogers and Shoemaker[7], Bolam[8] and Miles[9], spoke of compatibility of innovations. For

example there needs to be compatibility between the school type used and the innovation, between the skills and knowledge of the trial teachers and the innovation, and between a project's philosophy and its setting. On the basis of this evidence it seems reasonable to suggest that schools would be most likely to continue with the Science 5/13 project after the trials where it was seen as being compatible with the perceived needs and existing practices of the receivers.

2. Rogers and Shoemaker concluded that the greater the relative advantage of a particular innovation the greater the rate of adoption[10]. Rogers and Shoemaker defined relative advantage as the degree to which an innovation is perceived as better than the idea it supercedes. It could be argued that the position of the Science 5/13 project in terms of its relative advantage over existing practice, was different from other projects such as those dealing with the introduction of a new mathematics or reading scheme. In the case of science the research literature shows that at the time of the trials and up to the time when this research was conducted there was generally little science teaching taking place in primary schools[11], whereas in the case of mathematics and reading they were well established as central parts of the primary school curriculum. In the case of Science 5/13, then, if one is considering relative advantage one really needs to look at its position not with regard to other primary science projects but with regard to other parts of the curriculum. In this particular case, then, there is a link between what Rogers and

Shoemaker called the relative advantage of an innovation and what Bolam[12] talked about as the competitive strength of an innovation. Bolam suggested that the competitive strength of an innovation could be looked at in terms of its success in the struggle against other innovations and activities competing for scarce resources. Apart from Nuffied Junior Science (which is usually regarded as the forerunner of Science 5/13 rather than a competitor) there was little competition in the science area in primary schools. In practice, therefore, Science 5/13 had to compete for scarce resources more with other areas of study rather than with other teaching in the same area.

The position, though, was a little different outside the primary sector. In particular in the secondary schools, but also to a lesser extent in the middle schools, there was a question of relative advantage as well as competition in the science area, for example, from Nuffield Foundation projects[13].

It might be imagined, then, that one of the factors likely to influence continuation with the Science 5/13 project in primary schools would be the extent to which it was seen by those able to influence the distribution of resources as a worthwhile endeavour compared to other possibilities in other areas of the curriculum. In the case of the middle and secondary schools this factor might also be expected to be important though there might be the additional question of the extent to which Science 5/13 was able to compete with other science projects.

3. Rogers and Shoemaker concluded that the complexity of an innovation was negatively associated with an innovation's rate of adoption[14]. There would appear to be a number of ways of looking at the complexity of an innovation. Rogers and Shoemaker defined complexity as the degree to which an innovation is perceived as relatively difficult to understand and use. This definition goes someway to include an important factor described by Gross et al as clarity[15] in which they mean the extent to which an innovation's purpose is clearly stated. MacDonald and Ruddock looked at the language of communication used by the various project development teams[16]. They argued that it was inevitable that an in-group of word and phrases would be developed which could cause problems during wider diffusion of the project. As a consequence it may make innovation more difficult to understand, especially by those teachers not involved in the trials of a project, and so might hinder wider dissemination, even in the trial schools.

It might be thought, then, that one of the factors that could have influenced continuation with Science 5/13 in the trial schools could have been the extent to which those centrally involved with the project felt that they understood its aims and objectives. For example, to what extent did class teachers and headteachers feel that they understood its purpose? Similarly,to what extent did class teachers, in particular, feel that the project was difficult to understand and would be difficult to use?

4. The Curriculum Diffusion Research Project (C.D.R.P.) directed by Professor P.J. Kelly found that teachers at the extreme ends of teaching experience tended to have low adoption scores[17]. Thus it seems reasonable to suggest that in schools where the teachers involved with Science 5/13 were in 'mid career' they would be more likely to continue with the project after the end of the trials.

5. Havelock, based on the work of Barnett, emphasised the importance of the educational background of the receiver[18]. Crossland, in his study of the Nuffield Junior Project[19], reported that many trial teachers found their lack of scientific knowledge a handicap. Burstall[20] in her evaluation of the pilot scheme to introduce French into the primary school found similar difficulties arising from too few staff qualified to teach French. Thus it seems reasonable to suggest that in schools where the teachers involved with Science 5/13 had relevant pre-service training it would be more likely that they would continue with the project.

6. Shipman in his case study of the Keele Integrated Studies Project[21] discovered that staff turnover was a problem which hindered the diffusion of the project in the original trial schools. Therefore it might be thought that in schools where trial teachers moved away it would be less likely that the school would continue with the project after the trials.

7. Many writers including MacDonald and Ruddock[22], Hoyle[23], Dickinson[24], Watton[25], and Shipman[26], emphasised the important role of the

headteacher in the promotion and uptake of an innovation. Thus it might be thought that where the headteacher was positive towards Science 5/13 it was more likely that the school would continue to use the project after the trials.

8. Kelly in the C.D.R.P. survey[27], discovered that the higher the appointment level of the trial teacher the higher the adoption level. Although this survey examined science projects in the secondary school this finding also might have relevance in the primary school especially as the headteacher is thought to exert such an important role in the innovation process. Thus it could be suggested that there might be an association between the involvement of senior staff (headteacher, deputy headteacher, or a teacher with a scale post in the primary sector, or head of department elsewhere) in the trials of the Science 5/13 project and continuation with the project after the trials.

9. Two previous sections (see 6 and 7) highlighted the important role of the headteacher and the effect of the movement from the school of trial teachers. It would seem possible, then, that, like the trial teachers, if the headteacher involved during the trials were to leave towards the end or directly after the trials, this might have an adverse effect on the liklihood of continuing with Science 5/13 after the trials.

10. Humble and Ruddock in their evaluation of the Humanities Curriculum Project[28] concluded that a key factor at the local level was a

education authority's commitment to an innovation. For example, did this commitment show itself in clear policy statements? Thus it might be thought that schools would be more likely to continue with Science 5/13 after the trials if the local education authority supported the work.

11. Crossland, in his evaluation of the Nuffield Junior Science Project[29], spoke of the importance of the teachers' centres for support and training. Other researchers, including Humble and Ruddock[30], Shipman[31], and Stenhouse[32], discussed the necessity of adequate and effective support both at the local and school level. Thus it can be suggested that there might be an association between the support given to the trial schools using the Science 5/13 project and continuation of the project after the trials.

In chapter 3 when the factors affecting the success of an innovation were being discussed it was pointed out that one could not ignore the possibility of interaction between these factors. It is important that this should be remembered when considering the issues outlined above. It is quite likely, for example, that there will be some interaction between the extent of teaching experience (point 4 in the list above) and the appointment level of the trial teacher (point 8 in the list above). It is also clear that the issues discussed above are not really discrete but overlap. This discussion, then, has sought to point to some of the main areas of interest for the research but it is important that the listing should not be taken to imply that there is no interaction or overlap between the individual factors.

Methodology for collecting the data

The information used to examine the questions outlined in the last section was collected, first through a questionnaire survey, and second, through visits to trial areas. The questionnaire sought to obtain the following information: school type; facilities available in school; the teaching method adopted; previous involvement with the Nuffield Junior Science Project; pre-service details of trial teachers; in-service details before, during and after the trials; and trial teachers' impressions of the usefulness of the various Science 5/13 materials. The questionnaire devised incorporated questions which were of an open and closed type. A copy of the questionnaire form is reproduced in Appendix C.

The visits to the trial areas had a different focus to the questionnaire survey. The centre of attention was on the policy of the local authority, the support given during and after trials, and the attitude of Advisers/Inspectors to the project.

Schools in twenty different areas[33] were involved in developing the Science 5/13 trial materials. It was decided to look at the extent to which the trial schools continued to use Science 5/13 after the trials in a sample of areas rather than in the whole population. This decision was based largely on practical considerations. The sample population used was designed to include as wide a variety of school and local authority types as possible. As a result, it was decided to look at all of the schools in a number of local authority areas, rather than simply at a random sample of all schools. The areas in the sample were chosen to illustrate a variety of different circumstances: geographical position (for example urban - rural setting), school type (for example schools based on the traditional primary - secondary structure and others where middle schools were used) and the structure of the local Advisory service/Inspectorate. Nine areas[34] were selected for the sample population; this included 198 schools. A small pilot was undertaken in another area before the main research was undertaken.

The postal questionnaire took place about five years after the trials had finished[35]. The questionnaire was divided into two parts, (form A and form B). In the first instance both forms were sent to the present headteacher of the trial school. Form A was to be filled in by the teacher(s) who undertook the trials for the Science 5/13 project and concerned the position directly before, during, and after the trials. In most cases only one teacher was involved in a trial in any one school. Where this was not the case the headteacher was asked to give the form to the teacher who had been most centrally involved with the project in the school. Much of the questionnaire sent to the trial teacher dealt with the type and amount of help received before and during the trial period. Form B examined the position after the trials in more depth. The present headteacher in the school was asked to give details of the amount of work on Science 5/13 undertaken up to the time of the survey. If teachers were still working with Science 5/13 the headteacher was asked to select one to complete the second part of form B. As with form A, form B included the type and amount of help received from local support services. The next chapter analyses the data from the questionnaire survey.

Some difficulties were encountered with the use of the postal questionnaire sent out to trial schools: most of these lay with form A which was to be filled in by one teacher in each school who had been involved in the trials of Science 5/13. There was a certain amount of difficulty associated with locating trial teachers: many had moved to other schools and in some cases to different jobs. Often if the teacher had moved to another school in the same area the headteacher sent on form A directly to them, but on occasions it meant trying to find a teacher's new address to send a questionnaire form to them direct.

More generally it is recognised that postal questionnaires have drawbacks as well as advantages. The drawbacks include the tendency to concentrate on those issues which can be easily recorded and the fact that they cannot be used to examine the views and approaches of respondents in any depth. In practice postal questionnaires are best used to enable the researcher to research a number of respondents and to collect information which can be easily specified. In this research most of the information sought through the postal questionnaire has been of this kind. It has been used, for example, to collect information on school type, and on teacher background. On occasions respondents have been asked to express a view, on say the value of the Science 5/13 units, but questions of this kind have not predominated.

One further point should be made about the problems facing the use of the postal questionnaire in this research. In a number of cases teachers have been asked to recall, say details about the progress of the trials. Recall of events some time ago may not be perfect and in interpreting the results this will need to be borne in mind.

The research reviews undertaken in chapters 2, 3 and 4 drew attention to a number of points which formed the basis for the interviews with local authority Advisers/Inspectors. The interviews, then, were structured in so far as certain areas of questioning were decided upon before the interviews themselves took place. The areas of questioning are listed in Appendix D. However, it was considered important that those being interviewed should feel free to talk around these issues and raise other points they thought were relevant to the discussion. The main points in the interviews were written down: it was decided not to use tape-recordings because it was felt that given the positions held by some of those being interviewed they might not have been as forthcoming if tape recording had been attempted.

The interviews conducted with the local authority Advisers/Inspectors often led to additional interviews with other personnel in the support structure, most notably College of Education lecturers and teachers' centre wardens. This was useful as it not only gave further insight into the development of the project from other points of view, but also in some areas much of the support had been taken over either by the College of Education or co-ordinated by the teachers' centre, with the result that these respondents were able to give directly relevant information. The interviews with local authority Advisers/Inspectors also sometimes resulted in visits to local schools which had been involved with the trials for Science 5/13.

One of the other important aims of the area visits was the collection of documentary information. There was little difficulty in gaining necessary access and some of the documents were discussed during the interviews with local authority Advisers/Inspectors. The areas differed in the amount of documentation available: some areas, like area 2, held an immense store of literature about Science 5/13 meetings, while in other areas, where in-service provision had been centred around school visits, there was little documentary information available. There were also some differences between the areas in the type of institution holding the documentary information. In some areas Colleges of Education had co-ordinated much of the support and they held most of the relevant information, while in other areas teachers' centres, curriculum development centres or specialised Mathematics and Science centres had been much more important and held a great deal of the relevant information. However, in nearly all of the areas visited the local authority Adviser/Inspector had valuable written information, usually outlining the overall strategy for primary science.

In chapter 7 each area is looked at in turn in a separate section. Each section begins with a description of the area including, for example, details of the geographical setting, the number and type pf schools involved in the trials, the return rate for the questionnaire survey, and a brief comment on the extent of continuation with Science 5/13 after the trials. The discussion then turns to the development of the Science 5/13 project both during and after the trials as seen from the standpoint of the local authority Adviser/Inspector and other personnel from the support structure that were interviewed. At times reference is made to comments of personnel from the schools visited. Documentary evidence is used to help describe the development of the project: for example, to outline the number and type of in-service courses provided and to examine individual local authority policies relevant to the teaching of science for the 5 to 13 age range.

A comment should be made also about the nature of the evidence presented in that chapter. Much of the evidence referred to is the views of key personnel. As was explained earlier the interviews with these people were not tightly structured, and although a list of areas to be covered in the interviews was drawn up beforehand it was felt important that those interviewed could talk around issues and bring up other areas for discussion. The variety between areas was expected and in fact one of the aims of the interviews was to bring this out. However, it is recognised that because the interviews were conducted in this way the information collected must be evaluated on a different basis to that resulting from the questionnaire survey. There are dangers as well as benefits from the methodology adopted for the interviews. For example, not all issues were covered in the same way and in the same depth with everyone. In certain cases issues were more fully explored because the respondent wanted fuller discussion. This may or may not have been because the issue was genuinely more important in that area. Similarly there are major problems in interpreting the information obtained. To what extent has the interviewer encouraged the respondent, to discuss issues in certain ways and how should the information be evaluated? Which of the points that the respondent raised should be highlighted and which should not be treated as fully? There are real problems of interviewer bias to be taken into account. Nevertheless despite these problems, and they are not being minimised, such interviews can provide valuable information. One review of this kind of work in education research has said :

> *Depth interviews require considerable skill and in areas such as psychotherapy, practitioners receive extensive training in the necessary techniques. Consequently it is not something which can be undertaken lightly or by anyone not well-informed about procedures or hazards. Yet sensitively and skilfully handled the unstructured interview, sometimes lasting for two or three hours, can produce information which might not otherwise emerge.* 36

The problems facing the use of the information collected in this research from the area visits, though, are not confined to those normally associated with unstructured interviews. There is, for example, also the question of the fact that in some areas the range of what might be termed 'key informants' was greater than others. Similarly, in some areas the range of written material available was greater than in others. Again, in some areas'key informants' were keen that they should supplement their descriptions with visits to schools, but this practice was not uniform. All of this adds to many of the difficulties outlined in the last paragraph. How is this information to be interpreted and evaluated? The view that has been taken is that the information obtained is interesting and should be reported. However the basis on which it was collected needs to be stressed and taken into account in evaluating it. Further, it needs to be recognised that the area visits were undertaken after the questionnaire survey so that the interviewer undoubtedly was influenced by the information gained from the questionnaires and it must be likely that this would influence the conduct of the area visits, and the interpretation presented of them. What is being argued, in essence, is that it is a question of balancing the advantages and disadvantages associated with this part of the research and recognising the problems faced when interpreting the results.

Nature of the criteria used to illuminate the research questions

The remainder of the chapter looks at the criteria used to examine the eleven areas of study outlined in the first part of this chapter and the way in which relevant information was collected. Some of the research questions highlighted suggested fairly obvious and straightforward criteria though this was not the case in all instances.

Research question 1 considered the compatibility of the Science 5/13 project with the perceived needs and existing practices of the receiver. In this study such compatibility was assessed in a number of ways. These included an examination of: school type; facilities available in the school; the teaching method used and previous use by the school of the Nuffield Junior Science Project. All these points were covered in the questionnaire form (see question 2, form A; question 40, form A; question 3, form B (section 1), question 3, form B (section 2)).

Research question 2 dealt with the relative advantage of the Science

5/13 project over the existing practices it might replace and its competitive strength. From the evidence reviewed in earlier chapters[37] it has been suggested that because of the general lack of science at the primary level, teachers,in general, would be assessing the relative advantage of the Science 5/13 project against other curricular areas which included little or no science. However it was anticipated that the position in the secondary and middle schools would be different.

In the secondary schools there would be a significant amount of competition from other Schools Council and Nuffield Foundation projects in science such as the various 'O' level courses and the Combined Science Scheme. At the middle school level it was felt that some of these schemes, particularly Combined Science might be seen as an alternative for science work with the older children. It was hoped that questions such as why trial teachers had started work with Science 5/13 and why trial teachers and headteachers had discontinued work within the project would give some indication about the competitive strength of other innovations. (see question 50, form A, and question 4(c), form B (section 1)). In addition it was considered important to discuss this area in the interviews with the local authority Advisers/Inspectors.

Research question 3 involved the complexity of the Science 5/13 project. The criteria used included the trial teachers' assessment of the usefulness of various parts of the project's materials such as the Teachers Background Information units and the sections of the units dealing with objectives (see questions 32 - 36, form A). More information was gathered during the area visits where support staff were asked to outline areas of difficulty encountered by teachers.

Research question 4 suggested an association between the use of trial teachers in mid-career and the continuation with the project. Question 1, on form A, was used to collect this information.

Research question 5 looked at the association between pre-service training and continuation with the project. Question 6, on form A and questions 4 and 5, form B (section 2) looked at the pre-service training of teachers in science education.

Research question 6 dealt with the movement of trial teachers both during and after the trial period. Question 55, form A (section 4), was used to collect this information.

Research question 6, concerned the importance of the role played by the headteacher in promoting innovation. The first section of form B was specifically aimed at the headteacher. Question 10 in this section asked headteachers about whether they considered Science 5/13 to be a valuable project for use in their school. The following question (question 11) asked those who felt Science 5/13 to be valuable why they held this view.

Research question 8 looked at the association between the involvement of senior staff in the school trials and continuation with the project after the trials. The first question in section 1 of form A collected this information.

Research question 9 examined the association between headteachers' movement away from trial schools and continuation with the Science 5/13 project. The first two questions in section 1 of form B asked whether there had been any changes in headteacher since the trial period, and if so,how many changes had occurred.

Research question 10 examined the association between the positive attitude of a local education authority towards an innovation and its continuation. This was assessed, in part, by considering the amount of general support available to trial schools both during and after the trials. However this aspect is dealt with more centrally in connection with the next question. The present issue deals more with the presence of absence of policy statements by the decision makers in the local education authority and their effect upon the uptake of an innovation like the Science 5/13 project. This information, largely documentary evidence, was gathered during the area visits.

The final research question (11) looked in more detail at the effectiveness of the type and amount of support given both during and after the trials. In the questionnaire the trial teachers were asked to list the various local and national meetings attended both before and during the trials and in addition to rate their usefulness. Also they were asked to give details of the type of personnel who visited them in the classroom, the frequency of visits, and their purpose as seen from the teachers' point of view. Again they were asked to rate the usefulness of such visits. Similar questions were asked of the post-trial teachers in the trial schools. (See questions 7 - 31, form A (section 2) and questions 6 - 15, form B (section 2)). Also, in the first section of form A, trial teachers were asked about the presence of a local teachers' centre and its distance from their school. Similar questions were asked about other institutions such as Colleges of Education and Universities which might have provided support (see question 5, form A (section 1)). While the questionnaire dealt with the responses from the headteachers, trial teachers and post-trial teachers, the interviews aimed to gather information from personnel involved in supporting the project locally. Therefore the interviews supplied valuable material giving a better overall picture of the type and amount of support available within each area.

It is important to stress at this juncture that while the above formed the eleven main research questions and were the clear focus for the research, they were not used in a restrictive fashion. It was accepted from the outset that other interesting issues and points might be raised by respondents and therefore it was decided that the research design should be flexible enough to take account of them.

In the second chapter a number of theories of change were reviewed; for example, those by writers like Stenhouse[38], Havelock[39], and Schon[40]. No attempt will be made in this thesis to 'test' the theories. However it is intended to return briefly to a discussion of these theories at the end of the thesis to see to what extent they can throw further light on the operation of the Science 5/13 project. This discussion will be concerned less with the differences in continuation with the project between schools than with the organisation and development of the project itself.

Footnotes

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2. For further details see p. 102
3. Rogers, E.M., Shoemaker, F.F., Communication of Innovation, The Free Press, New York, 1971.
4. Kelly, P.J., Final Report of the Curriculum Diffusion Research Project, Chelsea College, University of London, 1975 and Nicademus, R.B., 'Why Science Teachers Adopt New Curriculum Projects', Educational Research, 1977, Vo. 19, No.2, pp. 83-91.
5. Booth, N., 'The Impact of Science Teaching Projects on Secondary Education', in Trends, 1975, Vol 1, pp. 25-32.
6. Gross, N., et al, Implementing Organizational Innovations, Harper & Row, New York, 1971.
7. Rogers, E.M., Shoemaker, F.F., Op Cit.
8. Bolam, R., 'The Management of Educational Change:Towards a Conceptual Framework' in Harris, A., Lawn, M., Prescott, W., Curriculum Innovation,Croom Helm, London 1975.
9. Miles, M.B. (ed), Op Cit.
10. For further details see p. 51
11. See for example: Booth, N., Op Cit, and D.E.S., Primary Education in England - A Survey by H.M. Inspectorate of Schools, H.M.S.O., London, 1978,
12. Bolam, R., Op Cit.
13. For further details of these projects see table 4.1, p.124
14. For further details see p. 52
15. Gross, N., et al, Op cit.

Footnotes (continued)

16. MacDonald, B., Ruddock, J., 'Curriculum Research and Development Projects : Barriers to Success', British Journal of Educational Psychology, 1971, Vol.41, pp. 148-154
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18. Havelock, R.G., Planning for Innovation Through Dissemination and Utilization of Knowledge, Centre for Research on Utilization of Scienctific Knowledge, Institute of Social Research, The University of Michigan, Ann Arbor, Michigan, 1969.
19. Crossland, R.W., 'An Individual Study of the Nuffield Foundation Primary Science Project', School Science Review, 1971-72, Vol 53, pp.628-638.
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24. Dickinson, N.B., 'The Head as Innovator : A Study of an English School District', in Reid, W.A., Walker, D.F., (ed), Case Studies in Curriculum Change, Routledge & Kegan Paul, London, 1975, pp. 136-178.
25. Walton, J., 'The Implications of Innovation', Forum,1972, Vol. 14, No. 2.
26. Shipman, M.D., Op Cit.
27. Kelly, P.J., Op Cit.
28. Open University, The Curriculum : Context, Design and Development - Teaching Strategies : A Systems Approach, Unit 15, Open University, Bletchley, 1972, pp. 106 - 118.

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29. Crossland, R.W., Op Cit.

30. Open University, (Unit 15), Op Cit.

31. Shipman, M.D., Op Cit.

32. Stenhouse, L., An Introduction to Curriculum Research and Development, Heinemann, London, 1975.

33. The twenty areas included nineteen local education authority authorities in England and Wales and one area in Scotland, which although it included four local education authorities were grouped together as one area for this research. For further details see footnote 4 in chapter 1.

34. The nine areas were : Anglesey, Birmingham, Kent, London (I.L.E.A.), Southamption, Staffordshire, St. Helens,Teesside and Scotland.

35. Although the trial period stretched from 1969 until 1972 the main trials (the first, second and third sets) ended in 1971. The questionnaire survey was undertaken five years after the end of the main trials. Those schools which were involved only in the first set and/or second set of trials would have received the questionnaire some six years after the trials ended.

36. Wragg, E.C., Conducting and Analysing Interviews, Rediguide, No. 11, University of Nottingham School of Education, 1978, p.11.

37. See footnote 11 in this chapter.

38. Stenhouse, L., Op Cit.

39. Havelock, R.G., Op Cit.

40. Schon, D.A., Beyond the Stable State, Temple Smith, London, 1971.

CHAPTER 6

Analysis of the Questionnaire Data

In the previous chapter the way that the sample population was chosen was outlined and comments were made about how the postal questionnaire was conducted. Table 6.1 shows the different school types within the sample and the total population of trial schools. From this table it can be seen that the types of schools represented in the sample population are not an exact mirror image of those in the total population. This is deliberate; the areas within the sample were specially designed so as to give more than proportionate weight to middle schools as their numbers in the total population were small. During and after the trial period many areas were in the process of changing over to a middle school system of organisation and it was felt important that as many schools of this type be included as possible.

Out of the 198 schools contacted by questionnaire, replies were received from 143; a response rate of 72 per cent overall. Table 6.2 shows the response rate by area. From this table it can be seen that the response rate in individual areas ranged from 64 per cent to 94 per cent. Table 6.3 compares the types of schools from which replies were received with that of the total sample population. From this table it can be seen that the weighting given to different school types in the original sample was maintained in the sample of schools who replied. However, this does not mean

TABLE 6.1 Comparison Between Total Science 5/13 Trial School Population And Sample Schools By School Type

SCHOOL TYPE	TOTAL SCIENCE 5/13 TRIAL SCHOOLS		SAMPLE OF SCIENCE 5/13 TRIAL SCHOOLS	
	No.	%	No	%
Primary	332	87.8	171	86.4
Middle	16	4.2	13	6.6
Secondary	30*	8.0	14	7.0
Total	378	100.0	198	100.0

* Includes 1 Special School

TABLE 6.2 Response Rate By Area

AREA	TOTAL SCHOOLS IN SAMPLE	REPLIES	% RESPONSE RATE
1	9	7	78
2	47	30	64
3	24	17	71
4	17	11	65
5	31	20	65
6	24	22	92
7	20	14	70
8	16	15	94
9	10	7	70
Total	198	143	72

TABLE 6.3 Comparison Between Schools From Which Replies Received And Those In The Total Sample By School Type

SCHOOL TYPE	SAMPLE SCHOOLS		SCHOOLS FROM WHICH REPLIES RECEIVED	
	No.	%	No.	%
Primary	171	83.3	121	84.6
Middle	13	6.6	11	7.7
Secondary	14	7.1	11	7.7
Total	198	100.0	143	100.0

that one can totally ignore the question of non-response. It might be imagined that schools not using Science 5/13 at the time of the survey would have been less likely to respond to the questionnaire because they were less interested in the issues raised. From subsequent inquiries there seems to be some basis for this belief. This will need to be taken into account at least as a possibility when continuation with the project is being discussed. Nevertheless, the non-response rate is not so high as to call the validity of the survey into question even if the interpretation of the results needs to be guarded.

Use of Science 5/13 by Trial School after the Trials

Table 6.4 shows that 56 per cent of the schools surveyed continued to use the Science 5/13 project directly after the trials finished. Of these only a minority (21 per cent) said they were using the project as a basis for a science course (see Table 6.5). The majority (79 per cent) used the project's materials as a general resource to fit in with more integrated work. By the time of the survey, only five years after the end of the trials the number of schools still using the project had fallen to 35 per cent. These results are shown in Table 6.6. Table 6.7 shows that only 20 per cent of those schools still continuing were using the project as a basis for a science course, the majority (80 per cent) were using the materials as a general resource.

The question of the way in which the materials were used is an important one. The Science 5/13 team never intended that the material

TABLE 6.4 Number Of Schools Continuing With Science 5/13 Directly After The Trials

DID YOUR SCHOOL CONTINUE TO USE SCIENCE 5/13 DIRECTLY AFTER THE TRIALS?				TOTAL	
YES		NO			
No.	%	No.	%	No.	%
80	55.9	63	44.1	143	100.0

TABLE 6.5 Use Of Science 5/13 Directly After The Trials

HOW DID YOUR SCHOOL USE SCIENCE 5/13 DIRECTLY AFTER THE TRIALS?				TOTAL	
AS A GENERAL RESOURCE		AS THE BASIS FOR A SCIENCE COURSE			
No.	%	No.	%	No.	%
63	78.8	17	21.25	80	100.0

TABLE 6.6 Number Of Schools Continuing Or Not With Science 5/13 Several Years After The Trials

IS YOUR SCHOOL STILL USING SCIENCE 5/13?				TOTAL	
YES		NO			
No.	%	No.	%	No.	%
50	35.0	93	65.0	143	100.0

TABLE 6.7 Use Of Science 5/13 Several Years After The Trials

HOW DOES YOUR SCHOOL USE SCIENCE 5/13 NOW?				TOTAL	
AS A GENERAL RESOURCE		AS THE BASIS FOR A SCIENCE COURSE			
No.	%	No.	%	No.	%
40	80.0	10	20.0	50	100.0

they produced be used as a straightforward science course; rather they saw it as fitting into a more integrated approach incorporating other subject areas. The project material, in the form of teachers' guides, was designed to show teachers how they might select activities for pupils so that they might achieve set objectives appropriate to a child's developmental level. It was intended that teachers should go on to use their own ideas for activities so tailoring the work more closely to the interests and developmental level of each pupil. The project undertaken by Wynne Harlen[1] subsequent to Science 5/13 emphasised this need by developing suitable in-service material to help teachers undertake such diagnostic work. Those local authorities committed to the policy of introducing science into the curriculum for the 5 to 13 age grouping, particularly in the middle schools, soon discovered that the materials of the Science 5/13 project provided them with the basis for a science course. A few other projects, notably the Nuffield Combined Science Project provided additional material and together these two projects were used as the basis for an elementary science course. In local authority areas where the central policy was not so committed those schools using Science 5/13 generally dipped into parts of the materials using it alongside a number of other resources to make up integrated topics of study.

The analysis of the questionnaire results which follows will concentrate on the association between various factors and coninuation with the project, without paying particular attention as to how the project work was used. There are two reasons for this:

one is that the numbers involved mean that statistical analysis of the results of the questionnaire would have been very limited if any attempt had been made to distinguish between different types of usage of materials ; the other is that the issue of the way the materials were used can probably be more profitably examined in later discussion once the questionnaire analysis has been completed.

Table 6.8 indicates that out of 80 schools who continued with the project directly after the trials ended, 44 (55 per cent) of these were still using it at the time of the survey. There were 6 schools (4 per cent of the sample replying) who stopped using the project directly after the trials but had begun again using the materials at the time of the survey. In one of these schools all the trial teachers left soon after the trials ended for promotion at other schools. A new headteacher had been appointed by the time of the survey and had sent teachers to a local in-science course which had included an introduction to the Science 5/13 project. As a result the school began using the materials again. Work at a second school was hampered also by the movement away of trial teachers and in addition by a move to new buildings. At the time of the survey the headteacher had just begun science work again involving Science 5/13. In a third school, the trial teacher had left directly after the trials. The school had a high turnover of staff and at the time of the survey had just acquired a person enthusiastic and competent to specialise in science. At the same time a change in the internal organisation of the school meant that science would form an important

TABLE 6.8 Number Of Schools Continuing On Or Not With Science 5/13 Directly After The Trials And Several Years After The Trials

		DID YOUR SCHOOL CONTINUE TO USE SCIENCE 5/13 DIRECTLY AFTER THE TRIALS?		TOTAL
		YES	NO	
IS YOUR SCHOOL STILL USING SCIENCE 5/13?	YES	44	6	50
	NO	36	57	93
Total		80	63	143

part of the curriculum; Science 5/13 was to be one of the resources used. The three remaining schools had been reorganised from primary to middle schools. Local authority policy had included science (involving Science 5/13) as part of the curriculum. Prior to reorganisation a number of trial teachers in these schools had left; in one school staff involved in the trials had become disinterested with the project. This leaves 37 schools (40 per cent of the sample replying) who did not continue with Science 5/13 directly after the trials, were not undertaking any work with the project at the time of the survey and had not done so in the intervening period.

Use of Science 5/13 and the Suitability of the Host

A great deal of research has indicated that one of the most important factors determining the success of an innovation is the suitability and receptiveness of the host. This was one of the factors highlighted by Schon.[2] To look more specifically at education Walton[3] mentions the role of timetabling, a point reiterated by Brown[4], although she places a rather different emphasis upon it. Writers such as MacDonald and Ruddock[5] stress the importance of the headteacher as a key figure in the innovation process within a school.

While the questionnaire survey was able to examine a number of the factors concerned with the suitability of the host it was thought more appropriate to look at others through interviews. Every area was visited after the questionnaire data had been analysed and interviews were conducted with key personnel. This work will be reviewed in the next chapter. Here only the issues raised in the questionnaire will be examined.

Table 6.9 shows the relationship between school type and the use of the project immediately after the trials. It can be seen that in terms of continuation the project was most successful in the middle schools and least successful in the secondary sector. In the primary sector (infant, junior and primary schools) more junior schools continued with the project directly after the trials than infant or primary schools. Table 6.10 examines the situation at the time of the survey. The general trend is the same as directly after the trials with the greatest percentage of schools continuing with the project in the middle school sector and the smallest percentage, in fact zero, in the secondary school sector. Some schools in the sample population changed school type between the period directly after the trials and the time of the survey. This was usually the result of a local authority policy to change to a middle school system and for this reason Table 6.10 also includes an analysis of the school type that existed at the time of the survey. The reduction in the percentage of junior schools continuing with the project at the time of the survey is explained by the change over of some junior schools into either larger primary schools or into new middle schools.

Several reasons can be suggested to explain why certain types of schools were more successful with the project in terms of continuing after the end of the trials. One possibility is that certain age groups of pupils were more suited to the materials and

TABLE 6.9 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Type Of School

	TYPE OF SCHOOL AT THE TIME OF TRIALS				
	INFANT	JUNIOR	PRIMARY	MIDDLE	SECONDARY
Schools continuing after trials	56.2	70.6	51.4	100.0	18.2
Schools not continuing after trials	43.8	29.4	48.6	0.0	81.8
Total	100.0	100.0	100.0	100.0	100.0
(N)	(32)	(17)	(72)	(11)	(11)

Chi Squared = 17.11333

DF = 4

Significance = 0.0018

TABLE 6.10 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Type Of School

	TYPE OF SCHOOL AT THE TIME OF THE TRIALS					TYPE OF SCHOOL AT THE TIME OF THE SURVEY				
	Infant	Junior	Primary	Middle	Secondary	Infant	Junior	Primary	Middle	Secondary
School continuing at time of survey	31.3	41.2	34.7	72.7	0.0	33.3	25.0	28.6	73.1	0.0
Schools not continuing at time of survey	68.8	58.8	65.3	27.3	100.0	66.7	75.0	71.4	26.9	100.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(N)	(32)	(17)	(72)	(11)	(11)	(24)	(12)	(70)	(26)	(11)

	At The Time Of The Trials	At The Time Of The Survey
Chi Squared	= 13.29657	= 24.33233
DF	= 4	= 4
Significance	= 0.0099	= 0.0001

ideas of the Science 5/13 Project. Stage 3 units were developed, in the main, for older children in the 5 - 13 age grouping, as would be found at the secondary stage of education. While it was recognised that some children at the top end of the age range would not have reached the appropriate Piagetian stage to undertake such work, it was hoped that on average the three stage 3 units could be tackled by the top age grouping. However in practice this was not the case; the third set of trials showed that very few children at the upper end of the 5/13 age range appeared ready for the type of work suggested in those units.[6] This factor might help to explain the low percentage of secondary schools continuing with the project but it is not the complete answer as a number of middle schools included in the sample also undertook some trial work with the same units.

Another possible explanation is that certain types of schools continued with the project because they had better facilities for undertaking science work. A number of writers (such as Gross,[7] Havelock,[8] and Schon[9]) have noted that the availability of support and facilities can be an important factor in the successful introduction of an innovation. The best facilities would be expected to exist in the middle and secondary schools where science is taught as a separate subject, usually by specialist teachers. This might explain the higher rate of continuation with the project in middle schools but would not help to explain the position in secondary schools. Tables 6.11 and 6.12 show the relationship between continuation with the project and the availability of

TABLE 6.11 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Facilities In Classroom

	FACILITIES AVAILABLE	FACILITIES NOT AVAILABLE
Schools continuing after trials	57.5	60.0
Schools not continuing after trials	42.5	40.0
Total	100.0	100.0
(N)	(87)	(45)

Chi Squared = 0.08

DF = 1

Significance = 0.780

TABLE 6.12 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Facilities In Classroom

	FACILITIES AVAILABLE	FACILITIES NOT AVAILABLE
Schools continuing at time of survey	33.3	35.6
Schools not continuing at time of survey	66.7	64.4
Total	100.0	100.0
(N)	(87)	(45)

Chi squared = 0.07

DF = 1

Significance = 0.798

certain facilities such as desk top space, display areas, sink, water and library area. The tables show no significant relationship between continuation with Science 5/13 and the availability of facilities. One reason for the absence of a significant relationship may be that the project does not require a great deal of extra facilities above those already existing in the normal primary classroom. This would certainly be the feeling of the project team whose emphasis was upon using the simplest equipment and facilities available in existing primary schools.

A further explanation for why certain types of schools continued with the project more than others might be the presence of more science specialists in middle schools than in primary schools. Of course science specialists would also be present in the secondary schools, though their failure to continue with the project might be the result of a number of other factors more specific to the secondary sector. The next chapter which examines the findings of the interviews with key personnel will discuss in more detail the problems facing trial teachers in the secondary schools. However, it might be worthwhile noting at this juncture that one of the main problems in secondary schools has been the difficulties involved in integrating projects like Science 5/13 into the science curriculum of the school. There are many science schemes available which can be used at the secondary level. There is, as a result, a high degree of competition. Also a science scheme is not usually thought of on its own but as one of a number of schemes some of which may be undertaken alongside it and others of which might be undertaken further up the school. One result is that many secondary schools choose a scheme of work which covers the whole age range of the school, rather than just one part of it (as was the case with Science 5/13). In addition although the philosophy of Science 5/13, with its emphasis upon the scientific method, sounds similar to the philosophy of many of the more recent schemes for the lower secondary age-range, in practice the absence of any set content makes it radically different. In the middle schools this difficulty was overcome in one area by the local authority setting up a working party to agree upon a common core of topics which would serve as a foundation for work in the high schools later. Different Science 5/13 units were listed for use with the various topics suggested. This area had decided to adopt 8 - 12 middle schools and unlike the 9 - 13 system the number of specialist science teachers was, at the beginning, very small. This itself created a problem, one which was partly overcome by intensive in-service training.

It is interesting, then, to look at the relationship between continuation with the Science 5/13 project and the subject background of the trial teacher. Tables 6.13 and 6.14 show that few schools where the trial teacher had a science degree continued with the project either directly after the trials or were still doing so at the time of the survey. In practice, many of these teachers were at secondary schools although some were also at middle schools. In those schools where teachers had either taken science as the main subject at college or taken a science course at college, a majority of these schools continued with the project directly after the trials. However,

TABLE 6.13 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Science Background Of Trial Teacher

	SCIENCE BACKGROUND			
	SCIENCE DEGREE	SCIENCE MAIN SUBJECT AT COLLEGE	SCIENCE COURSE AT COLLEGE	NO SCIENCE BACKGROUND
Schools continuing after trials	11.8	61.1	61.5	71.2
Schools not continuing after trials	88.2	38.9	38.5	28.8
Total	100.0	100.0	100.0	100.0
(N)	(17)	(18)	(26)	(66)

Chi Squared = 19.95

DF = 3

Significance = 0.000

TABLE 6.14 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Science Background Of Teacher

	SCIENCE BACKGROUND			
	SCIENCE DEGREE	SCIENCE MAIN SUBJECT AT COLLEGE	SCIENCE COURSE AT COLLEGE	NO SCIENCE BACKGROUND
Schools continuing at time of survey	11.8	44.4	30.8	43.9
Schools not continuing at time of survey	88.2	55.6	69.2	56.1
Total	100.0	100.0	100.0	100.0
(N)	(17)	(18)	(26)	(66)

Chi Squared = 6.87

DF = 3

Significance = 0.076

at the time of the survey this trend had been reversed. In those schools where the teachers had no science background, similar trends were observed : a majority of the schools continued with the project after the trials with the reverse trend at the time of the survey. However, it can be seen from the numbers shown in these tables that most trial teachers had no science training at college or university level.

One of the other major differences between the schools who took part in the Science 5/13 trials was the kind of teaching methods used. The questionnaire asked respondents to state the main type of teaching method they considered they used during the trial period. Tables 6.15 and 6.16 show the relationship between the different types of teaching methods and whether schools continued with the project directly after the trials and were still doing so at the time of the survey. The majority of respondents said that they used more informal child-centred, or active discovery methods. It could be argued that those schools whose teachers use active discovery methods, in tune with the philosophy of the Science 5/13 project, might be expected to be more likely to continue with the project after the trials ended than the average. Both tables show that a higher proportion of schools who continued with the Science 5/13 project employed trial teachers who used active discovery rather than teacher directed methods. However the difference was only slight.

A number of writers including MacDonald and Ruddock[10] have noted

TABLE 6.15 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Teaching Method Used During Trials

	TYPE OF TEACHING METHOD USED DURING TRIALS	
	ACTIVE DISCOVERY METHOD	TEACHER-DIRECTED METHOD
Schools continuing after trials	60.0	58.9
Schools not continuing after trials	40.0	41.1
Total	100.0	100.0
(N)	(40)	(90)

Chi Squared = 0.00553

DF = 1

Significance = 0.9407

TABLE 6.16 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Teaching Method Used During Trials

	TYPE OF TEACHING METHOD USED DURING TRIALS	
	ACTIVE DISCOVERY METHOD	TEACHER-DIRECTED METHOD
Schools continuing at time of survey	37.5	35.6
Schools not continuing at time of survey	62.5	64.4
Total	100.0	100.0
(N)	(40)	(90)

Chi Squared = 0.00023

DF = 1

Significance = 0.9879

that the attitude of staff in a school is an important factor in the success or failure of a project; particular emphasis has always been given to the attitude of the headteacher to the innovation. This was considered an important area to examine in this study. The questionnaire asked headteachers to consider whether Science 5/13 was a valuable project for their school. It was felt that schools where headteachers thought Science 5/13 was valuable would be more likely to continue with the project. It was though that a positive attitude on the headteacher's part might mean that they would give leadership and general support for the project

Tables 6.17 and 6.18 show that the majority of headteachers thought the project was valuable. The number disapproving or unsure was small so the comparisons should be treated with caution. Table 6.17 examines the position directly after the trials. The majority of schools where the headteacher approved of the project continued with it whereas the reverse was true where the headteacher disapproved. At the time of the survey (table 6.18) fewer schools (though still nearly half) where the headteacher thought that the project was valuable were still using it but none of those schools where the headteacher disapproved were still doing so. It could be argued however that, in the schools where they did not continue to use Science 5/13, the headteachers said that the project was unimportant or that they disapproved of it simply because their schools were not involved and that in the schools continuing to use Science 5/13 the headteachers said that they approved of the project simply

TABLE 6.17 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And The Attitude Of The Head Teacher To The Project

	IS SCIENCE 5/13 A VALUABLE PROJECT?		
	YES	NO	DON'T KNOW
Schools continuing after trials	70.3	15.4	23.5
Schools not continuing after trials	29.7	84.6	76.5
Total	100.0	100.0	100.0
(N)	(101)	(13)	(17)

Chi Squared = 24.35152

DF = 2

Significance = 0.0000

TABLE 6.18 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And The Attitude Of The Headteacher To The Project

	IS SCIENCE 5/13 A VALUABLE PROJECT?		
	YES	NO	DON'T KNOW
Schools continuing at time of survey	47.5	0.0	5.9
Schools not continuing at time of survey	52.5	100.0	94.1
Total	100.0	100.0	100.0
(N)	(101)	(13)	(17)

Chi Squared = 19.40099

DF = 2

Significance = 0.0001

because their schools involvement. When headteachers were asked to give reasons for discontinuing work with Science 5/13 the most common reasons included: one, that a considerable amount of time had been spent on the project during the trials and that after it was considered that this time should be used for other areas of the curriculum; two, that the project did not fit the needs of the school; three, that there was competition from another project(in the secondary school this was usually competition from Nuffield Combined Science); four, that the staff involved had either left or were not interested (the latter sometimes resulted because staff had taken on new responsibilities); and five, that the driving force had been the headteacher at the time of the trials and they had subsequently left.

In addition to the attitude of headteacher, the trial teacher plays an important role in determining whether or not a project will be successful. As with many Schools Council projects developed in the late 1960s and early 1970s, the trial teacher was involved in a considerable amount of clerical work necessary for the project to be evaluated by the central team. More specifically for projects like Science 5/13 and Primary French the trial teacher was aksed to undertake work in which she herself had not usually specialised. All of this, in addition to the normal day to day routine puts pressure upon the trial teacher. Therefore one would expect that if the project were to be successful a keen and enthusiastic trial teacher would be needed. One way of looking at this question was to ask teachers why they undertook the project in the first place. Were they keen to find out more about science or did they undertake the work because they had been asked by some other person (like the headteacher or another member of staff) or some other body (like the education authority)?

Tables 6.19(a) to 6.19(e) show the relationship between the reasons why trial teachers began Science 5/13 and continuation with the Project by the trial schools directly after the trials. Tables 6.20(a) to 6.20(e) show the same kind of relationships at the time of the survey. The tables show that the overwhelming majority of teachers said that one of the reasons for starting trial work was because they were interested themselves in finding out more about primary science (see table 6.19(d) and table 6.20(d)). The next two most popular reasons given for beginning Science 5/13 were that the head-teacher or the L.E.A. had asked them to take part (see tables 6.19(a) and (b), and tables 6.20 (a) and (b)). Only table 6.20(d) showed a significant relationship between the reason given for starting the Science 5/13 trials and whether the school continued on with the project. This table indicates that in those trial schools where the trial teacher started the Science 5/13 trials because of his/her interest in primary science, they were more likely to have continued on with the project at the time of the survey. This was not true directly after the trials. One possible reason for this finding could be that trial teacher interest, while not as important a factor directly after the trials was much more important some years later at the time of the survey. Later in this chapter it will be shown that there was a considerable turnover in the trial teacher

TABLE 6.19(a) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Initial Reason For Starting The Project - Invited By L.E.A.

	INVITED BY L.E.A.	
	MENTIONED	NOT MENTIONED
Schools continuing after trials	58.5	53.5
Schools not continuing after trials	41.5	46.5
Total	100.0	100.0
(N)	(53)	(86)

Chi Squared = 0.33

DF = 1

Signficance = 0.564

TABLE 6.19(b) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Initial Reason For Starting The Project - Asked By Headteacher

	ASKED BY HEADTEACHER	
	MENTIONED	NOT MENTIONED
Schools continuing after trials	54.8	55.8
Schools not continuing after trials	45.2	44.2
Total	100.0	100.0
(N)	(62)	(77)

Chi Squared = 0.01

DF = 1

Significance = 0.906

TABLE 6.19(c) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Initial Reason For Starting The Project - Asked By Another Member Of Staff

	ASKED BY ANOTHER MEMBER OF STAFF	
	MENTIONED	NOT MENTIONED
Schools continuing after trials	50.0	55.6
Schools not continuing after trials	50.0	44.4
Total	100.0	100.0
(N)	(6)	(133)

Chi Squared = 0.07

DF = 1

Expected frequencies too small

TABLE 6.19(d) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Initial Reason For Starting The Project - Own Interest

	OWN INTEREST	
	MENTIONED	NOT MENTIONED
Schools continuing after trials	52.3	66.7
Schools not continuing after trials	47.7	33.3
Total	100.0	100.0
(N)	(109)	(30)

Chi Squared = 1.97

DF = 1

Significance = 0.61

TABLE 6.19(e) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Initial Reason For Starting The Project - Other Reason Not Included In Tables 6.19(a) to (d)

	OTHER REASON	
	MENTIONED	NOT MENTIONED
Schools continuing after trials	58.3	54.8
Schools not continuing after trials	41.7	45.2
Total	100.0	100.0
(N)	(24)	(115)

Chi Squared = 0.10

DF = 1

Significance = 0.750

TABLE 6.20(a) Relationship Between School Continuing With Science 5/13 Project At The Time Of The Survey And Initial Reason For Starting The Project - Invitation By L.E.A.

	INVITED BY L.E.A.	
	MENTIONED	NOT MENTIONED
Schools continuing at time of survey	32.7	35.6
Schools not continuing at time of survey	67.3	64.4
Total	100.0	100.0
(N)	(52)	(87)

Chi Squared = 0.12

DF = 1

Significance = 0.724

TABLE 6.20(b) Relationship Between School Continuing With Science 5/13 Project At The Time Of The Survey And Initial Reason For Starting The Project - Asked By Headteacher

	ASKED BY HEADTEACHER	
	MENTIONED	NOT MENTIONED
Schools continuing at time of survey	27.9	39.7
Schools not continuing at time of survey	72.1	60.3
Total	100.0	100.0
(N)	(61)	(78)

Chi Squared = 2.14

DF = 1

Significance = 0.144

TABLE 6.20(c) Relationship Between School Continuing With Science 5/13 Project At The Time Of The Survey And Initial Reason For Starting The Project - Asked By Another Member Of Staff

	ASKED BY ANOTHER MEMBER OF STAFF	
	MENTIONED	NOT MENTIONED
Schools continuing at time of survey	16.9	35.3
Schools not continuing at time of survey	83.3	64.7
Total	100.0	100.0
(N)	(6)	(133)

Chi Squared = 0.89
DF = 1
Expected Frequencies too small

TABLE 6.20(d) Relationship Between School Continuing With Science 5/13 Project At The Time Of The Survey And Initial Reason For Starting The Project - Own Interest

	OWN INTEREST	
	MENTIONED	NOT MENTIONED
Schools continuing at time of survey	41.9	11.8
Schools not continuing at time of survey	58.1	88.2
Total	100.0	100.0
(N)	(105)	(34)

Chi Squared = 10.32

DF = 1

Significance = 0.001

TABLE 6.20(e) Relationship Between School Continuing With Science 5/13 Project At The Time Of The Survey And Initial Reason For Starting The Project - Other Reason Not Included in Tables 6.20(a) to (d)

	OTHER REASON	
	MENTIONED	NOT MENTIONED
Schools continuing at time of survey	34.8	34.5
Schools not continuing at time of survey	65.2	65.5
Total	100.0	100.0
(N)	(23)	(116)

Chi Squared = 0.00

DF = 1

Significance = 0.978

population at the time of the survey and it was those schools where the trial teacher had remained that were more likely to be continuing with the project.[11] Thus it might be suggested that the continuation of trial teachers at the trial schools and trial teacher interest might be two significant factors which, when acting tohether make the chances of a school continuing with the project much higher at the time of the survey.

However, caution needs to be exercised in interpreting these results. Tables 6.19 and 6.20 summarise spontaneous responses to the question about why the teacher concerned started work with Science 5/13. Some teachers responded by mentioning one factor, others responded by mentioning more than one. The statistical tests have been carried out on each of the factors independently. Further, it needs to be borne in mind that the teachers were asked to respond to a question which asked them about motives for starting work with a project some years earlier. Memories may fade over time, and the responses need to be evaluated with this in mind. It may be that teachers who were continuing to use Science 5/13 at the time of the survey were interested in the project at that point of time, and therefore mentioned this as an explanation for starting work with the project although some of the teachers may in fact only have become really interested in the project when they started working with it. In other words because of the difficulty of recall some teachers may have referred to their present feelings about the project when asked about their earlier feelings towards it.

It is not only important that teachers are enthusiastic and interested at the beginning of the trials but also that this keeness is maintained. This will largely depend upon their feelings towards the materials they are using. Tables 6.21((a) to (d)) and 6.22 ((a) to (d)) give some information on this subject and its relationship with whether trial schools continued with the project or not after the trials. Both sets of tables show that apart from the materials dealing with the objectives of the project the materials were found generally useful. However there was no significant relationship between teachers' views on the usefulness of the project's materials and whether schools continued with Science 5/13 after the trials. It would seem that the majority of teachers felt that the materials were useful for enquiry-based science teaching and that certain schools stopped work with the project for reasons not connected with the materials.

Burns and Stalker[12] argue that organisations which already have experience of innovation make better hosts for subsequent change. Thus it might be postulated that those trial schools that previously had worked with a primary science project would be more likely to accept Science 5/13 than the average. In this particular instance it was decided to look at whether those schools who had worked with the previous primary science project, Nuffield Junior Science, performed better in terms of continuation with the Science 5/13 project. Tables 6.23 and 6.24 show that former experience with Nuffield Junior Science was associated with a slightly lower rate of continuation with Science 5/13 after the trials. This may seem a rather surprising result. However, in this survey

TABLE 6.21(a) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attitude Towards Project Material - Teachers' Background Information

	TEACHERS BACKGROUND INFORMATION	
	USEFUL	NOT USEFUL
Schools continuing after trials	56.7	76.2
Schools not continuing after trials	43.3	23.8
Total	100.0	100.0
(N)	(104)	(21

Chi Squared = 2.76
DF = 1
Significance = 0.097

TABLE 6.21(b) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attitude Towards Project - Objectives In Teaching Science 5/13

	OBJECTIVES IN TEACHING SCIENCE 5/13	
	USEFUL	NOT USEFUL
Schools continuing after trials	65.5	56.2
Schools not continuing after trials	34.5	43.8
Total	100.0	100.0
(N)	(55)	(75)

Chi Squared = 1.13
DF = 1
Significance = 0.288

TABLE 6.21(c) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attitude Towards The Project - Unit's Value For Science Teaching

	UNIT'S VALUE FOR SCIENCE TEACHING	
	USEFUL	NOT USEFUL
Schools continuing after trials	61.4	53.6
Schools not continuing after trials	38.6	46.4
Total	100.0	100.0
(N)	(101)	(28)

Chi Squared = 0.56

DF = 1

Significance = 0.456

TABLE 6.21(d) Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attitude Towards Project - Unit's Value For Enquiry

	UNIT'S VALUE FOR ENQUIRY	
	USEFUL	NOT USEFUL
Schools continuing after trials	56.8	77.8
Schools not continuing after trials	43.2	22.2
Total	100.0	100.0
(N)	(111)	(18)

Chi Squared = 2.84
DF = 1
Significance = 0.092

TABLE 6.22(a) Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attitudes Towards Project Material - Teachers' Background Information

	TEACHERS' BACKGROUND INFORMATION	
	USEFUL	NOT USEFUL
Schools continuing after trials	34.6	42.9
Schools not continuing after trials	65.4	57.1
Total	100.0	100.0
(N)	(104)	(21)

Chi Squared = 0.54
DF = 1
Significance = 0.473

TABLE 6.22(b) Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attitudes Towards Project Material - Objectives In Teaching Science 5/13

	OBJECTIVES IN TEACHING SCIENCE 5/13	
	USEFUL	NOT USEFUL
Schools continuing after trials	36.4	37.0
Schools not continuing after trials	63.6	63.0
Total	100.0	100.0
(N)	(55)	(73)

Chi Squared = 0.01
DF = 1
Significance = 0.942

TABLE 6.22(c) Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attitudes Towards Project Material - Unit's Value For Teaching Science

	UNIT's VALUE FOR TEACHING SCIENCE	
	USEFUL	NOT USEFUL
Schools continuing after trials	37.0	35.7
Schools not continuing after trials	63.0	64.3
Total	100.0	100.0
(N)	(100)	(28)

Chi Squared = 0.02
DF = 1
Significance = 0.901

TABLE 6.22(d) Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attitudes Towards Project Material - Unit's Value for Enquiry

	UNIT'S VALUE FOR ENQUIRY	
	USEFUL	NOT USEFUL
Schools continuing after trials	33.3	55.6
Schools not continuing after trials	66.7	44.4
Total	100.0	100.0
(N)	(111)	(18)

Chi Squared = 3.30
DF = 1
Significance = 0.069

TABLE 6.23 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Previous Use Of Nuffield Junior Science Project

	SCHOOL USED N.J.S.P.	SCHOOL DID NOT USE N.J.S.P.
Schools continuing after trials	54.4	60.5
Schools not continuing after trials	45.6	39.5
Total	100.0	100.0
(N)	(57)	(8)

Chi Squared = 0.29225
DF = 1
Significance = 0.5888

TABLE 6.24 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Previous Use Of Nuffield Junior Science Project

	SCHOOLS USED N.J.S.P.	SCHOOL DID NOT USE N.J.S.P.
Schools continuing at time of survey	33.9	37.5
Schools not continuing at time of survey	66.1	62.5
Total	100.0	100.0
(N)	(56)	(80)

Chi squared = 0.06027
DF = 1
Significance = 0.8061

we have no way of checking how successful the Nuffield Junior Science project had been in these schools. One would suspect that the less successful the project the less impact it would have had in encouraging schools to develop science work and hence the less impact it would have had on continuation with Science 5/13. In fact, if Nuffield Junior science was unsuccessful, in terms of schools continuing with the project after the trials, this may have left schools with a negative feeling towards trying a new science project. The literature would tend to suggest that few schools continued with the Nuffield Junior Science project after the trials ended. E.R. Wastnedge, the director of the project, spoke of some of the difficulties the project encountered once the trials ended, and how indeed the impetus of the trial period was lost, effectively bringing the project to an end.

> *But then came 1966 and the end of the project. The hundreds of teachers and thousands of children were left on their own. What no one perhaps appreciated was that this kind of impetus could soon be lost, once the teachers involved were deprived of practical help and support in their classrooms during the difficult early days. The teachers who were with us in the pre-trial days always had team members on hand ready to help and advice. As a result they produced outstanding work. But after that the teachers had too few supports - and then none at all. The Project ended. The Foundation had donated enormous sums of money to curriculum development. There was a limit.* [13]

A number of writers (Rodgers and Shoemaker, [14] House[15], and Carlson[16]) have spoken of the relationship between the status of the adopters and the subsequent success of the innovation. To look more specifically at teachers, Kelly, in the Curriculum Diffusion Research Project[17] discovered that the number of years service of trial teachers is important. It is argued that the highest adoption rate is associated with teachers in mid career. Tables 6.25 and 6.26 examine the relationship between the number of years service of trial teachers and whether schools continued with the project. Both tables showed no significant relationship between the two factors. A majority of the teachers engaged in the trials (in the sample population) had been teaching ten years or less, and consequently it proved impossible statistically to use categories such as '11 to 20 years teaching experience' and 'over 20 years teaching experience' in the analysis because the numbers involved were too small. It was thought originally that the '11 to 20 years teaching experience' category would represent the mid-career category. Another way of studying the status of the adopter (in this case the trial teacher) was to examine the continuation rate of those schools where the trial teachers were in a promoted post[18] and those where they were not. The results, shown in tables 6.27 and 6.28, indicate that schools where trial teachers were in non-promoted posts were more likely to continue with the project, both directly after the trials and at the time of the survey, with the effect most marked in the former case; however neither tables give results which were significant at the 0.05 level.

Some writers have noted the relationship between the movement of key individuals and the success of an innovation. House[19], examining the movement of school superintendents has linked their movement to a willingness to change and therefore an attitude more sympathetic to innovation. However Shipman[20] and Smith[21] who looked at the teachers involved in the innovation agreed that the migration of trial teachers could have a detrimental effect upon future work with the innovation

TABLE 6.25 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Years Of Service Of Trial Teacher

	YEARS OF SERVICE IN TEACHING		
	0-5	6-10	OVER 10
Schools continuing after trials	62.5	55.0	59.6
Schools not continuing after trials	37.5	45.0	40.6
Total	100.0	100.0	100.0
(N)	(48)	(40)	(47)

Chi Squared = 0.51
DF = 2
Significance = 0.774

TABLE 6.26 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Years Of Service Of Trial Teacher

	YEARS OF SERVICE IN TEACHING		
	0-5	6-10	OVER 10
Schools continuing at time of survey	42.6	27.5	36.2
Schools not continuing at time of survey	57.4	72.5	63.8
Total	100.0	100.0	100.0
(N)	(47)	(40)	(47)

Chi Squared = 2.13
DF = 2
Significance = 0.344

TABLE 6.27 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Level Of Appointment Of Trial Teacher

	LEVEL OF APPOINTMENT OF TRIAL TEACHER	
	PROMOTED POST	NON-PROMOTED POST
Schools continuing after trials	47.8	63.3
Schools not continuing after trials	52.2	36.7
Total	100.0	100.0
(N)	(46)	(90)

Chi Squared = 3.01

DF = 1

Significance = 0.083

TABLE 6.28 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Level Of Appointment Of Trial Teacher

	LEVEL OF APPOINTMENT OF TRIAL TEACHER	
	PROMOTED POST	NON-PROMOTED POST
Schools continuing at time of survey	30.4	38.2
Schools not continuing at time of survey	69.6	61.8
Total	100.0	100.0
(N)	(46)	(89)

Chi Squared = 0.80
DF = 1
Significance = 0.372

in the trial schools. One of the research questions (number 9), discussed in the previous chapter, suggested that headteacher movement might have a similar effect.

Table 6.29 analyses the relationship between trial teacher movement and whether trial schools were continuing with the project at the time of the survey. The results show a correlation significant at the 0.01 level indicating the strong relationship between success in terms of continuation and non-movement of the trial teachers. It would seem that trial teachers rapidly became associated with the project and when they left, it may be that the necessary expertise was not passed on to other members of staff, so work with the project was discontinued. This point was further emphasised when the questionnaire data was analysed to find out at how many of the trial schools continuing with Science 5/13 directly after the trials the trial teacher was still using the materials. It was discovered that at 78 per cent of the trial schools that were still using Science 5/13 directly after the trials, the trial teacher was involved in the work.

Table 6.30 examines the relationship between headteacher movement and the continuation of the project in the trial school. It shows that the relationship is not significant at the 0.05 level. This finding contrasts sharply with the significant relationship found to exist between the positive attitude of the headteacher towards the project and the project's continuation. One answer for this could be that a favourable headteacher attitude might be transferred to trial teachers and others interested teachers in the early stages of the

TABLE 6.29 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And The Continuation Of The Trial Teacher At The Trial School

	IS THE TRIAL TEACHER STILL AT THE SCHOOL?	
	YES	NO
Schools continuing at time of survey	57.1	25.9
Schools not continuing at time of survey	42.9	74.1
Total	100.0	100.0
(N)	(42)	(85)

Chi Squared = 10.57638
DF = 1
Significance = 0.0011

TABLE 6.30 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And The Presence Of The Same Headteacher Both During And After The Trials

	WERE YOU AND THE HEADTEACHER BOTH PRESENT DURING AND AFTER THE TRIALS?	
	YES	NO
Schools continuing at time of survey	38.6	32.9
Schools not continuing at time of survey	61.4	67.1
Total	100.0	100.0
(N)	(70)	(70)

Chi Squared = 0.28000
DF = 1
Significance = 0.5967

project's development ; headteacher movement then becomes less important. An alternative suggestion, discussed earlier[22] was that headteacher attitude towards the project might be coloured by how well the project had been taken up in the school. Further examination of this point would require a detailed examination at school level.

Use of Science 5/13 and External Support and Policy

A number of writers have noted the importance of external as well as internal support in the successful adoption of an innovation (see for example, Shipman,[23] Humble & Ruddock[24]). External support can take a variety of forms. The first to be investigated is the availability of meetings and conferences at which problems can be discussed, ideas can be exchanged and enthusiasm for the introduction of the innovation can be maintained.

Tables 6.31 and 6.32 show the relationship between attendance by trial teachers at national meetings before undertaking the trials and continuation by the school with Science 5/13 directly after the end of the trials, and at the time of the survey. Tables 6.33 and 6.34 look in a similar way at attendance by trial teachers at national meetings during the trials. Research question 11 in chapter 5 suggested an association between external support and continuation with the project. However the tables show that fewer schools where trial teachers attended national meetings continued with the project than was the case where trial teachers had not done so. It needs to be noted though, that the numbers attending national meetings especially

TABLE 6.31 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attendance At National Meetings Before The Trials

	ATTENDANCE AT NATIONAL MEETINGS BEFORE THE TRIALS	
	YES	NO
Schools continuing after trials	45.9	64.1
Schools not continuing after trials	54.1	35.9
Total	100.0	100.0
(N)	(37)	(92)

Chi Squared = 2.89277
DF = 1
Significance = 0.0890

TABLE 6.32 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attendance At National Meetings Before The Trials

	ATTENDANCE AT NATIONAL MEETINGS BEFORE THE TRIALS	
	YES	NO
Schools continuing at time of survey	35.1	37.0
Schools not continuing at time of survey	64.9	63.0
Total	100.0	100.0
(N)	(37)	(92)

Chi Squared = 0.00006
DF = 1
Significance = 0.9937

TABLE 6.33 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attendance At National Meetings During The Trials

	ATTENDANCE AT NATIONAL MEETINGS DURING THE TRIALS	
	YES	NO
Schools continuing after trials	50.0	59.2
Schools not continuing after trials	50.0	40.8
Total	100.0	100.0
(N)	(4)	(125)

Chi Squared = 0.02192
DF = 1
Significance = 0.8823

TABLE 6.34 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attendance At National Meetings During The Trials

	ATTENDANCE AT NATIONAL MEETINGS DURING THE TRIALS	
	YES	NO
Schools continuing at time of survey	25.0	36.0
Schools not continuing at time of survey	75.0	64.0
Total	100.0	100.0
(N)	(4)	(125)

Chi Squared = 0.00610
DF = 1
Significance = 0.9378

during the trials, were small so interpretation of trends is difficult. Further the associations shown in tables 6.31, 6.32 6.33 and 6.34 were not significant at the 0.05 level.

In many of the areas included in the survey local in-service training at the local teachers centre was used to support teachers in their work with the project in the classroom. The exact nature of this support varied from area to area but generally the administration of the trials was discussed at such meetings and new areas of work were reviewed. Again, research question 11 in chapter 4 suggests an association between attendance at these meetings and continuation with the project by the school. Tables 6.35 and 6.36 show the relationship between attendance at in-service training meetings before the trials and continuation with the project Although table 6.35 shows a slight trend in the expected direction the results shown in table 6.36 are in the reverse direction, and neither tables show results significant at the 0.05 level.

Tables 6.37 and 6.38 look at the relationship between attendance at local in-service meetings during the trials and continuation with the project by trial schools after the trials. Although these meetings dealt with problems arising during the trials they also discussed how new areas of work might be tackled and served as a way of feeding ideas back to Science 5/13 headquarters. In some cases meetings were held in school time and teachers were expected rather than invited to attend. It is difficult from the results shown in tables 6.37 and 6.38 to pick out any important trends relating

TABLE 6.35 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attendance At In-Service Meetings At The Teachers' Centre Before The Trials

	ATTENDANCE AT IN-SERVICE MEETINGS AT THE TEACHERS' CENTRE BEFORE THE TRIALS	
	YES	NO
Schools continuing after trials	62.9	46.3
Schools not continuing after trials	37.1	53.7
Total	100.0	100.0
(N)	(97)	(41)

Chi Squared = 2.59440
DF = 1
Significance = 0.1072

TABLE 6.36 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attendance At In-Service Meetings At The Teachers' Centre Before The Trials

	ATTENDANCE AT IN-SERVICE MEETINGS AT THE TEACHERS' CENTRE BEFORE THE TRIALS	
	YES	NO
Schools continuing at time of survey	33.7	41.5
Schools not continuing at time of survey	66.3	58.5
Total	100.0	100.0
(N)	(89)	(41)

Chi Squared = 0.43402
DF = 1
Significance = 0.5100

TABLE 6.37 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Attendance At In-Service Meetings At The Teachers' Centre During The Trials

	ATTENDANCE AT IN-SERVICE MEETINGS AT THE TEACHERS' CENTRE DURING THE TRIALS	
	YES	NO
Schools continuing after trials	60.6	55.2
Schools not continuing after trials	39.4	44.8
Total	100.0	100.0
(N)	(71)	(67)

Chi Squared = 0.21398

DF = 1

Significance = 0.6437

TABLE 6.38 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Attendance At In-Service Meetings At The Teachers' Centre During The Trials

	ATTENDANCE AT IN-SERVICE MEETINGS AT THE TEACHERS' CENTRE DURING THE TRIALS	
	YES	NO
Schools continuing at time of survey	38.7	34.3
Schools not continuing at time of survey	61.3	65.7
Total	100.0	100.0
(N)	(62)	(67)

Chi Squared = 0.27
DF = 1
Significance = 0.605

attendance at in-service meetings with continuation of the project. The results in both tables were not significant at the 0.05 level

Apart from these more formal contacts a few schools held less formal meetings where trial teachers came together to discuss problems. These meetings were normally arranged by the local authority and took place between a number of nearby schools. In some areas these less formal meetings took place alongside the more formal course of meetings held at the teachers' centre. In fact, only a relatively small number of schools (18 schools or 12.6% of the total sample) did so. A higher proportion who held such meetings continued with Science 5/13 directly after the trials and were still using the project at the time of the survey than those who did not. However, the association between attendance at informal local meetings and continuation with the project was not a strong one and was not statistically significant.

Apart from meetings and conferences one of the other important external factors said to have an effect upon the success of an innovation is the kind of support offered by other people and bodies. People like local authority Advisers/Inspectors, H.M.I.s and bodies such as colleges of education. Tables 6.39 and 6.40 show the relationship between visits by members of staff at local colleges of education to offer assistance or advice with Science 5/13 during the trials and continuation with the project, directly after the trials and at the time of the survey. Table 6.39 shows that a higher proportion of schools who had not received visits than of those who had received them continued on with Science 5/13 directly after the trials. The

TABLE 6.39 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Visits By College Of Education Staff During The Trials

	VISITS BY COLLEGE OF EDUCATION STAFF	
	YES	NO
Schools continuing after trials	44.0	63.6
Schools not continuing after trials	56.0	36.4
Total	100.0	100.0
(N)	(25)	(99)

Chi Squared = 2.43431
DF = 1
Significance = 0.1187

TABLE 6.40 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Visits By College Of Education Staff During The Trials

	VISITS BY COLLEGE OF EDUCATION STAFF	
	YES	NO
Schools continuing at time of survey	32.0	37.4
Schools not continuing at time of survey	68.0	62.6
Total	100.0	100.0
(N)	(25)	(99)

Chi Squared = 0.25
DF = 1
Significance = 0.618

relationship was not significant at the 0.05 level. Table 6.40 shows little difference between those schools receiving visits and those not receiving visits from college of education staff. If one examines both tables it shows that relatively small numbers of schools received such help from their local colleges of education during the trials. In fact of all school types it was the secondary schools that received most help. Earlier it was noted that secondary schools had the lowest continuation rate of all school types.[25]

The next type of support to be examined is that offered by H.M.I.s Tables 6.41 and 6.42 show the relationship between visits by H.M.I.s to discuss Science 5/13 work with teachers in trial schools during the trials and continuation with the project directly after the trials and at the time of the survey. The tables show that again a relatively small number of schools had received such visits (as with the visits by college of education staff) although the numbers were a little higher this time. As before the two tables show a similar trend. Table 6.41 which looks at the situation directly after the trials indicates that a higher proportion of schools that had not received visits from H.M.I.s, than of those that had received such visits, continued with the project. Table 6.42 shows little difference between those schools receiving visits and those not receiving visits from H.M.I.s. Once again the rather unexpected result may in part be a reflection of the fact that a relatively small number of schools and possibly an uneven distribution of school types received help from H.M.I.s.

TABLE 6.41 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Visits By H.M.I.s During The Trials

	VISITS BY H.M.I.s	
	YES	NO
Schools continuing after trials	48.7	62.9
Schools not continuing after trials	51.3	43.8
Total	100.0	100.0
(N)	(39)	(89)

Chi Squared = 1.70739
DF = 1
Significance = 0.1913

TABLE 6.42 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Visits By H.M.I.s During The Trials

	VISITS BY H.M.I.s	
	YES	NO
Schools continuing at time of survey	33.3	37.1
Schools not continuing at time of survey	66.7	62.9
Total	100.0	100.0
(N)	(39)	(89)

Chi Squared = 0.17
DF = 1
Significance = 0.684

The third type of support to be looked at is the help received from L.E.A. Advisers/Inspectors; tables 6.43 and 6.44 show the relationship between visits by L.E.A. Advisers/Inspectors to the schools during the trials to help and discuss problems connected with Science 5/13 and continuation with the project both directly after the trials and at the time of the survey. The tables show that many more schools received visits from L.E.A. Advisers/ Inspectors than any of the other personnel so far discussed in this section. Table 6.43 shows a positive relationship between those schools receiving visits and continuation with the project directly after the trials. However, table 6.44 shows less difference between those schools receiving visits, and those not receiving visits from local authority Advicers/Inspectors. The results shown in both tables were not significant at the 0.05 level.

The fourth type of support to be studied was the help given by members of the Science 5/13 team. They made visits to some of the trial schools to look at how their materials were being developed and discuss any points of difficulty that teachers might have. Tables 6.45 and 6.46 show the relationship between these visits and continuation with the project both directly after the trials and at the time of the survey. A majority of schools had received visits from Science 5/13 personnel. Table 6.45 shows that directly after the trials there was only a small difference between those schools receiving visits and those not receiving visits from Science 5/13 personnel, with a slightly higher proportion of schools visited by Science 5/13 staff continuing with the project. Table 6.46 looks

TABLE 6.43 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Visits By L.E.A. Advisers During The Trials

	VISITS BY L.E.A. ADVISERS	
	YES	NO
Schools continuing after trials	61.5	45.5
Schools not continuing after trials	38.5	54.5
Total	100.0	100.0
(N)	(109)	(22)

Chi Squared = 1.33277
DF = 1
Significance = 0.2483

TABLE 6.44 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Visits By L.E.A. Advisers During The Trials

	VISITS BY L.E.A. ADVISERS	
	YES	NO
Schools continuing at time of survey	33.9	45.5
Schools not continuing at time of survey	66.1	54.5
Total	100.0	100.0
(N)	(109)	(22)

Chi Squared = 1.05
DF = 1
Significance = 0.305

TABLE 6.45 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And Visits By Science 5/13 Team Members During The Trials

	VISITS BY SCIENCE 5/13 TEAM MEMBERS	
	YES	NO
Schools continuing after trials	59.1	57.1
Schools not continuing after trials	40.9	42.9
Total	100.0	100.0
(N)	(88)	(42)

Chi Squared = 0.04
DF = 1
Significance = 0.833

TABLE 6.46 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And Visits By Science 5/13 Team Members During The Trials

	VISITS BY SCIENCE 5/13 TEAM MEMBERS	
	YES	NO
Schools continuing at time of survey	31.5	45.2
Schools not continuing at time of survey	68.5	54.8
Total	100.0	100.0
(N)	(89)	(42)

Chi Squared = 2.35
DF = 1
Significance = 0.125

at the position at the time of the survey. This time a higher proportion of schools that had not been visited by Science 5/13 team members were continuing work with the project than was the case with schools that had received a visit from the team. This finding is surprising but the association was very weak immediately after the trials and was not significant at the 0.05 level on either occasion.

So far we have been looking at the relationship between various kinds of support given during the trials and continuation with the project both directly after the trials and at the time of the survey. Some of the schools continued to get support after the trials were over. For example, some attended meetings both national and local: the numbers, though,were small, for only 2 or 1.4 per cent of schools sent teachers to national meetings, only 15 or 10.5 per cent of schools had teachers who attended local in-service training at the teachers' centre and only 20 or 14 per cent attended more informal local meetings. Similarly, although some schools received visits from different personnel after the trials, the numbers who received such visits were small: 33 or 23.1 per cent of schools received visits from local college of education staff, 32 or 22.4 per cent received visits from H.M.I.s and 22 or 15.4 per cent received visits from L.E.A. Advisers/Inspectors (in each case only visits concerned with the project itself have been counted). Although the numbers are small there was a positive association between support of this kind after the trials and continuation with the project at the time of the survey. The support given after the trials is discussed in more detail in the next chapter.

The evidence presented so far concerning the external support given to trial schools and teachers has suggested that little support was given to these schools after the trials ended. One explanation for this is that trial schools might be looked upon as having the necessary expertise simply because they had participated in the trials. A second explanation may be that some trial teachers and schools may have considered that they already had devoted sufficient time and energy to one project and that they needed to look at other areas of the curriculum. A third explanation could be that as trial teachers left the original trial schools, interest in the project waned so that no new staff were sent to courses and meetings about Science 5/13. However, as we shall see in the next chapter one particular area took a very positive stand to continue with the Science 5/13 project. It became local authority policy that middle schools should have science as part of their curriculum. A core of work was outlined and Science 5/13 was listed as one of the main projects to be used in this core. This decision involved a system of intensive courses to help teachers use the ideas suggested in Science 5/13. This work and the type of support offered by other areas after the trials is discussed in more detail in the next chapter.

Humble and Ruddock [26] argued that one of the factors affecting the successful implementation of an innovation in education was the proximity to a teachers' centre. Such a teachers' centre would be able to give teachers easy access to meetings and courses. Table 6.47

TABLE 6.47 Relationship Between Schools Continuing With Science 5/13 Project Directly After The Trials And The Distance From The Teachers' Centre

	DISTANCE OF TRIAL SCHOOL FROM TEACHERS' CENTRE (IN MILES)		
	0-4	5-9	10 and over
Schools continuing after the trials	60.4	65.0	11.1
Schools not continuing after the trials	39.6	35.0	88.9
Total	100.0	100.0	100.0
(N)	(96)	(20)	(9)

Chi Squared = 8.72
DF = 2
Significance = 0.013

examines the relationship between the nearness of a teachers' centre to the trial school and whether a trial school continued with the project after the trials ended. The table shows a significant relationship at the 0.01 level, indicating that those schools within a radius of (0-9) miles from the teachers' centre had a greater chance of continuing with the project than those schools which were further away. Table 6.48 examines the same association but at the time of the survey. Although it shows a similar pattern the association was not significant at the 0.05 level.

Humble and Ruddock[27] also argued that another of the factors critical to the success of an innovation in education was the type of local authority and the attitude it adopted. Earlier in this chapter it was mentioned that authorities varied in the type of support they gave to projects like Science 5/13. In most authorities the help given rested with the L.E.A. Advisers/Inspectors. However, in a few cases such work was backed up by official local authority policy to introduce science in the primary and middle sectors, particularly the latter. People differ in their interpretation of the type of science best suited for primary and middle school children. This topic is discussed in more depth in the next chapter where each area's approach to science in the early years is outlined. This chapter concentrates upon the data collected from the survey. Tables 6.49 and 6.50 look at the relationship between continuation with Science 5/13 and the different areas in which the trial schools were located to see if an area's approach could be responsible for continuation with the project. Both directly after the trials

TABLE 6.48 Relationship Between Schools Continuing With Science 5/13 Project At The Time Of The Survey And The Distance From The Teachers' Centre

	DISTANCE OF TRIAL SCHOOL FROM TEACHERS' CENTRE (IN MILES)		
	0-4	5-9	10 and over
Schools continuing at time of survey	32.3	45.0	11.1
Schools not continuing at time of survey	67.7	55.0	88.9
Total	100.0	100.0	100.0
(N)	(96)	(20)	(9)

Chi Squared = 3.28
DF = 2
Significance = 0.194

TABLE 6.49 Number of Schools By Area Continuing With Science 5/13 Project Directly After The Trials

	AREA								
	1	2	3	4	5	6	7	8	9
Schools continuing after trials	42.9	43.3	70.6	45.5	75.0	36.4	92.9	60.0	28.6
Schools not continuing after trials	57.1	56.7	29.4	54.5	25.0	63.4	7.1	40.0	71.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(N)	(7)	(30)	(17)	(11)	(20)	(22)	(14)	(15)	(17)

Chi Squared = 20.72923
DF = 8
Significance = 0.0079

TABLE 6.50 Number of Schools By Area Continuing With Science 5/13 Project At The Time Of The Survey

	AREA								
	1	2	3	4	5	6	7	8	9
Schools continuing at time of survey	42.9	26.7	29.4	0.0	30.0	27.3	64.3	73.3	28.6
Schools not continuing at time of survey	57.1	73.3	70.6	100.0	70.0	72.7	35.7	26.7	71.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
(N)	(7)	(30)	(17)	(11)	(20)	(22)	(14)	(15)	(7)

Chi Squared = 23.16362
DF = 8
Significance = 0.0032

(table 6.49) and at the time of the survey (table 5.50) there were major variations in continuation with the project between schools in different areas. Table 6.49 shows that in three areas (Areas 3,5 and 7) more than 70 per cent of the trial schools continued with the project directly after the trials. In two areas (Areas 6 and 9) less than 40 per cent of the trial schools continued. Table 6.50 shows that in only two areas (Areas 7 and 8) were more than 60 per cent of the trial schools still undertaking work with the project at the time of the survey. The same table shows that in six areas only a third or less of the trial schools were still doing so. In both tables the relationship observed were significant at the 0.01 level. Any further discussion about why certain areas were more successful than others will be taken up in the next chapter when each area's approach will be looked at in more detail.

Use of Science 5/13 and the Suitability of the Project

There is a certain amount of overlap between this discussion and that already undertaken under the heading of the suitability of the host. For example, factors like the type of school, the type of timetable, the type of teaching method adopted, the facilities in the school and the background of the teacher could all be discussed in terms of the suitability or unsuitability of the project in a particular setting. The philosophy behind Science 5/13 was explicit in its bias towards a child centred approach with discovery learning. The content of science was only of secondary importance compared to the method of science. It was hoped that such a philosophy would fit in well with teaching methods used for the 5 to 13 age range, where a less formal approach might be used more frequently than in later years. Certainly from the data gathered from the survey and subsequent follow-up,secondary schools found great difficulty fitting such a scheme of work into their activities. They favoured the more formal, content based Nuffield projects like Nuffield Combined Science which formed a foundation for later work. Certainly the rigid timetabling used in most secondary schools runs contrary to the type of work envisaged by the Science 5/13 team. Middle schools vary in the way they are run, those catering for the 8 to 12 age group tend to be more primary based whilst those taking the 9 - 13 age range can become more formal at the top end as children are prepared for examination subjects at the secondary school. It would seem that the Science 5/13 material suits the primary schools most. It is in these schools where different subjects can be easily integrated around topics like the ones suggested in the Science 5/13 project. Timetabling is usually flexible so that once children become interested in an area of work they can continue. The results presented earlier in this chapter showed that secondary schools were the least likely to continue with the project after the trials ended. However, those most likely to be continuing at the time of the survey were not the primary schools but the middle schools. It would seem that local authority policy to include science such as Science 5/13 in the curriculum of middle schools may be a more important consideration than simply the suitability of material in terms of school type.

Inter-relationships between variables

In the preceding pages we have been examining the data collected using a questionnaire survey to illuminate issues raised in the research questions listed in chapter 5.

Table 6.51 summarises the relationships found to exist between the independent variables used in the analysis of the questionnaire responses and the dependent variables concerned with the continuation of the Science 5/13 project both directly after the trials of the project had ended and at the time of the survey. From this table it can be seen that five independent variables showed a significant association with continuation of the project immediately after the trials. These were: school type at the time of the trials; science background of the trial teacher; attitude of the headteacher to the project; distance of trial school from the teachers' centre; and area. In three cases the association was significant also at the time of the survey. These were: school type at the time of the trials; attitude of the headteacher to the project; and area. Three other variables were examined only at the time of the survey because it would not have been appropriate to consider them earlier. In two cases (school type at the time of the survey and continuation of the trial teacher at the trial school) the association was significant. In one case (reason why the trial teacher started Science 5/13 - own interest) the association, although tested for both directly after the trials and at the time of the survey, was only significant at the time of the survey.

TABLE 6.51 Relationship Between The Independent Variables And The Continuation Of the Science 5/13 Project Both Directly After The Trials And At The Time Of The Survey

	CONTINUATION WITH SCIENCE 5/13 DIRECTLY AFTER THE TRIALS			CONTINUATION WITH SCIENCE 5/13 AT THE TIME OF THE SURVEY		
	Chi-Squared	DF	Significance	Chi-Squared	DF	Significance
School type at the time of the trials	17.11333	4	0.0018	13.29657	4	0.0099
School type at the time of the survey	-	-	-	24.33233	4	0.0001
Facilities Available	0.8	1	0.780	0.07	1	0.798
Science background of trial teacher	19.95	3	0.000	6.87	3	0.076
Teaching method during trials	0.00553	1	0.9407	0.00023	1	0.9879
Attitude of Head to Project	24.25152	2	0.0000	19.40099	2	0.0001
Reason why trial teacher started Science 5/13						
(a) invited by L.E.A.	0.33	1	0.564	0.12	1	0.724
(b) asked by Headteacher	0.01	1	0.906	2.14	1	0.144
(c) Asked by another member of staff	0.07	1	-	0.89	1	-
(d) own interest	1.97	1	0.161	10.32	1	0.001
(e) other reason	0.10	1	0.750	0.00	1	0.978
Attitude of trial teacher towards project material						
(a) Teachers' background information	2.76	1	0.097	0.54	1	0.473
(b) Objectives in teaching Science 5/13	1.13	1	0.288	0.01	1	0.942
(c) Unit's value for science teaching	0.56	1	0.456	0.02	1	0.901
(d) Unit's value for enquiry	2.84	1	0.092	3.30	1	0.069

TABLE 6.51 (continued)

	CONTINUATION WITH SCIENCE 5/13 DIRECTLY AFTER THE TRIALS			CONTINUATION WITH SCIENCE 5/13 AT THE TIME OF THE SURVEY		
	Chi-Squared	DF	Significance	Chi-Squared	DF	Significance
Previous use of N.J.S.P.	0.29225	-	0.5888	0.06027	1	0.8061
Years of Service of trial teacher	0.66	2	0.717	2.13	2	0.344
Level of appointment of trial teacher	3.01	1	0.083	0.80	1	0.372
Continuation of Head at the trial school	-	-	-	0.28000	1	0.5967
Continuation of trial teacher at trial school	-	-	-	10.57638	1	0.0011
Attendance at national meetings before trials	2.89277	1	0.0890	0.00006	1	0.9937
Attendance at national meetings during trials	0.02192	1	0.8823	0.00610	1	0.9378
Attendance at in-service meetings at Teachers' Centre before trials	2.59440	1	0.1072	0.43402	1	0.5100
Attendance at in-service meetings at Teachers' Centre during trials	0.21398	1	0.6437	0.27	1	0.605
Visits by college staff during trials	2.43431	1	0.1187	0.25	1	0.618
Visits by HMIs During trials	1.70739	1	0.1913	0.17	1	0.684
Visits by LEA Advisors during trials	1.33277	1	0.2483	1.05	1	0.305
Visits by Science 5/13 team members during trials	0.04	1	0.833	2.35	1	0.125
Distance of trial school from T.C.	8.72	2	0.013	3.28	2	0.194
Area	20.72923	8	0.0079	23.16362	8	0.0032

Of course, it is possible that there were inter-relationships between a number of these independent variables we have looked at. Such inter-relationships have been examined for four independent variables that were, either examined both at the end of the trials and the time of the survey and the association was found to be significant on each occasion, or examined only at the time of the survey and the association was found to be significant at that time, (the variable school type at the time of the survey was not used because it was clear that while there were some changes in school type betwen the end of the trials and the survey in most cases such did not occur).

These inter-relationships are summarised in table 6.52. From this table it can be seen that considerable inter-relationship exists between three of these variables (the headteacher's views on the value of the project, the type of area and the school type), but not the fourth variable (whether the trial teacher remained at the trial school or had moved away).

In some circumstances it would be possible to move on from this stage using further statistical analysis to investigate the nature of these inter-relationships in more detail and so examine the respective strengths of those three independent variables in causing the continuation patterns observed. However, in this case the number of cases is too small for further analysis to be useful.

Nevertheless knowledge of these inter-relationships is important fo it alers us to the fact that the explanatory value of some of the independent values may be less strong than supposed at first sight. Although this cannot be elaborated further here it will be returned to in the more detailed investigations reported in the next chapter.

TABLE 6.52 Inter-Relationships Between Those Independent Variables Which Showed Significant Association With Continuation Of The Science 5/13 Project

	Chi Squared Value	Degrees of Freedom	Significance Value
School type at time of trials by attitude of Head of Project	45.25916	8	0.0000
School type at time of trials by continuation of trial teacher at school	0.42640	4	0.9803
School type at time of trials by area	164.13759	32	0.0000
Attitude of Head to Project by continuation of trial teacher at school	0.41203	2	0.8138
Attitude of Head to Project by area	47.83037	16	0.0001
Continuation of trial teacher at school by area	5.62613	8	0.6890

Footnotes

1. 'Progress in Learning Science' was set up in April 1973 by the Schools Council to investigate ways of helping teachers to match science activities to individual pupil needs. It was based at the School of Education, University of Reading and the director was Dr. W. Harlen.
2. Schon, D.A., Beyond the Stable State, Temple Smith, London, 1971.
3. Walton, J., 'Structure and the Curriculum', in Walton,J., (ed) Curriculum Organisation and Design, Ward Lock Educational, London, 1971.
4. Brown, S.A. 'Integrated Science - A Useful Innovation', A.S.E. Bulletin, 1974, No. 59 pp. 22-26.
5. MacDonald, B., Ruddock, J., 'Curriculum Research and Development Projects : Barriers to Success', British Journal of Educational Psychology, 1971, Vol 41, pp. 148-154.
6. Wynne Harlen, the evaluator for the Science 5/13 project wrote in her evaluation report (Evaluation and Science 5/13, (draft edition), Schools Council, 1973) that a considerable number of teachers found Stage 3 units unsuitable for most of their children, because they were not ready for such work.
7. Gross, N., et al, Implementing Organizational Innovations, Harper & Row, New York, 1971.
8. Havelock, R.G., Planning for Innovation through Dissemination and Utilization of Knowledge, Centre for Research and Utilization of Scientific Knowledge, Institute of Social Research, The University of Michigan, Ann Arbor, Michigan, 1969.
9. Schon, D.A., Op Cit.

Footnotes (continued)

10. MacDonald B., Ruddock, J., Op Cit.

11. For further details see p. 254 in this chapter

12. Burns, T., Stalker, G.M., The Management of Innovation, Tavistock Publications, London, 1961.

13. Wastnedge, R., 'Whatever Happened to Nuffield Junior Science?' Unit 13, Open University, Course E283, pp. 39-40.

14. Rodgers, E.M., Shoemaker, F.F., Communication of Innovations, The Free Press, New York, 1971.

15. House, E.R., The Politics of Educational Innovation, McCutchan, California, 1974.

16. Carlson, R.O., 'School Superintendents and Adoption of Modern Math : A Social Structure Profile', in Miles, M.B., (ed), Innovation in Education, Teachers College, Columbia University, 1964, pp. 329-341.

17. Kelly, P.J., Final Report of the Curriculum Diffusion Research Project, Chelsea College, University of London, 1975.

18. Teachers in promoted posts included headteachers, deputy headteachers, assistant headteachers and teachers with scale posts in the primary sector,or heads of department elsewhere.

19. House, E.R., Op Cit.

20. Shipman, M.D., Inside A Curriculum Project, Methuen & Co Ltd., London, 1974.

21. Smith, M.P., 'Curriculum Change at the Local Level', Journal of Curriculum Studies, 1971, Vol 2, No. 2 pp. 158-162.

22. For further details see p. 221

23. Shipman, M.D., Op Cit.

24. Open University, The Curriculum : Context, Design and Development - Teaching Strategies : A System Approach, Unit 15, Open University, Bletchley, pp 106-118.

Footnotes (continued)

25. For further details see p. 208

26. Open University, Op Cit.

27. Ibid.

CHAPTER 7

Analysis of Unstructured Interviews and Documentary Evidence Gained from the Area Visits

In chapter 5 the basis for the interviews in the local authorities areas of the sample population was outlined. It was suggested that the main aim was to obtain the views of those involved in support roles, about the trial and post trial situation. Appendix D lists the guidelines used for the interview questions. It begins with an outline of the questions used for the local authority Advisers/Inspectors with responsibility for Science 5/13. These were the first people to be contacted in each of the area. These interviews were important not only in their own right because of the information they provided about the progress of Science 5/13 but also as a way of gaining an overall view of key personnel in the support structure in each area. In addition the local authority Adviser/Inspector was able to give details about documentary evidence that might be available. The exact title and role of other key personnel in the support structure of each area varied because local authorities pursued different support policies : some, like areas 2 and 4, favoured specialist centres for science where teachers attended in-service courses. Although the majority of areas used teachers' centres for meetings, especially during the trials, the personnel staffing these meetings varied from local authority Advisers/Inspectors, to College of Education staff, to teachers' centre wardens, to headteachers and to trial teachers themselves. In some areas the support structure was stable from the time of the trials until the time this research was carried out. However, in others there was considerable movement of support staff. Similarly, the level of documentary evidence varied considerably from area to area. In some cases there was a full record, for example, of in-service meetings, whereas in other areas little documentary evidence was available.

All of this means that the amount of work that could be undertaken in an area, apart from interviewing the local authority Adviser/Inspector, varied considerably. This clearly needs to be borne in mind when evaluating the material presented. It also means that the interviews with the Advisers/Inspectors need to be viewed as the most consistent source of information. Such personnel were contacted in all areas and the interviews with them proved illuminating.

It was mentioned in an earlier chapter, but it is worth re-inforcing the point, that in some areas local authority Advisers/Inspectors were extremely helpful and offered to visit trial schools with the researcher and arrange for discussions with headteachers and teachers in these schools. When such offers were made they were accepted and views and information gained are reported. However, this was not the main aim of the area visits, and it is even more important than with the rest of the results reported in this chapter to bear the relatively haphazard nature of these sources in mind. They are reported because they proved interesting but they cannot be presented as representative.

Area 1

There were nine schools involved in the trials and these were scattered throughout the area, some in rural settings, others in more urban surroundings. Some of the trial schools were engaged in more than one set of trials, a few in as many as three sets. Generally each school had one teacher involved in the trials, though, one school had three teachers. Seven of the nine schools returned usable questionnaires and the information contained in them was discussed in the last chapter. Just less than half the schools that returned questionnaires were using the project both after the trials and at the time of the survey. In two of the seven schools the headteacher was directly involved in the project as the trial teacher. At one of these schools the headteacher was also the area representative with responsibility for co-ordinating activities and attending meetings with other area representatives and the Science 5/13 team.

The rate at which trial teachers moved away from the trial schools in the post-trial period was high. Many of the trial teachers moved school soon after the trials were over. Generally the teachers moved for further promotion, often to posts as headteachers at schools within the area. At the time of the survey almost three quarters of the trial teachers had moved schools. It is interesting that in only one case did a school continue with the project if the trial teacher left. At the one school where they did continue the headteacher, who was there at the time of the trials and had stayed in the post trial period, was interested in the project and tried to encourage its use throughout the school. At the two schools where the trial teachers remained after the trials work continued with Science 5/13. At one of these schools the project was taken up by a number of other teachers but at the other,work with Science 5/13 was almost entirely restricted to the trial teacher.

The trial schools were mainly of the primary type with only one secondary school. In the previous chapter, tables 6.9 and 6.10 (pages 209 and 210) showed the continuation rate of different types of schools. The tables indicate that just over half of all the primary schools used in the sample continued with the project after the trials and that this number had been reduced to about one-third at the time of the survey. The picture for secondary schools was less encouraging with none of the schools involved in post trial work. If one looks at the primary schools in this area, the continuation rate, was slightly lower than the general average directly after the trials, but slightly higher by the time of the survey. These figures can not be explained solely in terms of trial teacher movement, because on that basis one would have expected a much lower continuation rate at the time of the survey. It could be that the enthusiasm of some headteachers for the project, in spite of trial teachers leaving, was one reason for the higher continuation rate at the time of the survey.

However, the interview with the local authority Adviser responsible for primary science suggested there were several factors, some more general than others, which had hindered the continuation and further dissemination of Science 5/13 in the trial schools. One factor concerned the recent move to include welsh language teaching as a compulsory part of the primary school curriculum. In July 1977 central government issued a consultative document endorsing the feeling that 'children in Wales should be given the opportunity to have Welsh in their curriculum in accordance with parental wishes and where practical considerations allow'.[1] Towards this end local authorities in Wales were encouraged to formulate policies on the matter and the Secretary of State for Wales was considering obtaining grants from several bodies to assist the cost of bilingual education. In this part of Wales the result had been that approximately one hour of each day had been set aside for welsh language teaching. Although the local authority Adviser was sympathetic to the philosophy of the Science 5/13 project and encouraged its development, he was only too well aware of the competition from other areas of the curriculum such as welsh language teaching which, in this area, was now a compulsory part of the primary curriculum. The remarks made by the headteachers and teachers visited in the schools were mixed. Some teachers were critical of the time spent, in an already over-crowded curriculum, on welsh language teaching, while others, including one headteacher felt that as many of the text books as possible should be written in the welsh language. This meant that books, such as the Science 5/13 units, which were only available in english would not be viewed as favourably for use in the schools.

A second factor highlighted by the local authority Adviser as hindering the development of Science 5/13 in the post trial period arose from changes in local regional policies. Although local authority reorganisation itself had led to some policy changes others had been imposed in the years after reorganisation with the start of cuts in educational spending. The result, as viewed by the local authority Adviser, was a growing sense of isolation. Whereas, prior to reorganisation it had been relatively easy to travel outside the area and attend meetinngs, and make contact with people and agencies outside, at the time of the interviews, such opportunities were greatly reduced. This, he thought, was particularly detrimental to the development of a project like Science 5/13 where attendence at national meetings arranged by the Schools Council on the Science 5/13 project and at other regional meetings to discuss developments was important to provide stimulus and maintain momentum for future dissemination.

He considered that a third factor which caused problems in the post trial period was the re-organisation of tertiary education establishments in the area. This had tended to disrupt the support system available to trial schools. One of the local Colleges of Education had amalgamated with the Department of Education at a nearby University. Some of the personnel at these institutions who had been involved with in-service courses for the Science 5/13 project were apprehensive about how future in-service provision would be organised.

A fourth factor concerned his own role and that of other key personnel in the post trial period. Although he was a strong supporter of science in the primary school generally and of the Science 5/13 project in particular, he found that he had insufficient time in the post trial period to devote to the project in order to follow developments effectively. His particular remit was to oversee all aspects of the primary curriculum and it was inevitable that with such a work load science could only represent a small part, especially when other areas of the curriculum had been neglected during the trial period of the project. One of the results of this was the gradual reduction in in-service provision after the trials. During the trials teachers involved attended workshop sessions to try out the materials and regularly met for discussions. Directly after the trials the workshop sessions continued under the guidance of the primary Adviser and the area co-ordinator. These sessions were seen as crucial because the local College of Education, which trained most of the teachers in the area, incorporated little or no science in the majority of its teachers' training. The reductions in educational spending and the increasing difficulty of releasing teachers during the day for courses resulted in a gradual decrease in course held during school time and a change to evening meetings based on a more voluntary basis. Unfortunately teachers were not as enthusiastic in attending eventing meetings of this kind. Also, an H.M.I. who had enthusiastically supported the schools during the trials retired in the post trial period leaving a significant gap in the support structure at a crucial point in the establishment of the project.

In conclusion, it would seem that a number of factors including (i) an inadequate support system in the post trial period, (ii) competition from other innovations such as the introduction of the welsh language into schools, and (iii) the moving away of trial teachers, combined to hinder the progress of Science 5/13 in the trial schools. However, another possible reason highlighted in the local discussions for its comparative failure was the local authority's policy regarding science in the primary school. There was no attempt, as with the teaching of welsh, to insist that science should be included in the curriculum and as a result it would appear that other subjects which were either considered of greater priority or followed the interests of primary teachers more closely were included at the expense of science. In some instances this was counteracted by the enthusiasm of certain people including the primary Adviser, some headteachers and other teachers, who wanted to keep Science 5/13 alive. It was argued, though that these counteracting forces were not sufficiently strong in the post trial period to overcome those factors hindering the development of the Science 5/13 project.

Area 2

This was one of the largest areas in terms of the number of schools involved in the trials. Forty seven schools were used in the trials of which thirty schools returned usable questionnaires. These schools consisted of five secondary schools, ten primary schools, twelve junior schools and three infant schools. All of the schools were located in an urban setting. This area was involved in all four sets of the trials. Directly after the trials just less than half of the thirty schools were still using the project, but by the time of the survey only about one quarter of the schools were still doing so.

The area was unique in that it based its support for teachers at a Mathematics and Science Centre. This Centre, run by a director and her staff, organised the in-service courses for teachers. At the time of the survey in-service courses based on Science 5/13 were still operating. Two of the staff at the Centre were particularly interested in the project, one had been a member of the Science 5/13 team, while the other had organised most of the courses during and after the trials. Few of the other nine areas used in the survey ran as many in-service courses in the post trial period as were offered in this area. However, as has been noted, despite this effort, few of the original trial schools were continuing with the project at the time of the survey.

Interviews with staff at the Centre, the local education authority Inspectors, headteachers and teachers revealed a number of possible reasons for the relatively low number of schools continuing to use Science 5/13 at the time of the survey in this area. The first reason highlighted particularly by interviews with staff at the Mathematics and Science Centre, concerned the role of the Centre in overall in-service provision for teachers. The Director of the Centre suggested that the primary role of the staff at the Centre was to organise and run in-service courses based at the Centre. In some circumstances, such as during the trials of a project, staff were allowed to visit teachers in the schools but generally visits to schools were not encouraged by the local authority Inspectors. The problem with this approach was that direct assessment of the impact of the courses could not be obtained by Centre staff through visits to schools : instead reliance has to be placed on feedback, in the form of a written or verbal report from teachers, headteachers and the local authority Inspectors. In-service courses arranged either directly or in close association with the local authority Advisers/ Inspectors have the advantage that they involve the people who have the responsibility for visiting schools and assessing curriculum development. In this area, although the local science Inspector had an office in the Centre it appeared from the interviews that the staff at the Centre were fairly autonomous when it came to organising and running the in-service courses.

In these circumstances it is hardly surprising that the policies of the Mathematics and Science Centre were said by the teachers not to match the needs of teachers in schools. The interviews with staff at the Centre and teachers showed differences in their interpretation of how primary science should be taught. Certainly the interviews at the schools and the materials exhibited by schools at the Primary Science Fair held at the time of the interviews indicated that the schools generally saw science as integrated with other subject areas, often including it as part of a wider project based on the environment. However, Science 5/13 courses organised at the Centre in the post-trial period looked more narrowly at individual units.

It is also worthwhile commenting that although the questionnaire survey showed that Science 5/13 was not used in many of the trial schools after the trials it is possible that some form of science, with Science 5/13 being seen as one of a number of resources, was being taught. There was some evidence to support this view from the interviews with teachers. It is also interesting that at the time of the interviews the in-service courses based on the Science 5/13 materials were being modified to incorporate a broader topic approach.

A second reason given for the low continuation rate in this area was connected with the Science 5/13 materials themselves. The member of staff at the Mathematics and Science Centre most concerned with the in-service courses during the trial period, noted that the teachers encountered difficulty reading through the units; for example, they reported finding the objectives hard to deal with and, as a result, it became necessary to simplify them. Also, he observed that because the materials were published at various stages during the trials, teachers had problems seeing the units as a whole. In addition few teachers had any science background. As a consequence he needed to supply a lot of help, making and using even the simplest equipment. It became necessary to go through the units, almost page by page. This was the main reason why, in the post trial period, the in-service courses developed along the restricted lines noted earlier A third reason which was said to have hindered the use of the Science 5/13 project concerned a number of issues operating at the school level. In discussions with the staff at the Mathematics and Science Centre and the local authority Inspectors three main issues were highlighted, including high teacher mobility, the low priority given to science in the primary sector and the increasing difficulty of releasing teachers during school time for in-service courses. All three points were taken up with headteachers and teachers when visits were made to the trial schools. As a general case headteachers supported the view that teacher mobility was a problem. The questionnaire survey showed that at the time of the survey over half of the trial teachers in this area had left the trial schools. Headteachers pointed out that much of the impetus for continuing with the project after the trials came from the trial teachers, so that often, movement away from the trial school had meant the project was discontinued. To turn to the issue of why science was given low priority in the primary curriculum it was interesting that while, in general, both headteachers and teachers saw science as a valuable part of the curriculum, they were able to point to several reasons why relatively little use had been made of Science 5/13. Headteachers interviewed highlighted the competing nature of other areas of the curriculum and the disinterest generally shown by primary school teachers in science. A few, especially those who had no direct experience of the trials spoke of their own lack of knowledge about science. Many of those teachers interviewed expressed reservations about science in the primary school curriculum because they often felt they lacked the necessary expertise. However, many were bringing bits of science into their work, usually as part of an environmental approach. The issue of decreasing in-service provision during school time was raised by some headteachers as a problem, especially in areas like science, where teachers desperately needed some support. Similarly, the staff at the Mathematics and Science Centre were concerned about the move to arrange in-service courses to evenings, when only the more committed teachers would attend.

A fourth general reason, suggested by the member of staff at the Centre most involved in the trials, for the low continuation rate in this area concerned the relationship between the Centre for Mathematics and Science and the After Care Committee; the latter was set up by the Schools Council to follow post trial developments. He considered that the development work which had taken place after the trials had not been viewed in a favourable light by the After Care Committee. In particular the development of work cards had not been welcomed. This obviously was a disappointment to those involved in working parties in this area who saw their efforts towards producing pupil work cards as an important step towards giving teachers more help with Science 5/13. Indeed the working party had been set up as a direct consequence of teacher demand for work cards. It is ironical that in 1978 the Schools Council itself set up a project called 'Learning through Science'[2] to produce pupil work cards based on the Science 5/13 materials. As a result of the perceived opposition of the After Care Committee to the production of work cards and because copy-right difficulties would only allow work cards to be used at in-service courses, development work at the Centre was stopped. This conflict between the After Care Committee and the Centre effectively curtailed local curriculum development using the Science 5/13 materials.

A fifth main reason, highlighted in particular by staff at the Mathematics and Science Centre, for a low rate of continuation in the trial schools was related to the types of schools used. The earlier discussion has already covered the problems associated with the junior, infant and primary schools. The secondary schools included in the trials encountered even great difficulties continuing with the project in the post trial period. None of the secondary schools were using the Science 5/13 materials at the time of the survey. One of the schools had continued directly after the trials to use material from the units to produce topics for less able children but this work had stopped by the time of the survey. It was thought that one of the main factors hindering the progress of the Science 5/13 project in the secondary schools was the use of alternative science courses, generally the Nuffield Combined Science Scheme, for the 11 to 13 grouping. This feeling was supported by teachers' views gained from visits to the schools. Also they mentioned that since the trials those secondary schools involved in trial work had undergone reorganisation changing from secondary modern to comprehensive secondary schools. Whereas Science 5/13 appeared to fit into the curriculum of the secondary modern school, in particular to meet the needs of the less able child, it soon became inappropriate in the comprehensive school with its wider ability range. This led to the use of courses like the Nuffield Combined Science Scheme which formed a recognised basis for later examination work.

Another factor responsible for the low continuation rate in the secondary schools, was, the teachers suggested, the high mobility of trial teachers. Almost all the trial teachers moved from the trial schools soon after the trials finished. Generally the trial teachers were the only ones involved with the project and hence when they left there was little expertise in the science departments to show how the materials could be used. Also, one of the teachers, involved in the trials in a secondary school, spoke of the inappropriateness of the in-service courses held at the Mathematics and Science Centre. He felt they were biased towards the primary schools with their younger age group. The staff at the Centre readily admitted that they considered the materials generally unsuitable for the secondary schools who already had a number of science schemes available to them.

In spite of the fact that relatively few schools continued with the Science 5/13 project in this area, especially at the time of the survey, there were signs at the time of the interviews, that there might be a revival in the use of the Science 5/13 materials. One of the local authority Inspectors described how, as a result of certain boundary changes, a number of extra schools had been brought into the area. These schools had formerly been in an authority committed to a middle school system. Partly as the result of pressure from the secondary schools, the middle schools had included science, using the Nuffield Combined Science Scheme, in the curriculum of the older 10-12 age group. Although some schools managed to cope with the work, others had encountered difficulties and as a result little science was taught. Part of the problem was the diversity of resources in the middle schools in terms of facilities, equipment and expertise of the teachers. As a result, when the schools were transferred to the control of another authority it was decided to look again at the type of science appropriate for the 8 to 12 age range. At the time of the interviews the policy of the local authority Inspector, responsible for science in the middle years, was to set up working parties, primarily of staff from the middle schools, to draw up suitable topic areas in science. For a number of reasons it was considered that the Science 5/13 materials should form an important part of these topic areas: first, the middle schools already had used the Science 5/13 project with younger children and were eager to extend its use; and second, the Mathematics and Science Centre which would provide any necessary in-service courses, was encouraging the use of Science 5/13 in the middle schools. Therefore it was considered that the 8 to 12 age range was ideal for the Science 5/13 project.

Also the local authority Inspector responsible for primary scinece expressed his growing concern about the limited amount of science taught in primary schools generally. In an attempt to remedy the situation a series of talks had been arranged with primary schools to keep them in touch with recent developments and encourage more teachers to include science in their work.

Area 3

In area 3 the trial schools were concentrated in two adjacent towns and were originally selected because of their previous involvement with the Nuffield Junior Science Project. These schools had been given special cash allowances for the Nuffield trials and such allowances were retained for their work with the Schools Council Project, Science 5/13. There were twenty four schools involved in the trials of which seventeen returned usable questionnaires. The seventeen schools consisted of eleven junior schools and six infant schools. This area took part in two out of the four sets of trials; the third set in 1971 and the fourth set in 1972. The local authority science Adviser at the time of the trials was the area co-ordinator and previously had attended a national meeting arranged by the central Science 5/13 team. Directly after the trials nearly three quarters of the seventeen trial schools were continuing with the project, but, by the time of the survey only about one quarter were still using Science 5/13.

The local authority science Adviser described the type of in-service provision before and during the trials. Before any of the trial work was undertaken all the trial teachers involved met and were given details of the general procedures to be adopted. They were then divided up into several groups, each of which met at regular intervals, usually one afternoon each week and often with the local authority science Adviser present. A representative of the national Science 5/13 team attended several evening meetings at the time of the trials and non trial teachers were invited to join the meetings to find out more about the project. These meetings were introduced usually by the representative of the national Science 5/13 team and this was followed by a series of brief talks by trial teachers about their work. An exhibition of children's work was also on show. The local authority science Adviser remembered that those evening meetings were successful in attracting large numbers of teachers. After the third set of trials a number of primary science courses were arranged for non-trial teachers who had little or no science background. One of the trial teachers became teacher/warden of one of the teachers' centres in the area and became a key person in the organisation of these courses. Other trial teachers also helped to tutor on the primary science courses. In the period of time from the third set of trials in Spring 1971 until the fourth set of trials in the Spring 1972, five primary science courses were arranged, each usually involving five sessions. One course was held at the local College of Education and involved one of its staff members. In addition four evening meetings were held during that time.

The local authority science Adviser recalled that at a meeting of the trial teachers held after the third set of trials several criticisms were made about the materials and the evaluation. For example, some teachers argued that the questions on the evaluation forms were ambiguous and were difficult to answer; others suggested that the forms took too long to complete and dealt with too wide a range of material. Some trial teachers also felt that they were expected to get through too much material during the trials.

The materials for the fourth set of trials were late reaching the schools so that a formalised system of meetings between trial teachers was replaced by a more flexible arrangement where teachers met when they thought they needed to. The amount of feed back was reduced in these trials and only individual reports were returned to the Science 5/13 team.

It could be argued that the intensity of the involvement of trial teachers in this area both with the trials themselves and with the courses during and immediately after the trials, possibly explains why almost three quarters of the trials schools continued with the project after the trials ended.

Documentary evidence including details of meetings and formal letters sent between the teachers' centre warden and the science Adviser outlining strategies for forthcoming in-service meetings indicated that soon after the fourth set of trials there was a general shift away from primary science courses because they were not considered effective in disseminating the Science 5/13 materials. It was argued in one letter that although by October 1972, 100 teachers had attended courses about primary science, once teachers returned to their schools they became isolated often without the necessary support to help the project in its early stages. It was felt also that generally these teachers had little experience of science in their education; for example, the local College of Education which some teachers had attended only provided six sessions of science in three years for non-specialists. The teachers' centre warden thought that one possible answer might be to given an in-service course to the whole school, rather than individual teachers, beginning with a seminar for headteachers to make them familiar with the project. This would be followed by in-service meetings involving all the teachers in a school. It was for this reason that the in-service meetings after Summer 1972 moved away from the use of primary science courses towards more school based work where the whole staff of a school was involved. Two 'one day seminars' were held for primary headteachers in two different parts of the area. Secondary school teachers were also invited to send represent-ativies who might be interested in using Stage 3 Units with lower ability children. The one-day seminars began by looking at the work of the Schools Council with specific reference to the 5/13 Science project and the various Nuffield Science schemes. Later the philosophy behind the Science 5/13 project was examined, with particular emphasis upon, 'With Objectives in Mind'. Much of the remaining time was devoted to practical work and discussions. Although one of the seminars was successful in terms of the numbers attending, and the general interest shown,the other was reported as disappointing with few headteachers attending and little enthusiasm shown for the project's materials. Another problem seemed to arise from the limited number of staff available to help run the seminars, particularly from trial teachers who normally would have acted as tutors at in-service courses. Also it was hoped to hold an exhibition at the seminars based on the work of teachers who had already attended previous primary science courses. The response was extremely poor. Some of the possible reasons suggested for this lack of response were (i) teachers only used Science 5/13 while the course was running ; (ii) the work tended to stop when the teacher started with a new class ; (iii) some materials had been sent earlier in the year for another course, and this was thought sufficient; and (iv) it was Christmas and teachers were too busy with other activities.

Gradually during 1973 and in the next three years the number of courses and meetings based on Science 5/13 became less and less. From the interviews conducted with the local authority science Adviser, headteachers and teachers there seem to have been three main reasons for this : first, a large number of the trial teachers began leaving the trial schools in this period, often for promotion, which involved them in other activities; second, other key personnel including the science Adviser found they had less time to devote to primary science; and third, the area changed over to a comprehensive system of education and this diverted some of the key personnel away from primary science.

The first of these points concerned the movement of trial teachers away from the trial schools. By the time of the survey only one quarter of the trial teachers were still at their trial schools. This figure almost mirrored the number of trial schools which were still using Science 5/13 at the time of the survey. The second point dealt with the changing nature of the science Adviser's role. After the trials he took on the role of a general Adviser in addition to his other responsibilities in science and as a result his time had to be divided between two sets of duties. At the time of the survey he found that almost all his time was devoted to non-science activities. The third point concerned the change over to a comprehensive system of education. This involved the local authority Advisers in a temendous amount of work, for example, interviewing teachers. This alone meant that in-service work had to be restricted and in fact no science courses were held in the three years prior to the survey.

In the interview with the local authority science Adviser there was a discussion on the status of science in primary schools. He expressed concern about the difficulty of promoting science, and thought that even if many headteachers considered Science 5/13 a valuable project few had the time to support its development in their schools. There were other areas, mainly in the basic subjects, which were given more priority. This view generally was supported in the interviews with headteachers and teachers. Headteachers often remarked that although an enthusiastic teacher may cope with Science 5/13, few teachers had sufficient interest in science from which development could start.

The local authority science Adviser did give some indications as to how the position of science in the primary schools might be improved in the future. The first concerned the role of advisory teachers. At the time of the survey two advisory teachers had been appointed in science; they were teachers from local schools who had been seconded for two years, spending part of their time assisting the Adviser and the remainder studying for a higher degree. Although such advisory teachers, if they had existed directly after the trials, might have had an important role supporting the project, the temporary nature of their posts might have made long-term planning difficult. Two further suggestions were made by the Adviser. The first concerned the appointment of primary teachers with a scale post in science. However this might have been resisted by head-teachers, as science was still not seen by them generally as an important part of the curriculum. A second possibility was the increased use of science workcards, but here again the science Adviser had reservations about their use; not only did he feel that some of the commercial ones were of poor quality but he also felt that they tended to stiffle initiative, especially when it came to recording observations.

One final comment might be made about the in-service provision in this area, and particularly the role and relationship of the various teachers' centres with the Advisory service. The science Adviser saw the wardens, of the teachers' centres in his area, as having three main tasks : first, to look after the fabric of the building; second, to organise resources; and third, to administer in-service courses. It seemed from the comments made that the wardens' roles, especially the administration of in-service courses depended upon their personality and initiative, not only in terms of how well they linked with teachers and the Advisory service but also in terms of the amount of commitment and enthusiasm they showed for the in-service courses they provided.

Area 4

This was an inner city area which had seventeen schools involved in the trials; fifteen were primary schools, two were secondary schools. In the previous chapter table 6.49 (page 283) showed that less than half of the trial schools were continuing with the project directly after the trials. Table 6.50 (page 284) indicated that at the time of the questionnaire survey not one of the trial schools was still undertaking work with Science 5/13.

During the course of the interviews four main factors were highlighted as having inhibited continuation with the project. The first concerns the rapid turnover of trial teachers after the trials ended. In this area nearly three quarters of the trial teachers had left the trial schools by the time of the survey. The significance of this factor in preventing effective dissemination within trial schools was accentuated by the second factor, the limited scienctific training of primary teachers. The high turnover rate of trial teachers meant that if the project was to continue in the trial schools much depended upon the attitude of other members of staff to the project. Many of the people interviewed, including headteachers, teachers and local authority Inspectors, spoke of the lack of interest shown generally by primary teachers in science; most teachers were more concerned with 'the basics' and had a particular interest in subjects like drama and history. It was apparent also that this lack of scienctific training had made many teachers wary of including much science in their work, because they did not feel sufficiently confident about it. This meant that even if some of the trial teachers were sympathetic to Science 5/13 and continued with it after the trials they found great difficulties in persuading their colleagues to bring more science into their work.

A third factor important in blocking the dissemination of Science 5/13 after the trials was the general feeling amongst headteachers that science did not represent an essential part of the curriculum; at best it was usually seen as a useful extra to be pursued by those teachers who have an interest in that area. It is worthwhile noting that the local authority Inspectors responsible for primary work expressed a similar attitude: they said that they felt that curriculum development in 'basic subjects' should have precedence over such development in science education. In this particular area most of the initiative for bringing primary science into the schools had come from the local authority science Inspectors rather than the Inspectors responsible for primary education. The main difficulty associated with this type of approach is that the science Inspectors were concerned in the main with secondary science, most found they only had a limited amount of time for looking at science in the primary school and could not sustain involvement over a prolonged period.

A fourth factor concerned the follow up of in-service courses in the schools. Although it would seem that the dissemination of Science 5/13 did not suffer from the lack of in-service provision, as in some other areas, problems with follow up after the courses were referred to. In-service courses in Science 5/13 largely were carried out at one of three Science Centres which existed in this area. Staff at one of the Science Centres spoke of a variety of approaches used to attract more teachers onto the courses and secure greater success in continuation when the teachers returned to their schools. There were two day courses to introduce Science 5/13, followed by further courses including out-door work taking an environmental approach. In addition evening meetings were arranged six weeks after the courses in an attempt to obtain feed-back about how the project was developing in the schools, but few teachers turned up. In this particular area the Centre staff were not allowed to follow up courses by visiting teachers in their schools; support in the schools was left up to the headteachers and local authority Inspectors. At the time of the interviews new types of courses were being arranged specifically for primary headteachers to engender more support. One of the main difficulties appeared to be following up development work in the school. Local authority science Inspectors said they had little time to undertake such work, so the impetus had to come from within the school. Also headteachers spoke of the difficulties of releasing teachers for daytime courses. It appeared that the general situation regarding attendance at in-service courses together with follow-up afterwards was deteriorating rather than improving.

The local authority Inspector in charge of science was hopeful that the decrease in teacher turnover rate, noted at the time of the interviews, could prove important in providing greater stability so that curriculum development could be better planned. Also it was hoped that the introduction of in-service meetings for primary headteachers might help science to be included more in the curriculum although the general attitude of primary headteachers and local authority primary Inspectors was less than favourable.

In conclusion views collected supported an argument that at least two of the four significant factors listed in the previous chapter, attitude of the headteachers and movement of trial teachers away from the trial schools, had a detrimental effect upon continuation with Science 5/13 and dissemination of the project in the trial schools in this area. In addition, these two factors, as well as being seen as important in themselves, were also seen to have had an impact on the support services, particularly the difficulties they encountered following up development work in the schools. The general attitude of headteachers towards science, the unwillingness of teachers to attempt science and the movement of trial teachers away from the trial schools were all to have made dissemination very difficult, even with a good provision of in-service courses.

Area 5

In this area there were thirty one schools, situated in urban and semi-urban settings, which were used in the trials of the Science 5/13 project and twenty of them returned usable questionnaires. Almost all of these were of the primary school type, though four were in the process of reorganisation to middle schools at the time of the trials. Most of the primary schools used in the trials covered the full 5 to 11 age range but a few were separate infant and junior schools. Table 6.49 page 283 in the previous chapter showed that three quarters of schools in this area continued with the project directly after the trials. However table 6.50 page indicated that by the time of the survey this figure had been reduced to less than a third.

During the interviews one of the main reasons given, especially by headteachers, for the relatively low rate of continuation at the time of the survey was the high teacher turn-over rate particularly in the years soon after the trials ended. In fact by the time of the survey three quarters of the trial teachers had moved away from the trial schools. However, more detailed examination of the position in this area suggested that trial teacher movement was not the only explanation for the relatively low continuation, for in fact, some schools where the teacher had moved contininued with the project, and, also at the time of the survey there were no schools where the trial teacher was still in post, using the project.

A second reason given for the low continuation rate was the difficulty involved in introducing a science project, like Science 5/13 into the primary schools. For instance, it was reported, usually by headteachers, that generally teachers felt frightened about teaching science. The local authority Inspector, with responsibility for science in the primary school, spoke of the general feeling in these schools that science was not to be regarded with the same importance as the 'basic skills' and often it was not thought to be as important as other areas such as games and, more general, environmental work. Although many primary teachers had little science training in their education the local authority, through its local Inspectorate, had tried hard to help teachers to become more familiar with primary science. The authority had held a number of courses for different age groupings covering the whole 5 to 13 age-range. Some of these were residential and consisted in the main of workshop sessions where teachers tried out activities connected with the various Science 5/13 units. Sometimes teachers would follow-up this kind of course by meeting at a local teachers' centre to discuss ideas and any problems. In addition there were evening meetings which looked at the ideas in Science 5/13 and the various experiments suggested. These took place all over the authority and were normally run by headteachers who had become deeply involved in promoting science in the primary schools. Nevertheless, from the evidence collected it seems, that despite the efforts of some head-teachers to encourage science, the view that science was not a really important part of the primary school curriculum continued to predominate. This was, as in other areas, in sharp contrast to the findings of the questionnaire survey which revealed that generally headteachers considered that science had a valuable role to play in the primary school curriculum.

A third reason, often expressed by headteachers and teachers for the low rate of continuation, concerned the feelings of the trial teachers themselves about their trial work; some found themselves overwhelmed during the trials. Although many of the schools had previously been involved in the Nuffield Junior Science Scheme, some trial teachers had little experience of bringing science into their work. Most teachers spent a considerable amount of time using the Science 5/13 materials and co-operating with the efforts to evaluate the project. In fact, some teachers felt that they had spent so much time on Science 5/13 during the trials that they had neglected their other work and once the trials were over they felt they had to return to these neglected areas.

Finally there were two reasons given during the interviews with the local authority Inspector and headteachers which were peculiar to this particular area. The first concerned the use of a school run by the British Forces Education Service as a trial school. One of the major features of this type of school was its shifting population. Generally there was a third more movement among the pupil population than in other schools. This trial school had difficulty in completing the trials simply because of this problem. It is understandable in these circumstances that schools of this type might well emphasise the basic subjects rather than science to ensure that their pupils do not suffer unduly. The second reason concerned one part of the area where there was still a selection examination at the end of the primary school. Some of the trial schools were situated in this part of area 5. Headteachers of such schools often spoke of the need for a fairly formal approach emphasising the basic skills. At one school the headteacher described the use of Science 5/13 as spasmodic, giving the impression of teachers occasionally dipping into the books for ideas to include in project work.

However, in spite of the many reasons given for trial schools not continuing with the project, many of which centred on the difficulties encountered in the primary schools, some more promising signs were to be seen in the middle schools, four of which were used as trial schools. The local authority Inspector in charge of science described how these schools were reorganising into middle schools at the time of the trials. By the time of the interviews they had been operating as schools for the 9 to 13 age grouping, for about five years. In the early days bridging groups had been set up; these consisted of science staff from the feeder middle schools and the upper schools. They were concerned with the type of science to be taught in the middle schools and looked at two science schemes, Science 5/13 and the Nuffield Combined Science scheme, to see how they might be used to form a viable scheme of work from the first schools upwards. They aimed to draw up a list of basic areas of scientific knowledge which a 13 year old might be expected to know upon entry into the upper school. The result was an agreed list of topics which were drawn up for the guidance of first, middle and upper school teachers. Each middle school had appointed a head of science who was responsible directly for the science taught to the 11 to 13 age group, and advised class teachers further down the school about the appropriate science for the 9 to 11 age grouping. Although one of the main aims of the list drawn up by the bridging group was to ensure that all middle schools covered similar work it was hoped that this could be done without restricting either the choice or enthusiasm of the teacher.

It was recommended in the document drawn up by the bridging group that the first schools should use, in particular, two of the Science 5/13 units, Early Experience, Stage 1 and Using the Environment - Early Explorations, Stage 1. These two books were thought to be of specific relevance to the first schools. Many of the remaining units contain some Stage 1 work and it was suggested that some of these could be introduced to the 5 to 8 age grouping. The first two years of the middle schools were seen as a continuation of the work in the first school using other Science 5/13 units, mostly at Stage 2 level. The teaching at this level, as in the first school was class based, organised and developed by the class teacher. A series of science topics, drawn essentially from the Nuffield Combined Science Scheme and the Scottish Integrated Science Scheme, were suggested for the guidance of teachers teaching science to the 9 - 13 age grouping in the middle school. These topics included such areas as sound, light, air and acidity. Each of these areas was expanded to give further guidance. Although it was hoped that most of this material would be used as a 'core' for the last two years in the middle schools, interviews with staff showed there was a considerable amount of variation between the four schools in terms of how much of the core was covered. Some had turned to the Science 5/13 units and used these instead.

Interviews with staff at some of these schools revealed also a feeling that part of the problem in the post trial period had been a lack of cohesion between the four middle schools and this might have been the result of a weak bridging group. There were staff changes in science at both the middle and upper schools: this meant new personalities and new ideas were brought into the group. It was said that unfortunately the leadership of the group weakened. A head of science at one of the middle schools spoke of the need to revitalise the bridging group, not only in order to bring greater cohesion so that all pupils entering the upper school at 13 had covered similar work, but also because it was time to begin revising some of the ideas drawn up in the original document.

The local authority Inspector described how a further three middle schools which opened at the time of the survey near to the existing ones went through a similar discussion machinery involving a bridging group. However this time the result seems to have been a greater commitment to follow a core using material from Science 5/13 and the Nuffied Combined Science Scheme. As with the other middle schools the teaching of Nuffield Combined Science to the older 9 - 13 age grouping was to be undertaken by science specialists and was to take place in a laboratory setting. The younger age grouping would use the Science 5/13 units. Local courses were to be run for non-specialist class teachers to help them understand more about the Science 5/13 project and how to use its materials. Despite some difficulties the introduction of middle schools into this area did seem to be assisting the dissemination of Science 5/13.

Area 6

Area 6 included four local authorities in Scotland. Altogether there were twenty four primary schools involved in the trials of Science 5/13. Twenty two usable questionnaire forms were returned after the survey. The overall continuation rate for all four authorities was low, both directly after the trials and at the time of the survey; only about one third of the trial schools were continuing directly after the trials and this proportion had been reduced to about one quarter by the time of the survey. Most of the schools were situated in urban areas though a few were located in more rural settings.

In the first of the local authorities ten schools were involved in the trials of the project. These schools took part in three sets of trials although like the other local authorities used in Scotland, extra units were tried out before the official trials began. The trial schools were situated in a number of towns located near to each other. Only one of the trial schools continued with the project directly after the trials but by the time of the survey the number had been increased to two.

In spite of the low number of trial schools continuing with the project, the local authority area was fairly active, both at local authority level through the primary Adviser and at College level, in promoting Science 5/13, but as is explained later, this support was patchy in the post trial period. The primary Adviser and science staff at the local College of Education worked closely together during the trials. The interviews with them suggested they were committed to the same general policy concerning primary science with an emphasis upon a child centred approach as outlined in the materials of the Science 5/13 project. Science 5/13 was seen as the main science resource to be used along with other areas of the curriculum in an integrated way. This meant that the Science 5/13 units were used in a fairly flexible manner. During the trials the local College of Education in conjunction with the primary Adviser provided an extensive support system including workshop sessions and meetings for reporting back and discussion, in addition to visits made to the trial schools to help teachers with the units. One H.M.I. who was involved with the project in this area and made several visits to the trial schools was reported to have been very enthusiastic about the project. In spite of the amount of support given to the project during the trials and the good work produced by trial teachers, the continuation rate after the trials was low. Interviews with local authority Advisers, College of Education staff, headteachers and teachers highlighted a number of reasons for this position. The first reason concerned the gradual disintegration of the support system available to teachers in the trial schools after the trials. In the trial schools themselves many of the trial teachers left usually for promotion to other schools or to take up lectureships at Colleges of Education. By the time of the interviews only two of the trial teachers were still at the original trial schools. Also after the trials the local College of Education found that it had to cut in-service courses for teachers because of a high intake of pre-service students.

Originally the courses which took place were similar to those in the trial period with schools asked to nominate teachers and arrange for release during school hours. However, soon after the trials the primary Adviser withdrew the nomination system of release for primary science (in favour of other areas of the curriculum) leaving the Colleges to advertise and organise the courses themselves. Also the staff at the College of Education became so busy during the day with pre-service teaching that the in-service courses were arranged after school hours and as a result attendance became more voluntary in nature and this led to a reduction in attendance. Apart from the decline in in-service provision by the College of Education, the primary Adviser found that directly after the trials she had to stop working with Science 5/13 in order to consider other areas of the curriculum which had been partly neglected during the trials. Also the H.M.I.s became less directly involved in the work of Science 5/13 in the area once the trials were completed.

The second reason mentioned for the low continuation rate after the trials related to the kind of support given to schools in the post-trial period. This was aimed primarily at those not used in the trials. This approach was based on the assumption that the trial schools would be able to disseminate the project internally using the expertise of teachers involved in the trials. As the discussion has already shown this did not happen and only a few trial schools continued with the project after the trials.

A third reason suggested in interviews with the primary Adviser, headteachers and teachers themselves, for the low rate of continuation with the project concerned factors operating within the trial schools themselves. In addition to the high mobility of trial teachers in the post trial period, two other factors were highlighted. These were: one, the low level of expertise in science of most primary teachers, which made many teachers express feelings of insecurity; and, two, the general feeling among headteachers that science was not a priority area in the primary curriculum.

In the interview with the head of the science department at the local college of Education she explained that at the time of the interviews there had been another shift of emphasis by the college of education. The number of pre-service students had been drastically reduced and as a result the amount of time available for support to schools had increased. At the same time the Scottish Education Department had launched a new Environmental Studies project[3] which incorporated science, mainly through Science 5/13, as one important part. The College, with its new emphasis upon in-service provision, provided courses on the new project with the science department at the College arranging workshop sessions using the Science 5/13 units. The in-service work began with meetings for the headteachers who later nominated two teachers from each school to attend three-day release courses. After these courses members of the science staff visited schools for half a day every week to help teachers with the units. This lasted for one term. In the second term the contact was reduced with the College tutor taking on more of an advisory role.

At this point in time another set of teachers were taken into the College for a new three-day release course. The availability of unemployed teachers in the area meant that they could be engaged and used to release teachers to attend courses. This was particularly important for smaller schools where otherwise it would have been difficult to release teachers. The head of the science department described this new approach as an attempt to overcome some of the difficulties encountered in earlier trial schools. It attempted : first, to make headteachers more committed to the use of Science 5/13 by involving them initially in the in-service work; second, to involve two members of staff rather than one so that they could give support to each other in the early stages and provide the school with more expertise; and third, to make the support as far as possible school based with tutors from the College going into schools as much as possible to work alongside teachers. Also the head of the science department outlined a number of significant points associated with the new system of workshops and school based in-service work. First, it seemed that success with the Science 5/13 units depended to a large extent upon the teacher's type of organisation; those teachers who persisted in using formal class instruction found difficulties whereas those who used a more fluid group arrangement had fewer problems. Although some teachers in the more traditionally shaped classrooms did encounter a number of difficulties these, in the main, were overcome and did not seem to be a critical factor affecting continuation. Second, the amount of science training undertaken by a teacher seemed less important than the general expertise of the teacher in terms of her teaching ability. Third, the headteacher appeared to play an important role in giving support to the teachers. It was vital that the headteacher accepted that Science 5/13 was a valuable part of the child's curriculum and not just an extra to be undertaken by a teacher if she was interested; if the head took the latter view development of Science 5/13 within the school was limited. Fourth,the College tutor also played an important role. Just as teachers preferred different teaching styles so tutors themselves preferred a particular classroom organisation; some suited a more informal approach whilst others felt insecure because the end-points were not clearly defined. This was similar to the insecurity felt by some teachers who were not used to the more unstructured approach necessary in Science 5/13 if the scientific skills associated with observation and experimentation were to be followed through. Like the teachers, tutors favouring a more formal approach felt open to criticism, making them even more anxious. The relationship the tutor was able to build up with the teacher seemed a critical factor in determining whether schools continued to seek help at a later date.

If one looks at those trial schools which continued with the project after the trials there was one school which used the project directly after the trials and was continuing at the time of the survey. Also there was one school which stopped work with the project after the trials but had restarted work with it by the time of the survey. In the latter case the headteacher explained that this was the result of a new member of staff having an interest in Science 5/13 and after she attended a course at the College she began work with the project in the school. Work on the project had stopped in this school after the trials because all the trial teachers left and there was no one sufficiently interested to continue with it.

The trial schools in the second local authority area studied were located in and around two towns. Some of the schools were fairly rural in their setting. The size of the schools varied considerably, one had a roll of only 55 pupils while another had nearly 700 pupils. There were seven schools which took part in three sets of trials: in the period directly after the trials just less than half of the trial schools continued with the project and by the time of the survey this had been reduced to a third.

Like the first Scottish local authority area to be studied this area was fortunate during the trials because it had a similar support system involving the local authority through its Advisers, the local College of Education and The Scottish Education Department through its Inspectors. Documentary evidence relating to the trial period backed up a number of points made by College of Education staff, local authority Advisers, headteachers and teachers about the trial units and the in-service courses. First, teachers often encountered difficulty in making, setting up and working pieces of apparatus. They thought that if they had been given more help with the apparatus generally either in the project units or form the College tutors, this might have reduced their initial feelings of uncertainty about undertaking a project in science. Second, some teachers found the project too restrictive and wished it had been integrated with other subjects such as history, geography and drama to make it more suited for the primary school; this happened in later trials. Third, there were problems of storage and general organisation of resources which was partly overcome by the local authority providing specially made science trolleys. Fourth, teachers found it necessary to arrange their rooms to provide suitable work areas where children could experiment. Fifth, pupil work cards were often used to organise individuals and groups on separate assignments. Sixth, infant teachers taking part in the trials of the Early Experience Unit, were generally doubtful of the scientific value of the project; a view the local authority Adviser, responsible for primary work, attributed this to the teachers being sceptical about their own abilities.

There was a considerable amount of support given to the area as a whole in the post trial period. Interviews with the local authority Adviser responsible for primary science and the science staff at the local College of Education showed that both had worked closely together to organise in-service courses and arrange visits to see teachers in school. Each year different parts of the area were invited to attend the courses. At the time of the interviews many of the schools attending the courses were sending the whole of their staff to the meetings rather than just one or two teachers as was more common in earlier years. Also the assistant headteachers were becoming more involved, helping to support the project back at school.

However, in spite of the support given directly to schools during the trials and more generally to the whole area in the post trial period the continuation rate in the trial schools was far from exceptional, especially at the time of the survey. At the interviews conducted with headteachers, teachers, local education authority Advisers and College staff a number of factors were mentioned which were said to have hindered dissemination of the project in the trial schools.

Trial teacher mobility was often quoted by headteachers as an important factor in inhibiting continuation with Science 5/13. In most schools only teachers involved in the trials used the units so that when these teachers left,work with the project stopped. However teachers mobility was by no means the only or the main factor said to be responsible for the failure of Science 5/13. Although some schools had a high turnover of trial teachers in the post trial period, this local authority area suffered less than most from this problem. Overall just less than half of the total number of trial teachers stayed on at the original trial schools. If all those schools where the trial teachers stayed had continued with the project the continuation rate would have been much higher at the time of the survey. This clearly suggests that other factors were also important. Further, why was it that wider dissemination of Science 5/13 in the trial schools, beyond those involved directly in the trials, was so difficult?

A second factor, claimed to be important by some of those interviewed especially teachers, which partly answers these questions, was the nature of the project itself. Some of the trial teachers spoke of the difficulties they encountered using a science project when they themselves had little training in science. They spoke of the frustration of not knowing the answers to questions, the outcome of experiments and the general feeling of uncertainty when one was using a discovery approach based on children's interests. In other areas of the curriculum they had usually been able to work more towards fixed goals with a minimum degree of uncertainty. Therefore some teachers found themselves unfamiliar with both the method and content of the project.

A third factor mentioned concerned the amount of support given to trials teachers in the post trial period. In the trial period, in spite of the type of difficulties associated with the project itself, the majority of trial teachers continued and successfully completed the work. After the trials much of the support structure changed. There was less direct incentive to use the units because of the reduction in the number of visits to schools by Advisers and College staff and the in-service courses associated with the trials came to an end. Although other in-service courses were provided different groups of schools were chosen each year in an attempt to promote wider dissemination. In some cases there were headteacher changes in the trial schools and the new headteacher had little interest in, and therefore provided little support for, Science 5/13. College staff and Advisers running in-service courses in the post trial period observed that in many cases a certain threshold of support was necessary to keep teachers using the units. In the latest in-service courses held at the time of the interviews, where the whole staff of a school were involved, it was hoped that teachers would feel less isolated, gaining support from each other.

A fourth factor highlighted particularly by the support personnel was the influence of the headteacher in the post trial period. In the two trial schools which were continuing with the project at the time of the survey both had headteachers enthusiastic that science should be included in the primary curriculum. One of the head-teachers supported his teachers by helping them in their classrooms with the Science 5/13 units. The other headteacher supported a wider environmental approach with Science 5/13 as an important part. However in the other trial schools it was said that there was little support from the headteacher. Also there were a number of headteacher changes in the trial schools and it was claimed that often the new headteacher had little interest in promoting primary science leaving any development work up to the teachers themselves. Although both the questionnaire survey and the interviews showed that headteachers considered Science 5/13 a valuable project, generally they did not see it as a priority area of the curriculum. It could be argued that in this situation there was little direct incentive for trial teachers or any other teachers in the trial schools to continue or work with the Science 5/13 project.

The third local authority area in Scotland to be studied used only four schools in the Science 5/13 trials. They were all situated in an urban position. This local authority area was involved in two sets of trials. Three out of four of the schools continued with the project directly after the trials but by the time of the survey only one school was still using Science 5/13.

The local authority primary Adviser explained that at the beginning of the trials introductory sessions were arranged by himself and held in the teachers' centre. Later courses, which looked at the units in more depth, were organised by the College staff and held at the local College of Education. Teachers attending the courses held during the first set of trials were used to help arrange later courses for new teachers. The trial schools themselves were chosen either because the headteacher was enthusiastic about the project or because the teacher was thought sufficiently competent to take the trials seriously.

Directly after the trials only one trial school did not continue with the project. The primary Adviser and the present headteacher noted that this school had encountered a number of difficulties during and directly after the trial period. First, there were two changes in headteacher during that period. Second, immediately after the trials the school moved into new buildings. Third, although one of the trial teachers was highly committed to the project she left soon after the trials. At the time of the survey only one of the four schools was using the project and the headteacher there explained that even this was in a rather limited way using Science 5/13 as just one of many resources in an environmental studies approach.

It appeared from the interviews conducted that three main factors were felt to have contributed to the general low rate of continuation with Science 5/13 in the trial schools of this area. These were first, the movement of trial teachers away from the trial schools; second the attitude of headteachers to the project; third, the general in-service provision in the post trial period.

The first point concerned teacher mobility. By the time of the survey five of the seven trial teachers had left the trial schools, usually for promotion. A common feeling among headteachers was that once these teachers had left it proved very difficult for the project to survive, as they were the main motivating force behind Science 5/13 being taught in the school.

The second point referred to the attitude of headteachers. At the interview with the local authority Adviser responsible for primary work he considered that although the original headteachers present at the beginning of the trials had generally been keen to use the Science 5/13 units, this had altered because all the schools had undergone changes in their headteachers not only in the post trial period but also during the trials themselves. He considered that at the time of the interviews two of the headteachers had no interest in Science 5/13 and this together with the general lack of expertise in the school because of trial teacher mobility meant that no teachers were interested in undertaking the project in these schools.

The third point dealt with the in-service provision in the post trial period. In the immediate post trial period the primary Adviser explained that the science department at the College of Education in conjunction with the Advisory service organised in-service courses in science for teachers. Unfortunately directly after the trials Science 5/13 was not included in these courses for primary teachers. Also the project was not used in the pre-service courses. It was argued by the primary Adviser that this would have been a valuable time to have included Science 5/13 in the courses in order to increase the number of teachers familiar with the project. Later, in the post trial period the education authority, through the Advisory service continued to work with the local College of Education to organise in-service courses in the area, based around the Science 5/13 units. The primary Adviser explained that although some of the courses, like the full time one month courses held at the College, were planned by the teachers in conjunction with the school to choose the most suitable subject area, others were run to give the teachers additional qualifications and were not directly linked to curriculum development in the school. The primary Adviser described how, in an attempt to fit in-service courses more to the needs of the schools, there had been a 'decentralised' approach to in-service provision during most of the post trial period. It was agreed by the Advisory service and College of Education that the starting point should be the needs of the schools. However, much seemed to depend upon the initiative of individual headteachers and College tutors to determine the amount of curriculum development which actually took place.

Consequently at the time of the interviews it had been agreed that such an approach needed more structure in order to co-ordinate the needs of schools with effective in-service provision and to follow up developments in schools once the teachers finished the courses.

The fourth local authority area to be studied in Scotland used only three primary schools and five teachers in the trials. The schools were mainly involved in the fourth set of trials although two of the teachers took part also in the third set of trials. The schools were situated in a number of nearby towns.

One of the people most closely associated with supporting these schools was a lecturer at a College of Education situated some distance from the area. He explained that during the trials support was given by the local education authority through the Advisory service, a College of Education and the Scottish Education Department. Some meetings were arranged by the College of Education but mainly the teachers were left to try out the units on their own. Visits to schools were arranged and normally these were undertaken by the College and an Inspector from the Scottish Education Department.

The results of the questionnaire data showed that very little work continued after the trials. One of the main reasons quoted by head-teachers for the low continuation rate with Science 5/13 in the trial schools was staff turnover particularly high mobility among trial teachers. By the time of the survey all the trial teachers in two of the schools had left and most had moved almost directly after the trials. Other reasons given for the low continuation rate were: one, the lack of science expertise generally among primary teachers so that there was insufficient enthusiasm for Science 5/13 even with encouragement from the headteacher; and two, the time spent on other innovations such as 'Fletchers Mathematics' left very little time to stimulate activity in other non-priority areas.

Although College staff spoke of return visits to some of the schools in the area in the post trial period in an attempt to re-start the project, this approach did not appear to have been strong enough when compared to the type of problems listed, and failed to stimulate renewed development in the trial schools.

It could be argued that in this area the enthusiasm of headteachers in the trial schools was not sufficient to keep the project alive. One headteacher, who had involved most of his staff during the trials in Science 5/13 in addition to helping himself, thought he was fortunate during the trial period because a number of his staff had science qualifications and appeared confident about tackling a science project. Unfortunately in the post trial period there was an almost complete change of staff and there was little enthusiasm for the project among the new staff.

Area 7

Twenty schools were involved in the trials of Science 5/13 from this area. The schools only took part in the third set of trials. It was a large urban area in which secondary schools had just been reorganised along comprehensive lines. At the same time a more general reorganisation of schools in parts of the area had been started based on a four tier structure involving first schools (5 to 8 years), middle schools (8 to 12 years), secondary comprehensive schools (12 to 16 years) and secondary colleges (16 to 18 years). The twenty schools which took part in the trials consisted of eleven primary schools and nine middle schools; of these fourteen returned usable questionnaires.

Interviews with the local authority Advisers, headteachers and teachers indicated that both the reorganisation of secondary schools along comprehensive lines and the change over to a middle school system in some parts of the area involved many teachers in a tremendous amount of curriculum development work. This was borne out in the documentary evidence kept at one of the local curriculum development centres. At one point there were over five hundred teachers attending courses each week at one of the curriculum development centres in the area; this included primary teachers who wanted to extend their subject knowledge for more specialised teaching in the middle schools and secondary teachers who wanted to know more about the curriculum and teaching methods of the middle school as preparation for transferring to posts in the middle school sector. Also it was clear from the interviews that both reorganisations also involved the area in new building programs to provide additional and more specialised accommodation especially in the middle schools. This evidence was supported by reference to new building programmes in back issues of the local paper. Documentary evidence present at the curriculum development centre indicated a policy decision that semi-specialist staff were needed in these schools, responsible for particular subjects such as science, mathematics, art and craft, and french. It was hoped that these teachers would augment the work of the class teacher, and not detract too much from the family-style intimacy of the primary school.

There was documentary evidence to show that there were a number of in-service courses concerned particularly with the Science 5/13 project both at the time of the trials and later. The Science 5/13 materials were described as an appropriate way of introducing science at the first and middle school levels. The local authority science Adviser explained that the trials of the Science 5/13 project fitted in well with the reorganisation towards introducing middle schools and this certainly seems to have been the case. In the year 1969-70, one year before the trials, one of the local in-service courses examined the type of science content applicable to pupils in middle schools. The purpose was to provide a background content course in science for teachers in middle schools. It was anticipated that drawing up such a scheme would need junior and secondary school teachers to work together so that the development of science would be seen as a continuation. In the following year (1970-71), in service courses were held to examine the type of science appropriate for first schools. Similar types of in-service courses looking at suitable science topics for use in middle schools and more generally at discovery science for the 5 to 12 age group continued until the mid 1970s. In all of these courses the Science 5/13 project was one of the main references. In the Session 1974 to 1975 new in-service courses dealing with the aims and objectives for science in the middle years began. There was also an in-service course examining the use of Science 5/13 in the secondary schools. In the following years leading up to the time of the interviews there were less science courses and thosewhich took place were based on a broader look at science using other projects such as the Craigie Kit as well as Science 5/13.

The documentary evidence showed also that alongside the type of in-service courses already described there were a number of meetings for teachers involved in the trials of the Science 5/13 project. Ten meetings, each of about two hours duration were held at the curriculum development centre to give instruction, allow practical work and discussion about the trial materials. These meetings continued during the trials. Also local education authority Advisers, an Inspector from the Department of Education and Science, and members of the Science 5/13 team visited the trial schools to watch the trials in action and offer advice.

The results of the questionnaire survey showed that directly after the trials this area had the highest rate of trial schools continuing with the project, of all the nine areas. Almost all the trial schools continued with the project. By the time of the survey it was the the area with the second highest continuation rate, about two thirds of the trial schools still using the Science 5/13 materials

In the interviews conducted with local support personnel it was suggested that the main reason for this success was that the project fitted in with the general policy of this area to include science in the curriculum of children aged five to twelve years. This was particularly true in the middle schools where attempts were made to include appropriate accommodation and specialist staffing to make effective science teaching a reality. It was for this reason that various in-service groups were set up in the early 1970s to draw up an appropriate science scheme for the middle schools.

However finding the appropriate science scheme was not without difficulties. Documentary evidence indicated that the scheme finally drafted by the working party made reference to a number of projects including; Nuffield Junior Science, Science 5/13, Nuffield Combined Science, Nuffield 'O' Level Biology, Nuffield 'O' Level Chemistry and Nuffield 'O' Level Physics. The local authority Adviser explained that these projects reflected the presence of teachers at both primary and secondary levels on the working party. Early work in the middle schools was based upon the Science 5/13 materials. The science representatives from the secondary schools had hoped that pupils in the final year of the middle school (11 to 12 years) could start the Nuffield Combined Science Scheme and then continue with the course in the first year of the secondary school. The science Adviser thought that the secondary schools were worried that if they had to begin the Nuffield Combined Science Scheme in the first year of the secondary school with children now entering a year later, at the age of twelve, it would prove difficult in the limited time available to prepare them adequately for the 'O' level examinations. The Middle School Science scheme, with its emphasis in the later years upon work like the Nuffield Combined Science project which was normally reserved for the secondary stage, was not generally well received by the middle schools. The teachers had more sympathy for a greater emphasis on the Science 5/13 materials which followed a primary approach to science. It appeared from the interviews that liaison between the secondary schools and the feeder middle schools was limited so that discussion between these schools did not seem to help remedy the situation. Later a panel of primary and middle school teachers formed a working party to draw up suggestions for a continuous science course for the 5 to 12 age group. The suggestions in the document were presented in three stages closely following the Science 5/13 approach. At each stage, activities were grouped under topic headings such as: looking at things, listening to things, comparing things and growing things. The main references were the Science 5/13 units and the Middle School Science Scheme drawn up by the previous working party. Together these two schemes, particularly the second one drawn up by the primary and middle school teachers, have provided a support framework for teachers attempting science with the 5 to 12 age group. Also the presence of in-service courses, dealing with science for this age group especially in the early days, provided extra support for these teachers.

The interviews conducted in this area also highlighted two main reasons that might help to explain why the continuation rate was not even higher, particularly at the time of the survey. The first concerned the high mobility of trial teachers away from the original trial schools. By the time of the survey two thirds of the trial teachers had left the trial schools, often for promotion based on their work with the Science 5/13 materials both during and after the trials. However because the inclusion of science into the curriculum of the primary and middle schools, particularly the latter, became general policy in many schools, the loss of expertise from the school in terms of trial teachers moving did not hinder the projects development to the extent observed in so many other areas.

The second reason concerned the strength of commitment trial schools felt towards following the two science schemes drawn up by the working party. In the primary schools, especially, the degree to which the suggestions were followed depended much upon the lead given by the head and the interest shown by his staff.

Nevertheless, the abiding impression left from the interviews in this area was that generally Science 5/13 was still well used and that the relatively high continuation rate could be accounted for, in large measure, by the support and encouragement given to the schools and by the policy stance of the local authority.

Area 8

Area 8 was a large county area including a number of industrial and market towns. There were sixteen schools involved in the Science 5/13 trials of which fifteen sent back usable questionnaires. The sample consisted of two infant, six junior and eight primary schools. These schools were only involved in one set of trials, the third set which took place in 1971.

Reorganisation of local government in 1974 had brought more industrial towns to the area. The result was that at the time of the survey and interviews various types of school systems existed. After the trials of Science 5/13 ended there was a general move in the area to adopt a middle school system incorporating the age grouping 9 to 13 years in the middle segment. The local authority science Adviser interviewed saw this type of age grouping as being preferably to the 8 to 12 age range because he considered that in the latter case schools tended to stay too primary orientated lacking the provision of specialist teachers and facilities. He explained that at the beginning of the reorganisation along middle school lines, curriculum development working parties were set up to cover different aspects of the curriculum. They produced reports which gave recommendations for future overall policy. Generally the policy adopted for science in the middle years had incorporated the aims and objectives of the Nuffield Combined Science course and the Schools Council Science 5/13 project. The policy document drawn up by one part of area 8 spoke in these terms about the type of science best suited for the 9 to 13 age grouping.

> *The groups felt that there should be some sort of common thread for science teaching in the Middle school, to prepare the pupils for the upper school. Many basic skills should be instilled but a common grounding of content should also be given. This means that a flexible syllabus can be envisaged, which in its final stages should leave the children with basic core knowledge. It is felt that by the end of the Middle school, each pupil should have reached at least the standard as under the present arrangements.*
> [4]

Later in the same document it was suggested that science in the first two years of the middle school was to form part of a general curriculum linking with other subjects but that in the last two years science was to be allocated a minimum of 2½ hours each week. Also there was to be at least the equivalent of 1½ specialist teachers in the middle school with one acting as a science coordinator within the school and involved in teaching science throughout the school. Accommodation was to consist of one laboratory, mobile benches and an outdoor resources area. A list was included of recommended apparatus. At the end of the document a further list outlined the 'essential components' for a middle school course. This consisted of a number of science areas which were later broken down into more detailed areas of study.

The need to include science in the curriculum of pre-secondary children was not restricted to the middle years. The following quotations give an overall view of the needs of children in first schools (5 to 9 years) as recommended in another Science Curriculum Development Report.

> *It is important that children become aware of their environment at an early age, and this automatically involves scientific study. Whilst the child's ability is developing*

through practical activity and experiences, the acquisition of knowledge should not necessarily be compartmentalised. Thus science has a part to play in an integrated area of study, not as a separate entity.

First schools would not be expected to have a trained science teacher on their staff, but the level of "Science" based work would not consist of advanced, difficult or obscure concepts. Teachers have the opportunity of increasing their expertise from In-service Courses organised by the Authority.

Science work in the first school does not need complicated equipment, but it is advantageous if a sink is available in the classroom along with an electrical point.

5

The report went on to suggest possible topics which teachers could use. The main references given were from the Science 5/13 units.

The range of in-service courses offered by the local authority fitted neatly around the policy outlined in the various Curriculum Development Reports. The local authority Adviser responsible for science described how in science there were three types of courses: One dealing with the needs of the first schools which were run with the help of staff from the local College of Education and looked at the type of practical experiences most suited to this age range; another catering for the middle schools which were either background content courses organised by a local Polytechnic or those centered around a series of booklets entitled 'Children Investigating' which were produced by teachers in the area; and another which were residential and looked at a number of science issues covering all age ranges. These residential courses had included talks by Wynne Harlen a member of the Schools Council's Science 5/13 team. It was at the residential summer schools that booklets in the 'Children Investigating' Series had been originally produced. Most courses which looked at the 5 to 13 age grouping used the Science 5/13 units, especially for the 5 to 11 age range.

The results of the questionnaire survey showed that while just under two thirds of the trials schools continued with the project directly after the trials, this figure had increased to almost three quarters of the trial schools by the time of the survey. In fact at the time of the survey this area had the highest proportion of trial schools still using the project. Interviews conducted in the area with support personnel, headteachers and teachers suggested that the main reason for this success, especially at the time of the survey, was the re-organisation of many of the trial schools to first or middle schools during the post trial period. Both these types of schools attempted to include science in their curriculum as suggested in the policy documents drawn up during the reorganisation. All these schools which had reorganised or were in the process of reorganising into first or middle schools at the time of the survey were using the Science 5/13 materials. The schools not continuing with the project were either primary schools or junior schools and although the headteachers of these schools, like all the headteachers in this area, saw the Science 5/13 project as being valuable, it was not considered sufficiently important in these types of schools to be included in the curriculum as part of the school's policy. Another reason for the high continuation rate suggested from the interviews was the way in which the in-service course attempted to meet the particular needs of the new first and middle schools, showing how materials from the Science 5/13 project and the Nuffield Combined Science project could be used.

In spite of the success in this area, there were indications from the interviews that the number of trial schools continuing with the project might have been greater. The mobility of trial teachers from the trial schools was greatest in the schools not continuing with the project at the time of the survey. Whereas only half of the trial teachers had left from those schools continuing with the project, three quarters of the trial teachers had left from those schools not continuing. Also in the schools where the teaching of science became a part of the school curriculum, as in the first and middle schools, the movement away of the trial teachers was not as significant a factor as in the primary and junior schools where whether any science was taught or not depended much more upon the headteacher and the interest of his staff.

From the interview conducted with the local authority science Adviser, it seemed there were three ways in which the amount of science taught in the first and middle schools might have been increased and improved. First, he was concerned that the time allocation given to science varied from one middle school to another. In some schools headteachers still needed to give more emphasis to science. Second, the science specialists in the middle schools tended to concentrate too much at the top end of the school; much more could have been done with those children in the first two years who generally were taught by non-specialist teachers. The science Adviser thought that headteachers and science specialists with responsibility posts needed to encourage and support non-specialist teachers and, if necessary give advice about attending in-service courses. Third, there was the need for more liaison between schools to discuss developments in science generally and more specific issues such as the loan of certain equipment. Meetings between science staff with responsibility posts were underway at the time of the interviews. They met with the science Adviser to discuss a variety of issues and were well attended.

Area 9

Ten schools from Area 9 were involved in the trials of the Science 5/13 project. The trial schools represented a wide spread of school types. There were two infant schools, four junior schools, one primary school, and three secondary comprehensive schools. The area took part in all four sets of trials although most schools were only involved in one set of trials. The schools used in the early trials were those involved in the previous Nuffield Junior Science project with new schools added later. Seven out of the ten trial schools returned usable questionnaires. The data collected in that survey showed that both directly after the trials and at the time of the survey only about one quarter of the trial schools were still using the Science 5/13 materials.

The interviews conducted in this area with headteachers, teachers and the local education authority Adviser, responsible for work with Science 5/13 suggested four main reasons for the low rate of continuation after the trials ended. First, teachers pointed out that there were very few local in-service meetings arranged by the Advisory service for the dissemination of the Science 5/13 project. This mirrored the small number of courses arranged for trial teachers during the trials themselves. Instead of courses during the trials the local authority Adviser, responsible for primary science, said he believed in visits to the trial schools to discuss the units and the evaluation procedure. The majority of schools had only one teacher involved in the trials at any one time. The Adviser was in favour of using only a small number of teachers from each school: he suggested that involving large numbers of teachers in any one school would be disruptive. In the post trial period the Adviser described his approach to in-service support for primary science as essentially school-based with the schools giving the lead. This was well illustrated at one primary school visited during the interview period, where one teacher described how a primary science course involving Science 5/13 had been organised and run by a group of primary teachers on their own because they felt that such courses were important. Interviews with the primary Adviser suggested he was sceptical of the value of any in-service courses run in the area. He claimed that in the past he had found teachers very unwilling to attend meetings. Also the area was well served by a number of Colleges of Education, some of which had an active interest in Science 5/13 and had organised a number of courses on the project and primary science generally. However the primary science course organised by the teachers themselves at the time of the interviews had been popular, possibly indicating that had such courses been available at a local level they might have been well attended.

The second reason which the primary Adviser highlighted for the small number of trial schools continuing with the project after the trials was the absence in the infant, junior and primary schools of supportive headteachers. In nearly all the trial schools the head-teachers had left soon after the trials. During the trials some of these headteachers had been actively involved in the trial work.

When they left this was not only the loss of a key person in terms of expertise but also of support for the trial teacher and other teachers who might have used the project. In general the new headteachers had not shared the same commitment to the Science 5/13 project.

The third reason suggested, particularly by headteachers, for the low continuation rate with Science 5/13 concerned the general movement of trial teachers away from the trial schools after the trials ended. At the time of the survey all but one of the trial teachers in the infant, junior and primary schools used in the survey had moved from the trial schools. This meant that many of these schools had lost both the headteacher and the trial teacher at the time of the survey.

The fourth reason put forward by the primary Adviser for the low continuation rate was connected with the failure of the project in the secondary schools used in the trials. In this area the main explanation for the failure seemed to be that all the trial secondary schools were taking part in an interim scheme for comprehensive reorganisation. The new system included two sets of schools covering the 11 to 16 age group and 13 to 18 age group with possibilities of transfer at 13+ and 16+. The reorganisation had led to a common core in science for the 11 to 13 age group which did not include the Science 5/13 project. He had discovered that teachers, looking at the Science 5/13 units for possible inclusion, thought that the materials in the project did not cover the factual knowledge needed in their course. Secondary school teachers confirmed this themselves and also said that they tended to see the units as made up of a series of unrelated experiences.

Concluding remarks

It was stressed at the beginning of this chapter that care needed to be taken interpreting the information presented. The information about the range of support services and courses available in the different areas probably causes least difficulty. In most cases it was possible to check the information with a number of different sources and to refer to documentary evidence. In some cases mention was also made of a local authority policy on the use of science in, say, middle schools. Again it was relatively easy to check at least the outlines of this policy with different sources and with documentary evidence.

The greatest difficulty of interpretation comes with the views noted of individuals interviewed in the different areas. Not only did the range of prople interviewed vary from area to area but in this type of interview there is always the danger that the interviewer will press particular points that he or she feels are important and that the reports of the interviews will have been influenced by the structure or interpretation imposed on them by the interviewer. Although every attempt was made to avoid these problems by recording views as they were presented rather than making judgements between them it is recognised that such attempts can only have been partly successful. The need, for example, to select what to report means that necessarily this will have been the case.

This latter qualification then clearly needs to be borne in mind when considering general conclusions that might be drawn. However, what appears from the evidence presented in this chapter is that a number of factors seemed to cause problems for the use of Science 5/13 after the trials in a number of different areas. These included trial-teacher turnover, the attitude of headteachers, the concern felt by many primary school teachers about using science material with which they were unfamiliar, competition from other areas of the curriculum and the type and extent of in-service provision after the trials. On the other side of the equation a number of factors were mentioned as encouraging the use of Science 5/13 after the trial period. These included, school type, and possibly more critically, the policy of the local authority.

Footnotes

1. D.E.S. (& Welsh Office), Education In Schools, A Consultative Document, H.M.S.O., London, Cmnd.6869, 1977, p.13.
2. 'Learning Through Science' is a Schools Council project set up in 1978, to extend until 1984, under the directorship of Roy Richards, and based at Goldsmith's College, University of London.
3. S.E.D., Environmental Education, A Report by H.M. Inspectors of Schools, H.M.S.O., Edinburgh, 1974.
4. Staffordshire Education Department, Report of the Curriculum Development Working Party For Science Education - Stafford Area, p.2.
5. Staffordshire Education Department, Report of the Curriculum Development Working Party For Science Education - Stoke On Trent Area, p.2

CHAPTER 8

Conclusion

This chapter is divided into three parts. The first examines the eleven research questions outlined in chapter 5 and considers what light can be thrown on them by the evidence gathered from the questionnaire survey and the area visits. The second part of the chapter looks at the various theories of change, first outlined in the review of the literature in chapter 2, in an attempt to better understand the organisation and development of the Science 5/13 project itself. The final part of the chapter proposes one way in which the relevant factors affecting the continuation of the Science 5/13 project might be linked together.

However, before the main areas are examined a comment might be made about the way in which the Science 5/13 materials have been used in schools. It has been noted before that the Science 5/13 team never intended that they should be used as a set course, but rather that they should be used as a guide and a resource. In tables 6.5 and 6.7 it was shown that the overwhelming majority of schools that were using Science 5/13 were using it as the team intended, as a resource. Directly after the trials 17 schools said that they were using Science 5/13 as a course, but 63 said that they were using it as a resource: at the time of the survey the comparable numbers were 10 and 40. It is also clear, though, that a number of schools that said they were not using the Science 5/13 project in fact used the materials on occasions. For example, in the review of the area visits it was noted that in area 5 a number of schools said thet they occasionally 'dipped into' the Science 5/13 books. Schools in other areas, for example area 2, also apparently used the books in a similar way. It is clear, then, that there is not as easy a divide between the schools using and not using Science 5/13 as one might like to imagine. In practice there is a continuum with at one end Science 5/13 being used as the basis for a course and at the other end Science 5/13 books never being consulted at all : there are a large number of different categories in between these two extremes. A research project which spent considerably longer on school visits and looked at the work in the schools in much more depth than this one would have been necessary to take this issue further. It is, though, an issue which needs to be borne in mind in the discussion of the results. In defence of the categories adopted it might be argued that the schools that said that they were using Science 5/13 seemed to be those that either used it as a basis for a course, or as a central resource for a programme of teaching. Those who used the materials less frequently seemd to say that they were no longer using the project. Nevertheless, it is accepted that the categorisation is far from watertight and allocation is based on the respondent's own assessment.

The Research Questions

The previous two chapters examined the data collected from the questionnaire survey and the area visits. The questionnaire survey looked at the development of the Science 5/13 project, directly before, during and after the trials. The questions were aimed at the headteachers in the trial schools and the teachers involved in using the project's materials. The questionnaire tried to look at progress at the school level. It was highly structured and as such was not thought to be the best way to examine local support structures which might vary greatly from area to area. Reasons for possible variation might include differences in geographical settings or in policy decisions at local authority level. The effect of key personnel in the support system, each with his own particular interests, philosophy and personality could have been important. Some, if not all of these differences, it was thought, would be difficult to assess fully by questionnaire and could be better understood after visits to each area to interview key personnel in the support system and to search for documentary evidence outlining the type of support given to schools immediately before, during and after the trials. Both the data from the questionnaire survey and the material acquired from the visits to individual areas were used to look further at the eleven research questions listed in chapter 5.

Research question 1. The first research question considered the relationship between the 'compatibility' of the innovation and the perceived needs and practices of the receiver. One of the criteria used for measuring compatibility was school type. The analysis of the questionnaire data in chapter 6 showed a significant relationship between school type and continuation: the percentage of schools continuing with the project directly after the trials and at the time of the questionnaire survey was highest in the middle schools and lowest in the secondary schools.

In the discussion in chapter 7 based on information collected from visits to individual area, it was suggested that middle schools might be under some pressure to ensure that the foundations of science were taught to their pupils, particularly the older age group, in an attempt to overcome the problems of later transfer at 12 or 13 years to the senior school where the number of years available for preparing pupils for external examinations had been reduced. No significant relationships were found in the questionnaire survey between any of the other criteria used to measure compatibility and the degree of continuation.

It should be mentioned, though, that in the area visits some comments were made which suggested that these factors should not be totally discounted. For example in area 6 it was noted that some schools had encountered difficulty in making, setting up and working pieces of apparatus. In fact the apparatus demanded by Science 5/13 was not specialist : a real attempt was made to ensure that simple easily available equipment could be used, although it is fair to comment that the project seemed to demand, a reasonable quantity of equipment and, a need to construct more complex items, such as water clocks, out of the simple equipment.

It was also suggested in the discussion on the visit to area 6 that some teachers found it difficult to adapt to the doscovery approach put forward by the project. It was said that in other areas of the curriculum they usually had been able to work much more towards fixed goals with a minimum degree of uncertainty.

It is also worthwhile mentioning that these discussions brought to light a slightly different angle on the idea of suitability of the host. For example in area 6 it was suggested that one of the problems had been the suitability or otherwise of the support staff. At one of the Colleges of Education involved in the school based in-service work using Science 5/13, the head of the science department had expressed the view that College tutors, just like teachers, had preferences for a certain teaching style and a particular type of classroom organisation, so that some tutors felt insecure with a discovery approach like Science 5/13 because the end points were not so clearly defined.

Research question 2. This research question dealt with the relative advantage and 'competitive' strength of Science 5/13. In the visits to individual areas a number of those interviewed suggested that although Science 5/13 competed well with other Nuffield science projects at the middle school level it did less well at the secondary level. The dominant reason put forward seemed to be one of compatibility: with fewer specialist staff and a more integrated approach the middle schools preferred to use the Science 5/13 materials especially with their younger age range, whereas the secondary schools, with a more specialist approach, used other Nuffield and Schools Council schemes which had been specifically designed for the examination system. In the primary schools, competition came not from other science schemes such as Nuffield Junior Science but more from other subjects in the curriculum. For instance in area 1 it was noted that competition came from the demands to teach the welsh language and in practice these demands had far more force behind them than Science 5/13. In other areas it was much more that science was not seen to be as important a part of the school curriculum as 'the basic skills': this comment was specifically recorded for instance in areas 4, 5, and 6. In area 6 Fletcher mathematics provided a specific competitor.

In some cases, though, it was not even a question of simply the 'relative advantage' or the 'competitive strength' of the project. Some primary teachers valued science highly but felt that during the trials they put so much time into this side of their work that other subjects had been neglected: the balance they argued needed to be restored. It is also worth noting that it was not just teachers who used this argument: so did members of the support staff (this was noted particularly in areas 3 and 6). For example, a local authority primary or science Adviser/Inspector has a broad remit and while they may be willing to devote a large proportion of their time to primary science for a limited period, say during the trials of a project like Science 5/13, they are unlikely to be able to continue to do so indefinitely.

Competition for time, of course, need not only come from other areas of the curriculum but may come from other aspects of work in and with a school. In areas 3 and 7 the time taken up with comprehensive reorganisation was noted. In a rather different but related way, the ability to continue work with projects like

Science 5/13, which are seen as 'expensive' in terms of the amount of support needed, can be difficult if there are cut backs in educational spending (this was specifically mentioned in areas 1 and 2).

Research question 3 This research question was concerned with the 'complexity' of an innovation. None of the criteria used in the questionnaire survey to assess complexity showed a significant relationship with continuation of the project after the trials. However the information produced during the area visits raised a number of interesting points. It was claimed by support staff in area 2 that the materials presented problems for trial teachers. They were said to have had difficulties coping not only with the objectives but also with the science content: this meant that much of the material needed simplifying at the in-service stage. Also there was a general move among support staff and teachers to prepare pupil materials in addition to the teacher materials of the Science 5/13 package a need which was later realised by the Schools Council and led to the setting up of the 'Learning Through Science' project[1]. Earlier it was noted that in area 6 it was claimed that trial teachers attending in-service courses had encountered difficulties with the materials. In particular they had needed help in setting up apparatus for experiments. In addition it was said that there was a general feeling by teachers that some of the trial units were too science-orientated and needed to be integrated with other subject areas to fit more easily into the 'topic' approach used in many schools.

<u>Research question 4</u> This research question concerned the relationship between the use of teachers in mid career and continuation with the project. There was no evidence from the questionnaire survey to suggest such an association. This particular research question was drawn from research into science schemes used generally at the secondary level. It may be that, when dealing with younger children (as in this case largely from the primary sector), the position is different. In the particular case of primary teachers this could be because few, whatever their length of service, have any experience with science. In such an instance, then, teachers in mid-career may be no more confident about dealing with science material than say colleagues with less teaching experience.

<u>Research question 5</u> This research question was concerned with the relationship between pre-service training and continuation with the project. The questionnaire data produced confusing results. Directly after the trials there was a statistically significant relationship between the continuation with the project and science background: at the time of the survey, the relationship was not significant at the 0.05 level. However, these results needed to be looked at in some detail. For example, after the trials the statistically significant relationship seems to have been the result of the data for those with a science degree. A very high proportion of those with a science degree were not continuing with the project at this time. This is contrary to what might have been expected. The explanation in this particular instance is that the

overwhelming majority of respondents with science degrees were teaching in secondary schools and for other reasons discussed elsewhere, secondary schools did not continue to use the project. At the time of the survey the same relationship was found as far as those with a science degree were concerned. The results for other teachers, those without a degree, were far less clear. Immediately after the trials a higher proportion of those without a science background at College than of those who had taken science as a main subject or a science course at College were continuing to use the project; at the time of the survey those who had taken science as a main subject at College were more likely (though only very marginally) to be using Science 5/13 than those with no science background. Interpretation of these results is difficult, first, because the trends are not strong or consistent, second, the numbers taking science as a main subject or a science course at College were small and; third, there is likely to have been overlap between the type of teaching position and school taught in on the one hand and science background at College on the other. For example, it might be that teachers with a science background at College are more likely than others to hold a responsibility post in science. (This latter point really mirrors the one made about teachers with science degrees.)

The information gained from the area visits suggested a conclusion very much more supportive to the line of thinking that led to the original research question. In many areas (areas 2, 3, 4, 5 and 6 might be highlighted) it was suggested that lack of expertise in science had been a problem. It was said that teachers who were unfamiliar with science often were uneasy about it and lacked confidence when dealing with it. This in itself had other implications. For example, in area 5 it was said that one result was that the local authority needed to do more work to support teachers without a science background: this placed a particular burden on advisory staff. The argument that was put forward, then was not that teachers without a science background were unable to use Science 5/13 effectively. The argument rather was that generally teachers without a science background were often unsure about using the project, so that they generally needed a considerable amount of support and guidance if they were to continue with it. Such support sometimes was forthcoming but it was a strain on resources (for example, replacement teachers for those attending courses) which some areas could not meet.

Research question 6 This research question examined the relationship between the movement of trial teachers away from the trial schools and continuation with the project. The data collected from the questionnaire survey showed that a significant negative relationship existed between these two factors. This was reinforced during the area visits. For example, the problem posed by trial teacher turnover was highlighted in ares 1, 4, 5, 6, 7, 8 and 9. The questionnaire survey and interviews conducted during the area visits both showed that many trial teachers moved quickly after the end of the trials, often for promotion. This meant that there was little time for any effective dissemination to take place in the trial schools in the post-trial period. In some cases the headteacher had been very supportive during the trials and provided a certain amount of continuity in this situation. However there was also a degree of headteacher movement after the trials and this reduced such continuity. Sometimes a new headteacher was appointed who had no previous working knowledge of the project. In addition, even where headteachers did not move it was suggested that often it proved extremely difficult to interest other staff members who had not been involved in the trials to undertake any work with the project and so continue the work started by the trial teacher.

The difficulty encountered in the dissemination of Science 5/13 in the post-trial stage suggests the importance of involving more staff members during the trials themselves. This seems particularly important with a project like Science 5/13 where its very nature as a science project did not appeal to the majority of primary school teachers.

However, it is important to note that while the problems posed by trial teacher movement were formidable, they were not insuperable. The discussion of the visit to area 7 suggested that in this particular instance trial teacher movement could be overcome by a local authority policy which strongly encouraged the use of a project like Science 5/13. No doubt, other action also could be taken to counteratct the effects of trial teacher movement. The point really is that if the expertise of trial teachers is lost after the end of trials then it takes some effort, probably resources and may be policy to replace it. The argument then, is, that trial teacher movement inhibits rather than prevents further work with the project.

Research question 7 This research question concerned the importance of the role played by the headteacher in promoting an innovation. The questionnaire data showed a positive relationship between whether headteachers thought Science 5/13 was a valuable project for their school and continuation with the project. In the discussion of the questionnaire data, though, it was noted that it was possible that headteacher attitude towards the project might be determined by whether the school was using it rather than the other way around. Also headteachers were asked why they considered Science 5/13 to be a valuable project for their school: it was hoped that this question would give some further insight into how headteachers viewed the project. Most headteachers mentioned the general approach of Science 5/13 highlighting its child-centred nature, the discovery learning involved and the way it could make children more aware of their environment. However there was some difference between headteachers when the question of how the units might be used was considered. Some saw them as a basis for science work, almost like a syllabus covering a core of work, while others saw the units more as resource books containing ideas which could be incorporated into different projects for use in a more integrated way. Some headteachers saw the Science 5/13 materials as particularly useful for their teachers, who, with little background knowledge of science could gain some support and confidence to bring more science into their work.

Research question 8 This dealt with the relationship between level of appointment of the trial teacher and continuation with the project. This particular research question was drawn from research into science schemes used generally at the secondary level. The research had shown that the use of a head of department as a trial teacher was associated with high adoption of a science scheme. The data from the questionnaire survey used in this present research showed the opposite trend, although the result was not significant. One possible reason for this difference could well lie in the different role of the heads of science departments in secondary schools and headteachers or deputy headteachers, or teachers with scale posts, in primary schools. The latter, especially headteachers, have much wider duties which usually involve a high percentage of non-teaching activities. Thus it is understandable that such duties could make it difficult for such teachers to continue with a new project like Science 5/13. In contrast although the head of a science department has some administrative duties in the running of the department, his expertise and duties relate mainly to the teaching of science.

Research question 9 This research question concerned the relationship between the movement of headteachers from trial schools and continuation with the project. The data collected from the questionnaire survey did not show a significant relationship at the 0.05 level, between these two factors. As was pointed out earlier, in chapter 6, this finding contrasts sharply with the significant relationship found to exist between the positive attitude of the headteacher towards the project and the project's continuation. It was suggested in chapter 6 that these results could be explained by assuming that a favourable headteacher's attitude might be transferred to trial teachers and other interested teachers in the early stages of the project's development; head-teacher movement then becomes less important. Also, as the trial period progressed, and especially in the post trial period, head-teachers generally appeared to become less directly involved with the project. Fewer demands were made on them by the Schools Council and local authority Advisers/Inspectors compared with the trial period.

Research question 10 This research question concerned the effectiveness of policy statements at the local authority level on continuation with the project. The questionnaire data showed a significant difference in continuation between the local authority areas. Visits to the individual areas showed that, at the time of the interviews, those with the highest continuation rates (area 7 and area 8) had made a commitment to a middle school system. In these cases the authority had drawn up a number of policy documents outlining how each area of the curriculum should be taught. Discussion at local Adviser/Inspector and teacher levels had resulted in outlines for a possible core of work at the first and middle school stages. Both areas used much of the Science 5/13 materials for this work together with parts of schemes like the Nuffield Combined Science project. Courses and meetings held mainly at local teachers' centres explained how these ideas could be put into practice including details of appropriate resources. One area (area 8) was particularly keen to promote scale posts in science as a way of coordinating activities at the school level. It was hoped that such personnel could help class teachers, particularly those teaching the 9 to 11 year age group, bring more science into their work. At the time of the interviews such a comprehensive reorganisation to a middle school system had not occurred in any of the other areas, although one area (area 5) had a pilot scheme in operation. In that area a 'bridging group' was set up to recommend what might be done in the middle schools and work with Science 5/13 was one of the suggestions made.

Research question 11 The final research question examined the relationship between the types of support offered to teachers and continuation with the project. The questionnaire included a number of items designed to ascertain the amount of support given before, during and after the trials. The analysis of the data gathered from the survey showed no significant relationship between any of the criteria used in the questionnaire and continuation with project after the trials. However the visits to individual areas did highlight some interesting points. Generally the interviews appeared to suggest that support was most effective if it was linked to a strong policy decision at local authority level to incorporate Science 5/13 into the school curriculum. For example, this was shown clearly in area 8 with its strong local policy, whereas in area 3, with less firm directives from the authority, even though there were an impressive number of in-service meetings at the Maths and Science Centre the result in terms of continuation with Science 5/13 in the trial schools was disappointing. One of the more interesting developments in the type of support offered to teachers in the post-trial period took place in some areas in Scotland. The emphasis there was upon school based in-service with college tutors working along side classroom teachers. In fact, because of cuts in educational spending, the College of Education involved in this work has since closed.

In some areas the kind of support offered appeared not to match that demanded by the teachers. For example, in area 2 it was noted that teachers and staff at the Maths and Science Centre seemed to have different views about how science should be tuaght in the primary schools. Whereas the teachers seemed to believe that science should be taught integrated with other subjects areas, often based on a project on the environment, the courses run from the Centre were organised much more around the detailed study of particular topics from the units. It was suggested that this difference of approach might not have been fully appreciated because the staff at the Maths and Science Centre generally were not expected or encouraged to visit schools. In one of the areas, area 9, the kind of support offered by the local authority Adviser also seemed to differ from that demanded by the teachers. The Adviser took the view that in-service support should be school based and school led. However, a number of teachers using the project (and it is important to note that in this area the majority of schools only had one teacher involved in it) decided that they needed more contact with others involved in work with Science 5/13 and organised their own primary science course.

In some areas particular difficulties were encountered with the kind of support offered after the trials. In area 4 although there was extensive in-service provision during the trials, much organised from the Science Centres, after the trials the Centre staff felt that because they were not allowed to undertake necessary follow up work by visiting teachers in their schools the effect of in-service courses was often lost. The result was that any support given in the schools themselves during the post trial period had to be given by other members of staff within the school or the local authority Inspectors, and the latter, in particular, seemed to have little time to undertake such work. In area 6 there was a similar breakdown in the support system after the end of the trials. For example, in one part of area 6, the local College of Education had to cut in-service courses because of an increase in the number of pre-service students, the local authority primary Adviser stopped working with Science 5/13 in order to consider other areas of the curriculum and the HMIs direct involvement declined.

It is important to recall that in-service courses in a number of the local authorities visited were less successful after the trials than they had been during the trials because resource contstraints meant that they had to be held out of school hours. Such timing obviously meant that a greater commitment was needed on the part of the teachers concerned.

Theories of Change

This discussion now turns to look at some of the theories of change presented earlier in chapter 2. It was pointed out in chapter 5 that no attempt would be made to test these theories in a systematic fashion: nevertheless it is felt useful to look again at them to see the extent to which they help us understand the progress of the Science 5/13 project.

Stenhouse[3] argued that effective change requires a 'research approach' at the school level so that new ideas can be effectively evaluated alongside school needs. This requires in particular a greater emphasis upon critical observation and recording in the classroom: this makes continuity easier within a school when teachers leave. Also it necessitates effective feedback to inform personnel who can coordinate the support available. Evaluation of Stenhouse's argument would depend on detailed school based research centring on classroom observation, and that has not been attempted in this instance. It may be worthwhile noting, however, that the approach to innovation that Stenhouse has put forward seems to contrast sharply with the type of in-service provision and school help available in many of the trial areas for Science 5/13.

The work of Havelock[4] and Schon,[5] in particular their possible models of change, was also reviewed in chapter 2. Whereas Havelock was more concerned with the stages through which change takes place, Schon looked more at the general process of social change and in particular at the diffusion of innovation. This part of the discussion attempts to see the development of Science 5/13 in terms of these models and then ascertain how the project might have been more effective in its uptake had a different approach been used.

Havelock outlined three main schools of thought which related to the process of change: one of these was the 'R, D & D' approach of which Science 5/13 could almost be a stereotype. In this approach all the activities stem from the centre, as in this particular case where the central team was set up by the Schools Council to write and test the materials, which were later published for teacher use. One of the problems of this approach is the lack of emphasis upon diffusion of materials after development: much more time is spent upon the research and development stages in producing teacher materials.

In his work, Havelock outlined two other approaches to change which attempted to overcome this problem. In the 'social-interaction' approach more emphasis is given to the network effect which can exist between and within areas to stimulate diffusion. The After-Care Committee which was set up by the Schools Council to oversee developments of the Science 5/13 project after the materials had been produced made an attempt to move in this direction by keeping in contact with trial areas and new developments. However the resources alloacated to the Committee were small compared with those available to the central team during the trials and so limited the committee's impact.

In the 'problem solving' approach, put forward by Havelock as his third main model, the emphasis is upon meeting client needs. In the case of Science 5/13 an important factor militating against effective uptake has been the reaction of primary school teachers towards science. If the project team had placed more emphasis on this difficulty before producing materials it might well have considered the additional need for pupil materials to provide more help. It is clear from the remarks made by the evaluator to the project, Wynne Harlen, that the question of pupil materials was not discussed seriously by the team.

> *I don't remember 'pupil materials' being a great issue initially. Maybe we just prevented discussion of it. Because we said teachers have to make the decision, we didn't raise it then, we put it out of court as a topic. But since then there's been a lot of talk about it.*
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In this quotation when Wynne Harlen talks about teachers having 'to make the decision' she would seem to be referring to one of the underlying ideas of the project that teachers were seen as the best people to decide which activities were most suitable for their pupils and hence the use of teachers materials which would not be as prescriptive as pupil materials.

Also, this present research has suggested a need for pre-service and in-service materials to increase teachers' awareness of what science is about generally and in particular the approach of the Science 5/13 project. The setting up by the Schools Council of the 'Progress in Learning Science' project has gone some way to meet this need.

The diffusion models outlined by Schon closely follow the schools of thought suggested by Havelock. However Schon's work gives a greater insight into the mechanism by which change evolves. It is interesting to look at these in an endeavour to examine the type of internal mechanism used by the Science 5/13 project and thereby again analyse how this mechanism might have been improved.

In Schon's 'centre-periphery' model, which accommodates much of Havelock's 'R, D & D' approach, information is radiated out from the centre (in this case the Schools Council) to the periphery (the trial schools). However the situation which existed during the trial period of Science 5/13 was more like the second of Schon's models, called the 'proliferation of centres' model where, instead of one main centre a number or proliferation of centres grew up at local authority level. They were allocated resources and expertise for dealing with the trial schools at the periphery. This is possibly the model that comes closest to explaining the infrastructure existing during the trial period. This model accommodates much of the 'social-interaction' approach of Havelock based on the network existing between and within areas Schon outlined a number of reasons why the 'prliferation of centres' model can fail to bring about effective change. A number of these have been encountered in this research. First, for example, there were liaison difficulties between the main centre and the secondary centres. This showed itself particularly in area 2 where local initiative was hindered because of a policy decision at the main centre to dissuade the production of pupil work cards. This led to frustration and eventually loss of motivation at this particular centre. Second, and possibly the most important reason for the low continuation rate of Science 5/13 in many areas was the constraint acting upon the resources at the main centre and secondary centres in the post-trial period. After the trial period the activities of the main centre were gradually phased out except for a skeleton after-care committee which attempted to oversee diffusion generally. However possibly the greatest difficulty lay in the local authority areas themselves where key personnel including local authority Advisers/Inspectors, College of Education staff, headteachers and trial teachers found they had less time to devote to the project and in many cases left the trial school or area altogether. This difficulty was compounded by the fact that teachers appeared to need a significant amount of support to undertake a project like Science 5/13 primarily because of their own lack of science training.

Schon's third model, the 'periphery-centre' model is similar to Havelock's 'problem solving' approach. Although it could be argued that the centre is more accurately seen in terms of secondary centres at local authority level, latterly the work of the Schools Council in promoting the new 'Learning through Science' project has shown the main centre making a response to teacher need in the form of pupil materials.

Barriers to Project Continuation

This chapter concludes by looking at a way in which the evidence collected about factors influencing continuation with the project might be linked together. The suggestion incorporates a series of three barriers acting at different levels of the educational system. Failure to overcome the barriers may militate against continuation with the Science 5/13 project.

One important barrier can be seen acting at the local authority level where an innovation could be incompatible with local policy. The degree of compatibility between the innovation and local policy ranges at one extreme from high compatibility where, for example, in the case of Science 5/13, commitment to a middle school policy could endorse the use of Science 5/13, to low compatibility at the other extreme, where there could be a negative attitude towards the project. A number of areas came close to the high compatibility and such compatibility seemed to strongly influence continuation with the project. None of the trial schools were so extreme as to fall into this last category but most lay somewhere in between. In such cases although Science 5/13 was often viewed by local authority Advisers/Inspectors as a valuable project the final decision as to whether the project be pursued rested with the school.

A second barrier can be seen to exist at the school level and the decisions made by the headteacher about the type of curriculum to follow. The more positive the attitude of a local authority the less important this barrier will be. For instance, in area 8, where the authority was committed to a middle school system there was less of a problem at the headteacher level although the quantity and quality of provision did vary from school to school. Some of the responsibility for this lay with the headteacher and senior staff in their decision as to how much time should be allocated to science generally and also the type of post allocated to the person responsible for science in the school. The remainder of the responsibility lay with the classroom teachers themselves and how well they taught science.

The third barrier operates at the classroom level itself. A teacher's lack of background knowledge in science or disinterest with the subject were important factors hindering the continued use of the Science 5/13 materials. The extent to which this type of barrier can be reduced and overcome depends upon issues like the effectiveness of local support systems and the attitude of head teachers towards the innovation concerned. Support systems canbe crucial in this context though it should be recalled that the type of support system may be just as important as its extent. Further, the type and extent of support system may be influenced by local authority policy. If a local authority has a policy that science should be taught in primary schools this may assist in the battle to ensure that sufficient resources are made available to provide an effective support system. Any problems associated with the Science 5/13 materials themselves, such as the additional need for pupil materials, or the approach used, only raises this barrier and makes uptake of the project more difficult.

In conclusion, it would appear from this research that the first barrier, that operating at the local authority level, is the most crucial. If, at the local authority level, the Science 5/13 materials become an effective part of the curriculum, through various policy decisions, then this barrier becomes insignificant and allows the project to continue reasonably effectively. However although this is possibly the best way for a project like Science 5/13 to continue to be used it is not the only way. Interest and expertise at the headteacher and classroom teacher levels can foster a project like Science 5/13 although wider diffusion beyond these key people can be a problem, especially when such personnel move away from trial schools breaking continuity. Sheila Parker, one of the team members who helped to draw up the Science 5/13 units summarises the difficulty experienced by teachers who try to use the materials on their own and lack the necessary support infrastructure

> *Its (the Science 5/13 project's) weakness lay in its tendency to rely on too much assumed inter-communication between people. Certainly its statements of objectives are off-putting in the extreme to many teachers who meet the published materials 'cold' and solely through the written word.*
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With hindsight it is not difficult, as this research has shown, to look at ways in which the project could have been improved, but, considering the stage of development which curriculum innovation had generally reached in the mid-to-late 1960's it is easy to appreciate the emphasis in the project upon behavioural objectives and guided discovery learning, and hence the whole rationale for the teacher materials produced.

Footnotes

1. The 'Learning Through Science' project was set up by the Schools Council in 1978 to extend until 1984, under the directorship of Roy Richards, and based at Goldsmiths College, University of London.
2. The sample population in this research consisted of the following school types: 86.4% primary, 6.6% middle and 7.0% secondary. Therefore teachers with promoted posts in this sample were generally headteachers, deputy headteachers and teachers with scale posts in the primary sector.
3. Stenhouse L., An Introduction to Curriculum Research and Development, Heinemann, London, 1975.
4. Havelock, Planning for Innovation through Dissemination and Utilization of Knowledge, Centre for Research on Utilization of Scientific Knowledge, Institute of Social Research, The University of Michigan, Ann Arbor, Michigan, 1969.
5. Schon, D.A., Beyond the Stable State, Temple Smith, London, 1971.
6. Elliott, J., 'Science 5 - 13', in Stenhouse, L., (ed), Curriculum Research and Design in Action, Heinemann Educational Books, London p.112.
7. Ibid, p.112.

CHAPTER 9

Critique of the Research Study

In any thesis that is concerned with a major substantive issue or issues there is a danger that methodological concerns will receive less attention than they deserve. A researcher can easily be drawn and become pre-occupied by such substantive matters and even if the importance of methodological concerns is recognised they may be given less space in writing up the final thesis than they deserve. This, for example, may lead the researcher to neglect either reporting certain methodological concerns in sufficient detail and/or outlining in full the implications of particular procedures adopted.

The aim of this final chapter is to centre on methodological issues and so re-dress any imbalance that there might have been earlier in the thesis. This retrospective look at methodological matters has some advantages. For example, it enables the researcher critically to reflect on the practices which she adopted in the knowledge that the reader is well aware of the substantive matters referred to: this can have clear advantages over a prior and more abstract examination of the same issues. Further this retrospective discussion can allow the researcher to point to new issues and methodological concerns which have emerged since work on the thesis was first started: this has particular value in this case because of the nine years that elapsed between the commencement of the research and the submission of the thesis.

While the main focus of this chapter is a critical analysis of methodological issues it is also the case that the period of time that has elapsed since this thesis was started has implications for the substantive issues considered in the research. They were written about within the context of developments in science education and curriculum innovation of the mid 1970s. The literature reviews reflect this and, generally, do not cover material after 1978. A number of writers have made more recent contributions on the subject of science education and curriculum innovation: a selection are listed at the end of this chapter.

The remainder of this chapter has been divided into four main sections which consider issues relating to: one, the starting point of the empirical study reflecting upon how relevant issues for the research study were generated and decided upon; two, the first part of the data gathering process, where appropriate methods were chosen; three, the second part of the data gathering process, concerned with how these methods were used; and four, the information gained from the research study, including an analysis of and justification for the claims made from the data collected.

Section 1 : The Starting Point, Reflecting Upon How Relevant Issues for the Research Study Were Generated and Decided Upon.

This section looks specifically at two criticisms which could be made of the initial stages of the research. The first concerns the research questions chosen for subsequent analysis in the research study. Critics might argue that these research questions were chosen without a clear strategy in mind. Second it could be argued that the criteria chosen to operationalise the research questions were not valid.

1. Was there a clear strategy for choosing the research questions used in the study and was this clearly stated in the research report?

The main focus of the research has been to examine curriculum implementation using the Science 5/13 project as a case study. The strategy adopted in the first instance was to use the literature reviews as a guide to the kind of issues that needed to be looked at in trying to understand as fully as possible why some schools continued to use Science 5/13 after the trials when others did not. The literature reviews showed that by the mid 1970s when this research was undertaken there was a movement away from the R, D and D approach to innovation which had tended to concentrate upon the research and development of 'packages of material' for schools towards the more neglected areas of diffusion and dissemination. In this area it appeared that the local authority might play an important role. Thus the main thrust of the research was upon issues like local authority policy and the availability of support services. It was decided early in the research to consider the development of Science 5/13 in the original trial schools, not only because it was seen as an innovative idea, but also, because it seemed likely to facilitate the study of issues such as the differences between the support offered during and after the trial period.

The research literature, which formed the basis for the eleven research questions, contained some issues which although interesting and relevant in the wider context of curriculum implementation were considered more peripheral to the specific case of the use of Science 5/13 in the trial schools in Great Britain. For instance, the work of Rogers and Shoemaker and more particularly that of Carlson, highlighting the important role of opinion leaders, raised interesting questions about the role of informal friendship groupings. Unfortunately Carlson's work, concentrating as it did upon the particular role of school superintendents in the U.S.A. was difficult to apply to the British situation.

Although it is judged that the questions investigated in this research included those factors highlighted at the time as important for the implementation of Science 5/13, it is accepted that if this research had been started some nine years later, in the mid 1980s the research questions might well have reflected a different emphasis, possibly one which looked in much more detail at the implementation of Science 5/13 in the classroom.

In practice two different kinds of questions were examined in this research. The first was the issue of whether particular factors were associated with continuation with the Science 5/13 project. In this case the exercise essentially was a quantitative one. Correlations were examined to see whether they were high enough to support the view that the factors in question were influencing continuation with the project.

The second kind of questions very much followed on from the first. Whereas the first were trying to identify factors that appeared to influence continuation with Science 5/13 the second were trying to understand in what way, or how, they influenced continuation. In essence the aim, then, in this second set of questions was to understand the mechanisms at work.

2. *Were the research questions operationalised in valid ways?*

Chapter 5 described how the research questions were operationalised in terms of more specific questions which could be asked to gain information from respondents. Some of these questions were relatively easy to operationalise. For example, for research questions 4 and 5, which dealt with teachers in mid-career and the educational background of the trial teacher, selecting the criteria was straightforward in terms of closed questions about, the number of years trial teachers had been teaching and their pre-service and in-service training.

However, for research question 1, which suggested a possible relationship between the compatibility of Science 5/13 with the setting in which it was used, there seemed to be a number of ways in which compatibility could be studied. In this research compatibility was assessed in a number of ways. These included an examination of : school type; facilities available in the school; the teaching method used and previous use by the school of the Nuffield Junior Science Project. There may well be other ways of examining compatibility. The decision to use the criteria listed above was based upon a judgement of the importance given to various criteria discussed in the literature reviews, with particular emphasis upon relevance to the Science 5/13 project. It is also worth noting that if the research were undertaken today, in the mid 1980s, compatibility may well have been examined in a slightly different way, with possibly more time spent looking at the compatibility of the innovation with various teaching styles.

This kind of issue is examined more fully later in the chapter (Section 2, question 2) in the context of the reliability and validity of the questionnaire as a way of collecting the data needed. The problem of operationalising research questions validly of course is one that is far from unique to this particular research and in the later discussion some of the comments made in the literature about ways of approaching this problem are noted.

Section 2 : The First Part Of The Data Gathering Process - Choosing Appropriate Methods

This section looks at two criticisms which could be made about the strategy for collecting data. First it could be suggested that the logic of using a questionnaire survey followed by more open-ended visits was not clear from earlier discussions. Second, it could be argued that the postal questionnaire was not a reliable and valid way of collecting the kind of data needed to answer some of the research questions. Another criticism which also relates to the first part of the data gathering process concerns the area visits.

Were they an appropriate method of data collection? However this issue is dealt with in the next Section because it can be discussed more fully alongside a consideration of problems relating to the collection of data, which is the subject of that Section.

1. The logic of using a questionnaire survey followed by more open-ended visits was not clear from earlier discussions.

Earlier, when discussing the strategy for choosing the research questions it was stated that in practice two different kinds of questions were examined in this research: the first were questions about whether particular factors were associated with continuation with Science 5/13 (the essentially quantitative exercise) while the second were questions about how factors influenced continuation with the project (essentially the mechanisms at work).

The questionnaire survey was dominated by the first kind of questions. For example, questions were asked about school type, length of teaching experience, educational background of the teacher, teacher mobility and headteacher mobility. The answers to these questions provided the data for statistical analysis. There are, of course, difficulties and dangers associated with using a questionnaire to collect such information. These include the reliance of questionnaires on shared understandings about the language, concepts and general situation involved. There are also problems relating, for example, to the ability of the respondent to recall the information required These and other issues are dealt with more fully in the next section.

However, despite these problems it was (and is still) believed that the questionnaire survey would be the most suitable way of collecting much of this information, for a substantial population, relatively quickly.

The area visits were much more concerned with the second than the first kind of questions. They were concerned particularly with questions about how factors influenced continuation with Science 5/13. The area visits were centred around extensive discussions with respondents like L.E.A. Advisers/Inspectors. Although, not part of the original design, similar discussions were also held with some other respondents including trial teachers and headteachers. These discussions were much more open ended. Although they were based on a list of topics to be covered they were far from tightly structured interviews. This method has its dangers which were well recognised by the researcher and are noted in the thesis. They will not be rehearsed here because they are dealt with with later in the chapter. However, this method is particularly useful for enabling the researcher to understand more about how factors influence, in this case, continuation with Science 5/13. It allowed the researcher to explore, for example, not simply what local authority policy documents were issued and what they said, but also how they were interpretted and implemented.

While it can be suggested that the questionnaire was dominated by the first kind of question and the area visits by the second, it needs to be stressed that there was some overlap. Some open-ended questions were asked in the questionnaire and some attempt, more generally was made to ask questions which would help the researcher to understand how factors influenced continuation. Similarly, one aim of the area visits, was to collect documentary information. However, the emphasis that has been referred to above remains correct.

The order in which the research was conducted with the questionnaire survey being undertaken before the area visits is justified on the grounds that the questionnaire survey provided information, some of which was used as the basis for, or as a background for the area visits. Of course, the aim of the area visits was not simply to follow up on and explore more fully issues raised by respondents to the questionnaire. One of the aims of the area visits was to collect information which could not have been gained from a school based survey. Nevertheless, it was recognised that there were some issues that were raised in the questionnaire that could be followed up in the area visits, and this argued for the logic of the order of research activity adopted.

2. The postal questionnaire was not a reliable and valid way of collecting the kind of data needed

This criticism has been partially touched on in the previous Section. At a general level it is accepted that a postal questionnaire was not ideal for collecting some of the data. However, it is judged that it was the most appropriate strategy available in the circumstances because the majority of the questions were of a closed type and suitable for a postal questionnaire (this was because the responses for such questions could, in the main, be easily predicted) and also because other practical alternatives such as conducting interviews with a much smaller number of schools would have been less valuable to the research. Therefore it was decided to us a postal questionnaire to collect data from the schools and insert, in addition to the closed type of questions, some of a more open nature.

Before examining the reliability and validity of the postal questionnaire it is necessary first to consider the interpretation placed on these terms by the researcher. Reliability can be considered as being concerned with the question of random error as compared with the problem of systematic error or bias. Unreliability of questionnaire responses may be thought of as arising in a number of different ways, two of which might be highlighted: the first we can call 'random misunderstanding' and the second, 'lack of saliency'. Both of these factors can reduce the reliability of a questionnaire, so that if a questionnaire were given again to the same population the results would not be identical. Random misunderstanding is associated with respondents misunderstanding the questions because they are ambiguous and the issue of saliency becomes important where respondents have to think about the answer they give (or manufacture one) because the facts relating to these questions do not come immediately to mind. When discussing reliability it should be remembered that the errors relating to'random misunderstanding' and 'lack of saliency' must be of a random nature which would cancel each other out and would not lead to any systematic bias.

The reliability of the postal questionnaire was one of the main issues examined through the pilot study conducted in one of the local authority areas not included in the sample population. The questions used were critically examined to see whether they gave rise to problems relating to misunderstanding and non-saliency. More specifically the items in the questionnaire were examined to see (a) if the questions had been interpreted clearly without obvious ambiguity; (b) if any instructions on the questionnaire had been difficult to understand, and hence had led to confusion; (c) if the answer categories were adequate (for example was there too high a percentage of answers in miscellaneous categories); (d) if there had been sufficient room for replies to open ended questions; and (e) if any questions had not been answered by a large number of respondents when it was anticipated they would have been able to do so.

In addition to a detailed study of the questionnaire returns from the pilot, a limited number of interviews were conducted with headteachers and teachers in the area to discuss the questionnaire. One of the main findings was that some trial teachers had encountered difficulties with one or two questions dealing with the details of courses and meetings attended at the time of the trials. To a certain extent this was not unexpected, as it had been, on average, five years since the trial period. It was decided, as a result, that a section of the letter sent with the questionnaire to schools would suggest that if respondents could not answer the questions because they could not remember the issue clearly, then they should write 'cannot remember' on the questionnaire form. It was hoped that this would overcome some of the problems associated with the saliency of certain questions. Of course one option would have been to delete the questions from the final questionnaire. On balance this was judged to be undesirable. The area of questioning concerned was an important and interesting one, and although some respondents were unable to recall details many others said they were able to do so. Also it was believed, and this turned out to be the case in practice, that it would be possible to check the validity of these answers to a certain extent through documentary evidence collected during the area visits.

There seemed to be few problems with ambiguity of the questions. No doubt in part this was because many questions asked for factual information. Of course this was not the case with all questions and it should be recorded that some comments were made about questions that sought to discover attitudes, for example about the usefulness of materials and courses. However, the comments were that given more opportunity more information could have been given rather than that difficulty had been encountered with, say, the four point scale used.

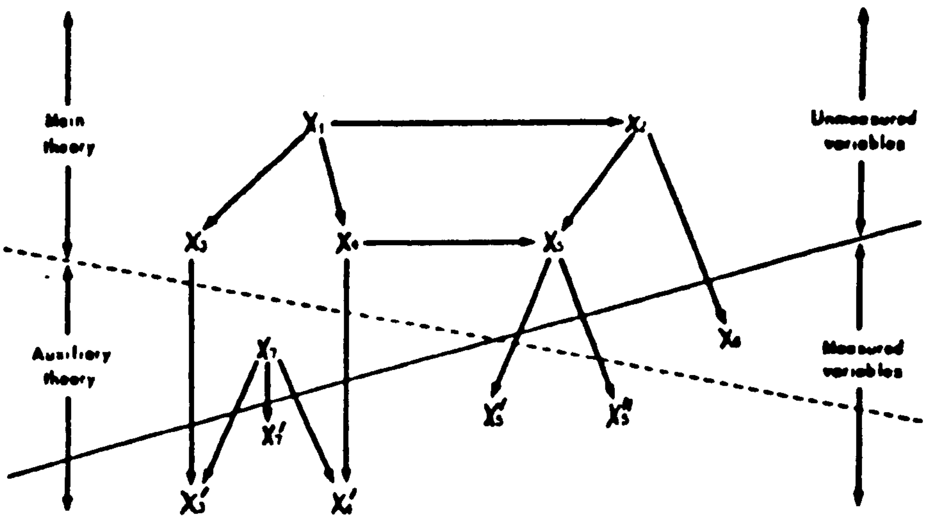
When one turns to examine the validity of using a postal questionnaire to collect certain kinds of data, as in this research, it is necessary to begin by examining the researcher's interpretation of the term validity. It is recognised that the term can be interpreted in a number of different ways. At a general level it can be seen as the extent to which the instrument (in this case the postal questionnaire) measures what it purports to measure. Within this general umbrella concept of validity there are a number of more specific ways in which validity can be discussed. There are broad questions of internal and external validity which deal essentially with the findings of the research. The former can be seen as the extent to which the findings actually mean what they purport to mean whereas the latter can be seen as concerned with how generalisable the results of the research are in terms of other populations in addition to the research sample (population validity) and how generalisable the results are in terms of other conditions (ecological validity).

When one looks in more detail at the validity of the measuring instruments used in research studies, much depends upon the use to which the measuring instrument is being put. For example, if the instrument is a test which is to be used to find out how much of a course pupils have understood, then it is important that the test samples all the appropriate subject matter (this type of validity is referred to as content validity). However if the measuring instrument is to be for selecting students it is important that the instrument predicts which students will be the most successful (this type of validity is referred to as predictive validity). If an alternative measuring instrument is needed in place of an existing one it is necessary to check that the new instrument will be as good as the one it is to replace (this type of validity is referred to as concurrent validity). However none of these three types of validity are particularly relevant to the research in hand. They deal more with measurement for decision making as opposed to the type of measurement used in the development of a theory. The latter has the disadvantage that it is generally much more difficult to operationalise the attributes or or constructs which are to be measured. This is the area of construct validity and is the concern of this research study.

Although this present section deals specifically with the validity of the postal questionnaire there are other related issues which also have relevance in a discussion of construct validity. First and foremost, the main purpose of this research has been to examine the implementation of curriculum innovation using the specific example of Science 5/13 in such a way that those factors affecting its use after the trial period might be isolated. A central decision then was which factors would be seen as important in this context. This was the first stage of operationalising the main aim of the research into the eleven research questions and has been covered earlier in this critique. The next stage of operationalising the research questions into variables which could be measured has also been discussed. The rigour of both of these stages has obvious implications for the validity of the research as a whole.

The discussion now turns to look more specifically at the validity of the postal questionnaire as a means for gathering the data collected in this research. Earlier in this Section the importance of construct validity was outlined, primarily as it relates to how appropriate the questions in the measuring instrument are for collecting information about the underlying constructs. This, as explained earlier, depends much upon how rigorously the research questions were operationalised into criteria which could be measured. Blalock[1] considers the dilemma facing the researcher in the field of social science where it is impossible to directly measure theoretical variables because they cannot be linked with specific operations. Blalock suggested a model which helps to approach the problem which is shown in Fig 1. This model makes a clear distinction between measured and unmeasured variables. While he agrees that 'no theoretically defined concepts are directly measurable'[2] he accepts that some come 'sufficiently close to the operational level that agreement is reached'[3] and are seen as directly measured (as is the case with variable X_6 in Fig 1). The model in Fig 1 offers a way by which those variables which are not directly measurable can be operationalised using an auxillary theory where for example the unmeasured variable X_5 is represented by the measured variables X_5' and X_5'' in the auxillary theory. Earlier in this chapter it was noted that in this research it was relatively easy to measure fairly directly certain variables like teacher turnover, level of appointment and educational background. Other variables were much more difficult to measure directly and Blalock's discussion is clearly particularly relevant in this context. Variables such as complexity and compatibility were particularly difficult to operationalise and indicators of them which could be measured, had to be found: for example, in the case of compatibility, 'school type', 'facilities available in the school', 'the teaching method used', and 'previous use by the school of Nuffied Junior Science' were used as indicators. It might be suggested, however, that it would have been more desirable in relation to such variables to make the auxillary theory, implicit in the operationalisation, more explicit: that is, to spell out the relationships which the researcher assumed between, for example, 'school type' and 'facilities' on the one hand and 'compatibility' on the other.

Fig. 1 Model Involving Distinctions between (1) Main and Auxilliary Theories and (2) Measured and Unmeasured Variables



From: Blalock, H M Jr, 'The Measurement Problem : A Gap Between The Languages of Theory and Research' in Blalock, H M Jr, and Blalock, A B, Methodology in Social Research, McGraw-Hill, London, 1971, p25.

However there is also a second question relevant to the discussion of construct validity which involves the appropriateness of the postal questionnaire as the correct method for obtaining the kind of data needed. There would be some justification for the criticism that in this research the postal questionnaire was not an entirely satisfactory method. The decision to use a postal questionnaire was strongly influenced by practical considerations which prevented more time being spent undertaking interviews. It was recognised for instance that those questions which dealt with how the materials were used in the classroom and how useful such materials were, would have been better asked in an interview situation which allowed the respondent to give a more detailed insight into their views. This was also true with regard to teachers' views about the usefulness of meetings attended: in this case it would have been interesting to examine the type of in-service help they thought most appropriate both during and after the trials.

However, at the end of the day, the practical constraints meant that a postal questionnaire was all that was really going to be possible, certainly if a sample approaching anything of the size outlined, was going to be covered. This does not mean that the problems and the difficulties with the approach adopted can be ignored: they obviously have to be taken into account in analysing the results.

Section 3 : Part 2 Of The Data Gathering Process - Collecting the Data

The second part of the data gathering process, that concerned with the actual collection of the data, examines two possible criticisms. The first concerns the role played by local authority Advisers/Inspectors in helping to assist the data collection. It might be suggested that the deliberate association with local authority Advisers/Inspectors which had the positive effect of helping the response rate, particularly in the pilot survey, may have significantly affected the replies given by respondents. A second criticism which might be levelled at this stage of the data gathering process might centre around the rationale for undertaking area visits as part of the research study.

1. Did the deliberate association with local authority Advisers/ Inspectors, which probably helped the response rate, significantly affect the responses?

The importance of the local authority Advisers/Inspectors both in supplying data themselves and in assisting with difficulties experienced in the field was appreciated from the start. The research literature had given some indication of these difficulties and prior involvement of the researcher in the Advisory service had suggested that the Adviser was not only a key person in his/her own right in local developments but also invaluable in assisting any research worker in this field who was interested in collecting documentary evidence. On occasions the local authority Advisers/Inspectors assisted the researcher with details about changes of addresses for some headteachers and teachers and also with changes in names of schools. Some Advisers also encouraged schools to complete the questionnaire and this was valuable and one of the factors that assisted a high response rate. However there was no direct contact, as far as is known, between Local Authority Advisers/Inspectors and the trial schools when the postal questionnaire forms were actually being completed. Nonetheless although there is little evidence that the researcher's apparent association with the L.E.A. Advisers/Inspectors influenced teachers' responses to the questionnaire, it must be recognised that there may have been such influences, and that these could be of a variable but unknown importance. It was only at the time of the area visits when the local authority Advisers/Inspectors offered to arrange visits to trial schools that they sometimes accompanied the researcher. Even then it was extremely rare for any one of them to be present during an interview. Respondents, when interviewed alone were told that the meeting would be confidential. However it is recognised that the influence of the Adviser/Inspector, in as far as he/she arranged the meetings, upon the respondents could have been more than realised by the researcher, though, in practice, it would have been very difficult to assess this influence. While it is accepted that this may have happened in a limited way with school staff and others working for the authority such as teacher centre wardens it seems less likely the Adviser/Inspector would influence staff in other institutions such as Colleges of Education. Although they may liaise with the Adviser/Inspector as part of an overall support structure they do not have the same links as those working for the authority.

2. Is there a good rationale for including the 'visits' part of the study?

There are a number of reasons, some made more explicit than others, why the research strategy included area visits. These are :

(a) at a general level, they enabled 'area' information to be obtained comparable to the 'schools' information obtained from the questionnaire ;

(b) they were a way of getting a fuller understanding of how things had worked, what events had occurred, what had influenced what, in relation to Science 5/13 in each area (i.e. as a way of getting at the mechanisms which led to the partial continuation with Science 5/13) ;

(c) they were a way of negotiating access to potentially useful evidence ; and

(d) more specifically they were a way of understanding how key personnel, especially local authority Advisers/ Inspectors perceived Science 5/13 and related issues such as resources and in-service training.

In relation to the first of these reasons a possible criticism which might be made is that there was a lack of consistency across areas not only with regard to the type of data gathered but also with regard to the data gathering procedures used. While it is accepted that such variety did exist in this part of the research, it was, in the main, attributable to the nature of the support structures existing within the different areas. For example, in one area the local authority Primary Adviser was involved in organising the trials of Science 5/13 while in another it was the local authority Science Adviser. In addition other support personnel involved varied significantly from area to area. For example in England and Wales there are more teacher centre wardens than in Scotland. This meant that the job title of the people interviewed in each area often varied. In addition areas varied in the degree to which one part of the support structure had taken the major role in providing support. In Scotland for example a great deal of help was given by Colleges of Education not only during, but also after the trials. Generally speaking this could be contrasted with the areas in England and Wales where the Advisory service worked closely with the teacher centre wardens in arranging the necessary courses: this often meant that experienced teachers (with regard to Science 5/13) were used to tutor on such courses.

The consequence of such variety between areas suggested the need for a flexible approach. It was decided that in order to deal with such variety within the support structure and at the same time maintain as similar an approach to each as possible, a list of guidelines would be drawn up as a bsis for the interviews and that these would be used with flexibility as the occasions arose.

It is maintained therefore that the strategy developed for the area visits fully incorporated the idea of variety between areas and the need to allow for this. However, adopting this approach did mean that the data collected would have to be interpreted with some caution, not only with respect to the variety of personnel interviewed but also with regard to some variation in the length of interviewing time available. The conditions for the interviews with local authority Advisers/Inspectors were similar from area to area. There was no restriction upon the time available and often the Adviser/ Inspector was seen on a number of occasions during the visit. While as a general rule headteachers, teacher centre wardens and College of Education staff were not restricted in the time available for an interview, teachers often had only a limited time to talk to the researcher either during a break or in classtime. However this variation in interview time was not considered a serious problem as the original strategy had been to interview only personnel in the support structure and generally these interviews had been conducted in sufficient depth. Additional interviews with the headteachers and teachers had arisen because the local authority Advisers/Inspectors had been extremely helpful in arranging school visits to give further insight into the 'school-side' of the research and it was felt that this often was difficult to refuse. This additional data was included as it presented further information about the schools' views, but unfortunately its inclusion gives the impression of a less rigorous approach.

The second reason highlighted for including area visits was to get a fuller understanding of how things had developed in the areas. It could be argued that the privileged position given to local authority Advisers/Inspectors and the importance attached to their explanations of developments within an area, play too dominant a part in the reports of the area visits. While it is accepted that in general the Advisers' reports were considered very important, in some areas, more specially in Scotland, importance was also attached to the information given by College of Education staff who, at times,were more directly involved. The reason for regarding the Advisers' reports as so important was that they were the people who not only appeared to have the best overall view of the situation, but also , had usually been most intimately involved with the developments of Science 5/13.

A further reason for considering the local authority Advisers/ Inspectors as important key personnel was their role as 'gate-keepers' to relevant documentary evidence, access to which was the third justification for undertaking area visits. As explained earlier in the thesis the amount of documentary evidence varied from area to area, depending upon the amount and type of support given. This was another factor which contributed to the rather uneven nature of documentary evidence gathered from the areas.

The final reason for including area visits involved a desire to achieve a greater understanding of how key personnel perceived Science 5/13. It could be argued as a possible criticism that this was not done in a consistent manner and there was a lack of detail in the evidence collected. This criticism has been touched on earlier where it was shown that it was not only difficult to deal with the areas in a uniform manner, but also, it was difficult in certain areas to gain any more detailed information either because there was little activity with Science 5/13 or little support had been provided. In the particular case of the criticism about the lack of detail in the reports given by key personnel, the researcher has some sympathy with this suggestion and recognised that taped interviews might have allowed some greater detail to be recorded : reasons for not using taped interviews have been well documented earlier in the main body of the thesis. In spite of not using taped interviews it is believed that the data collected from the local authority Advisers/Inspectors, staff at the specialist centres (like the Mathematics and Science Centre in Area 2) and staff at the Colleges of Education contained a considerable amount of information, especially in those areas where there had been developments in the post trial period. In addition because it was possible to meet Advisers/Inspectors (and sometimes other personnel) on more than one occasion the researcher was able to follow up points which had either been missed at the initial interview or had arisen from the visits around the area. It is considered that within the practical constraints of time and money, not to mention the researcher's fears of taking up too much time of important officials, it would not have been possible to spend longer working in the field, especially when one remembers the distances involved between the research institution and the areas concerned. However it is accepted that the information given by the teachers may have appeared scanty on occasions and this was often so because of the limited time teachers had available to talk to the researchers. The area visits' reports may well have appeared more consistent and less patchy without the additional information gained from personnel in the schools. As stated earlier although initially these interviews were not part of the research strategy they were included because the opportunity for them arose and it was thought a number of interesting points were raised which had not necessarily been picked up in any other way.

Section 4 : An Analysis Of, And Justification For The Claims Made From The Data Obtained

This final section examines two possible criticisms which could be made; both of which are connected with the question of validity. The first concerns the internal validity of the research and asks how far, in the context of this research, the factors, highlighted in the research findings as important for the continuation of work with the project, were correctly identified. A possible criticism which might be made is that it was not clear in the discussion earlier in the thesis how the research findings were to be interpreted. For example were the correlations which were found to be significant between the independent and dependent variables sufficient evidence to merit the conclusion that the independent variables concerned were the factors responsible for the continuation of Science 5/13?

A second criticism which might be made concerns the external validity of the research findings; that is with the question of how the results of the research might be generalised. It could be argued that in the discussion of how the research findings might be interpreted it was not made clear how the results could be generalised in the context of the type of sampling used.

1. An interpretation of the research findings was not fully discussed in terms of their internal validity.

It has been suggested earlier in this chapter when discussing the validity of the measurements made in the research that the most appropriate type of validity to be considered was construct validity. While it is accepted that a few of the research questions (such as those dealing with headteacher and teacher turnover rate) could be directly measured, the majority of the research questions were not of this type and needed to be represented by other criteria which could be measured. The criteria chosen had to be selected from a larger population of criteria using much the same process as was used when the main focus of the thesis was operationalised into the eleven research questions. It has already been outlined earlier in this chapter how available research findings and relevance of these to the particular case of Science 5/13 were used to make the selection of criteria. However it is important to remember at this stage, when one is considering the interpretation of the research findings, that these are not the only research questions which could have been asked and that these are not the only criteria or variables which could have been used to represent those factors which were not directly measureable. Hence it is acknowledged that one should be aware that although those independent variables, which did show significant correlation with the dependent variables were indicators of significant relationships, they only represented a sample of criteria or variables that might have been used and showed significant relationships. Although it is considered that the most relevant and important variables were selected (where selection was necessary) along with the most relevant research questions, a judgement is necessarily called for on the part of the researcher and it is recognised that such judgements were made. As a result the significant correlations which were found in this research must be taken simply as one more piece of evidence available to help build a possible theory.

One point which has been highlighted in this discussion is the close relationship between the validity of the measurements taken and the internal validity of the research as a whole: the rigour with which the main aim of this research was operationalised into the eleven research questions and subsequently operationalised again into the criteria needed for measurement determined the validity of the findings of the research.

2. *An interpretation of the research findings was not fully explained in terms of their external validity*

It might be argued that there was insufficient discussion, first about the exact nature of the sampling undertaken and second, about the implications of the sampling procedure in terms of how well the findings of the research might be generalised. While it is felt that the sampling procedure was explained it is accepted that the second point relating to external validity might be discussed further.

The type of sample used in this research can be described as a 'one stage cluster sample' in which all the units (in this case the trial schools within the areas used in the sample population) within the cluster have been used. The sampling of clusters was carefully stratified to reflect a variety of different circumstances : geographical position (for example urban-rural setting), school type (for example schools based on the traditional primary-secondary structure and others where middle schools were used) and the structure of the local Advisory Service/Inspectorate. It was decided, for reasons given in chapter 6 to include a higher percentage of middle schools into the sample population of trial schools.

While one is not as justified in taking the findings of this research and generalising these to the total population of trial schools as would be the case if a truly random sample of trial schools had been used it is suggested, on the basis of the stratified sample used, that the findings can be taken as a guide to the population of trial schools as a whole. However there would need to be some adjustment to allow for the inclusion of a higher percentage of middle schools into the sample population than existed in the total population. It is realised though that to extend or generalise the research findings beyond the total population of trial schools to other non-trial schools would not be possible since the population from which the sample of trial schools was chosen represented a specific grouping of schools which had been involved in the trials of the Science 5/13 project. Any attempt to use the findings from this research more generally would need to be attempted on a different basis. It would have to be on the basis of a more general conceptual or theoretical discussion in which the specific context in which the findings arose would need to be fully recognised.

Conclusion

At the beginning of this chapter it was noted that in writing a research report which was concerned largely with substantive issues, methodological concerns could receive less attention. For example it was suggested that this may lead the researcher to neglect either reporting certain methodological concerns in sufficient detail and/or outlining in full the implications of particular procedures adopted. Earlier in this chapter when validity and reliability were discussed it was accepted that these areas could have been dealt with in more detail. It is also felt that the reporting of preliminary investigations, such as details of the pilot study undertaken, were not discussed in sufficient detail.

It was also suggested at the beginning of this chapter that a retrospective look at certain methodological concerns would be of particular value. For example, while it is accepted that some mention of the influence of local authority Advisers/Inspectors upon the research should have been included earlier, it is suggested that an examination of the actual impact of the Advisers/Inspectors, as seen by the researcher, is most usefully done at the end of the research. In addition this retrospective look can allow the researcher to include new issues which have emerged since the research began some nine years ago. Broadly speaking there has been an increased interest in classroom based research compared with a more general look (as undertaken in this research) at implementation and diffusion. This raises the question of alternative strategies had the research been conducted in the mid 1980's rather than nine years ago. A strategy incorporating more classroom based research would have had the advantage of enabling the researcher to collect information directly on how the project was being implemented in the classroom. However a number of writers have pointed out that undertaking classroom based research, particularly in science, is not without its difficulties[4]. This is not the place to examine such contentions fully. The point being made is simply that if the research had been undertaken in the 1980's rather than the mid 1970's it is clear that the option of classroom based research would have been more fully considered.

Footnotes

1. Blalock, H.M. Jr., 'The Measurement Problem : A Gap Between The Languages of Theory and Research' in Blalock H.M. Jr., and Blalock A.B, Methodology in Social Research, McGraw-Hill, London, 1971, pp 5 - 27.
2. Ibid, p.24.
3. Ibid, p.24.
4. See for example: Delacote, G., 'Classroom Based Research in Science and Mathematics' in Archenhold, W.F., et al (eds) Cognitive Development Research in Science and Mathematics, The University of Leeds, 1980, pp 275-283; and, Power, C., 'A Critical Review of Science classroom Interaction Studies', Studies in Science Education, 1977, 4, pp 1-30.

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APPENDIX A : Members of the Science 5/13 Team

L F Ennever	Director	1967-73
A James	Deputy Director	1969-72
Mrs W Harlen	Evaluator	1967-73
Miss S J Parker		1967-73
D T Radford		1967-72
R Richards		1968-72
Mrs M Horn		1971-72
Mrs A M Mattock	Secretary	1967-73

Source: Harlen, W., Evaluation and Science 5/13, (Schools Council, Draft, 1973)

APPENDIX B : Science 5/13 Units

With objectives in mind

Early Experiences

Structures and forces - Stages 1 & 2

Structures and forces - Stage 3

Working with wood - Stages 1 & 2

Working with wood - Background Information

Time - Stages 1 & 2 and Background

Science from toys - Stages 1 & 2 and Background

Change - Stages 1 & 2 and Background

Change - Stage 3

Minibeasts - Stages 1 & 2

Holes, gaps and cavities - Stages 1 & 2

Metals - Stages 1 & 2

Metals, Background Information

Ourselves - Stages 1 & 2

Like and unlike - Stages 1 & 2

Children and plastics - Stages 1 & 2 and Background

Coloured things - Stages 1 & 2

Science, models and toys - Stage 3

Trees - Stages 1 & 2

Using the environment

- Volume 1 Early Explorations
- Volume 2 Investigations, Parts I and II
- Volume 3 Tackling Problems, Parts I and II
- Volume 4 Ways and Means

APPENDIX C

FORM A

QUESTIONNAIRE FOR TEACHERS INVOLVED IN THE TRIALS

OF THE SCHOOLS COUNCIL PROJECT, SCIENCE 5/13

NAME OF SCHOOL:

LOCAL AUTHORITY AREA (at the time of the trials):

NAME OF TEACHER

DATE OF TRIALS:

SECTION 1 : GENERAL INFORMATION

Q 1 How many years teaching experience did you have at the time of the trials ?
........Years

At the time of the trials did you hold a promoted post ?

YES	NO
1	0

If yes, Please give details ....

Q 2 Was your school previously involved in the trials of Nuffield Junior Science ?

YES	NO
1	0

In the space below please give the name(s) of the particular SCIENCE 5/13 Unit(s) (booklet(s)) with which you worked during the trial period.

....

....

....

Q 3 Did you have available during the trials a classroom with desk-top area, display area, and access to a sink and water ?

YES	NO
1	0

Q 4 In the space below please give the main reason(s) for starting trial work with SCIENCE 5/13

....

....

Q 5 Did you have a local teachers' centre at the time of the trials ?

YES	NO
1	0

How far away was :

(a) the local teachers' centre ....miles

(b) the nearest College of Education ....miles

(c) the nearest University ....miles

Q 6 Please give details of pre-service science training (science degree, extent of science at college, other science training etc.)

....

....

SECTION 2: INFORMATION ABOUT THE PRE-TRIAL SITUATION

Answer Q7 - Q9 inclusive ONLY if you TICKED YES for Q3

Q 7 Did you attend meetings on SCIENCE 5/13 at a local teachers' centre before the trials began in your school?

Tick the appropriate box

YES	NO
1	0

Answer Q8 and Q9 ONLY if you TICKED YES for Q 7

Please turn over for Q8

Q8. Please give details in the table below of the meetings which took place at your LOCAL TEACHERS' CENTRE BEFORE THE TRIALS BEGAN. An example is given for guidance.

Total Number of Meetings	Length of time each meeting took on average (Express in hours)	Total period over which all meetings extended (Express in weeks)	Main aim(s) of the meeting(s)	TICK THE APPROPRIATE BOX: Type of "activity" involved in the meetings — Discussion	Instruction	Demonstration	The use of discovery methods by you yourself in practical situations	Other (Please give details)	Organiser of the meeting(s): (i) Local authority adviser/organiser/inspector (1)	(ii) Other person(s) (Please give details)
				1	2	3	4	5	6	7
4	2 Hrs	8 Wks	1. To introduce "Minibeasts" to teachers who would use it in the trials	✓	✓	✓	✓		✓	

NOTE: (1) In some areas the local authority adviser is referred to as an organiser or local authority inspector.

Q 9 Using the 4 POINT SCALE given below please indicate how useful the PRE-TRIAL MEETINGS AT THE LOCAL TEACHERS' CENTRE were to you in the teaching of SCIENCE 5/13 during the trials.

4 POINT SCALE:

VERY USEFUL	FREQUENTLY USEFUL	OCCASIONALLY USEFUL	NOT USEFUL
1	2	3	4

TICK THE MOST APPROPRIATE BOX			
VERY USEFUL 1	FREQUENTLY USEFUL 2	OCCASIONALLY USEFUL 3	NOT USEFUL 4

Q 10 Did you attend any other kind of local meetings on SCIENCE 5/13 before the trial period (e.g. school based discussion groups, meetings of local teachers at a near-by College of Educa tion, etc.)?

YES	NO
1	0

Answer Q11 and Q12 ONLY if you TICKED YES to Q10

Please turn over for Q11

EXAMPLE

Q11 Please give details in the table below about any other kind of local meetings on Science 5/13 which took place BEFORE THE TRIALS BEGAN (eg school based discussion groups, meetings of local teachers at a near-by college of education etc). A fictitious example is given for guidance.

Location of Meeting	Total number of meetings at a particular location	Length of time each meeting took on average (Express in hours)	Total period over which all meetings extended if more than 1 (Express in weeks)	Main aim(s) of the meetings	TICK THE APPROPRIATE BOX (S): Type of "activity" involved in the meeting(s): Discussion	Instruction	Demonstration	The use of discovery methods by you yourself in practical situations	Other (Please give details)	Organiser of the meeting(s): Local authority/ adviser/organiser inspector [1]	Other (Please give details)	Type of meeting: Residential	Non-Residential
1. Bath College of Education	1	3 hrs	—	(1) To introduce the unit METALS before use in the trials	√	√	√	√	—		College of Education Staff		√
2.													
3.													
4.													
					1	2	3	4	5	6	7	8	9

NOTE: [1] See page 4 for further details

Q 12 Using the 4 POINT SCALE given in Q9 please indicate how useful the PRE-TRIAL MEETINGS YOU LISTED IN Q11 were to you in teaching SCIENCE 5/13 during the trials.

	Please insert the number quoted in Q11.	TICK the most appropriate box. Very Useful 1	Frequently useful 2	Occasionally useful 3	Not useful 4
EXAMPLE	1		✓		

Q 13 Did you attend any NATIONAL MEETINGS [1] in connection with SCIENCE 5/13 before the trials?

Tick appropriate box

YES	NO
1	0

Answer Q14 and Q15 ONLY if you answered YES to Q13

Note: 1. These are meetings where you met people from other parts of Great Britain.

Q14 Please give details in the table below of any NATIONAL COURSES which you attended, in connection with SCIENCE 5/13, before the trials. A ficticious example is given for guidance.

Location of meeting	Date (give month & year	Length of time the meeting extended over (express in days)	Organiser(s) of the meeting	Other personnel besides teachers at the course.	Main aim(s) of the meeting.	TICK THE APPROPRIATE BOX(S): Type of "activity" involved in the meeting(s): Discussion	Instruction	Demonstration	The use of discovery methods by yourself in the practical situation	Other (Please give details)	Type of meeting: Residential	Non-Residential
						1	2	3	4	5	6	7
EXAMPLE 1. Liverpool University	4:71	4 days	SCIENCE 5/13 team	Colleges of Education Staff and Advisers	(i) To examine the philosophy of SCIENCE 5/13. (ii) To review the units produced to date							
2.												
3.												
4.												

NOTE: 1 See page 7 for details.

Q 15 Using the 4 POINT SCALE given in Q9 please indicate how useful the PRE-TRIAL MEETINGS YOU LISTED IN Q14 were to you in teaching SCIENCE 5/13 during the trials.

	Please insert the number quoted in Q14	TICK the most appropriate box.			
		Very Useful 1	Frequently useful 2	Occasionally useful 3	Not useful 4
EXAMPLE	1		✓		

Tick the appropriate box

Q16 Did you become involved in any other way not mentioned on this questionnaire form so far with a near-by College of Education in connection with SCIENCE 5/13 before the trials began in your school?

YES	NO
1	0

Answer Q17 ONLY if you TICKED YES to Q16

Q17 Please give details in the space below as to how you became involved with this College of Education

....

....

....

....

Tick the appropriate box

Q18 Did you become involved in any other way not mentioned on this questionnaire form so far with a near-by University in connection with SCIENCE 5/13 before the trials began in your school?

YES	NO
1	0

Answer Q19 ONLY if you TICKED YES to Q18

Q19 Please give details in the space below as to how you became involved with this University.

Please turn over for SECTION 3

SECTION 3: INFORMATION ABOUT THE TRIALS THEMSELVES

Q20 Using the table below, indicate (by TICKING the appropriate box(s) the number of visits made to you by various people DURING THE TRIAL PERIOD.

TICK the most appropriate box

Number of times during the trial period when visits were made by the following people in connection with SCIENCE 5/13	NONE	1-5	6-10	More than 10 times
(i) SCIENCE 5/13 team members				
(ii) Advisory staff in your area				
(iii) H.M.Is.				
(iv) College of Education Staff.				
(v) Others (please give details)				
	0	1	2	3

Q21 Using the table below, indicate by TICKING the appropriate box(s) the aim, in your view, of the visits made by the following people to you during the trial period.

	AIM OF VISIT BY THE FOLLOWING PEOPLE					
	TICK, the appropriate box(s)					
	To provide materials e.g.books	To give advice on the method of SCIENCE 5/13	To give advice on the content of SCIENCE 5/13	To monitor progress	To give encour-agement	Other
(i) SCIENCE 5/13 team members						
(ii) Advisory staff in your area						
(iii) H.M.I'S						
(iv) College of Education staff						
(v) Other (Please give details)						
	1	2	3	4	5	6

Q22 Using the 4 POINT SCALE given in Q9 please indicate how useful the visits which you ticked in Q20 were to you in your teaching of SCIENCE 5/13 DURING THE TRIAL PERIOD.

	TICK the most appropriate box			
	Very Useful 1	Frequently Useful 2	Occasionally Useful 3	not Useful 4
(i) SCIENCE 5/13 team members				
(ii) Advisory staff in your area				
(iii) College of Education Staff				
(v) Others (Please give details)				

Q23 Did you attend meetings on SCIENCE 5/13 at a local teachers centre during the trials in your area.

Tick the appropriate box

YES	NO
1	0

Answer Q24 and Q25 ONLY if you TICKED YES for Q23

Q24 Please give details in the table below of the meetings which took place at your LOCAL TEACHERS' CENTRE DURING THE TRIALS. An example is given for guidance.

Total Number of Meetings	Length of time each meeting took on average (Express in hours)	Total period over which all meetings extended (Express in weeks)	Main aim(s) of the Meeting(s)	TICK THE APPROPRIATE BOX						
				Type of "activity" involved in the meeting(s).					Organiser of the meeting(s)	
				Discussion	Instruction	Demonstration	The use of discovery methods by you yourself in practical situations.	Other (Please give details)	(i) Local authority adviser/organiser/inspector [1]	(ii) Other person(s) (Please give details)
4	2hrs	8wks	1. To introduce the unit "Minibeasts" to teachers who would use it in the trials.							
				1	2	3	4	5	6	7

NOTE. 1 In some areas the local authority adviser is referred to as an organiser or local authority inspectors.

Q25 : Using the 4 POINT SCALE given below please indicate how useful those meetings at your local teachers centre mentioned in Q24 were to you in the teaching of SCIENCE 5/13 during the trials.

4 POINT SCALE:

VERY USEFUL	FREQUENTLY USEFUL	OCCASIONALLY USEFUL	NOT USEFUL
1	2	3	4

	TICK THE MOST APPROPRIATE BOX		
VERY USEFUL 1	FREQUENTLY USEFUL 2	OCCASIONALLY USEFUL 3	NOT USEFUL 4

Q26 Did you attend any other kind of local meetings on SCIENCE 5/13 during the trial period (e.g. school based discussion groups, meetings of local teachers at a near-by College of Education etc.)?

YES	NO
1	0

Answer Q27 and Q28 ONLY if you TICKED YES to Q26

Q27 Please give details in the table below about any other kind of local meetings on SCIENCE 5/13 which took place DURING THE TRIALS (if school based discussion groups, meetings of local teachers at a near-by College of Education etc.) A ficticious example is given for guidance.

EXAMPLE 15

Location of Meeting	Total number of Meetings at a particular location.	Length of time each Meeting took on average (Express in weeks)	Total period over which all meetings extended if more than 1. (express in weeks)	Main Aim(s) of Meetings.	TICK THE APPROPRIATE BOX(S)								
					Type of "activity involved in the meeting(s)					Organiser of the Meeting(s)		Type of Meeting	
					Discussion	Instruction	Demonstration	The use of discovery methods by you yourself in practical situations.	Other (please give details)	Local Authority Adviser/Organiser/Inspector.[1]	Other (Please give details)	Residential	Non-Residential
1. Bath College of Education	1	3hrs	/	(i) To introduce the unit Metals before use in the trials	✓	✓	✓	✓	/		College of Education Staff.		✓
2.													
3.													
4.													
					1	2	3	4	5	6	7	8	9

NOTE: 1 See page for further details.

Q28 Using the 4 POINT SCALE given in Q9 please indicate how useful the meetings mentioned in Q27 were to you in teaching SCIENCE 5/13 during the trials.

	Please insert the number quoted in Q27	TICK the most appropriate box			
		Very Useful 1	Frequently Useful 2	Occasionally Useful 3	Not Useful 4
EXAMPLE	1		✓		

Q29 Did you attend any NATIONAL MEETINGS [1] in connection with SCIENCE 5/13 during the trials?

Tick the appropriate box

YES	NO
1	0

Answer Q30 and Q31 ONLY if you TICKED YES to Q29

NOTE: See page 7 for details.

Q30 Please give details in the table below of any NATIONAL COURSES which you attended in connection with SCIENCE 5/13 during the trials. An example is given for guidance.

EXAMPLE

Location of meeting	Date. (give month & year	Length of time the meeting extended over (express in days)	Organiser(s) of the meeting.	Other personel besides teachers at the course.	Main aim(s) of the meeting	TICK THE APPROPRIATE BOX(S): Type of "activity" involved in the meeting(s): Discussion	Instruction	Demonstration	The use of discovery methods by yourself in the practical situation	Other (Please give details)	Type of meeting: Residential	Non-Residential
1. Liver-pool Univ-ersity	4:71	4 days	SCIENCE 5/13 Team	College of Education Staff & advisers.	(i) To examine the philosophy of SCIENCE 5/13. (ii) To review the units produced to date							
2.												
3.												
4.												
						1	2	3	4	5	6	7

NOTE: 1 See page 7 for details.

Q31 Using the 4 POINT SCALE given in Q9 please indicate how useful the NATIONAL COURSES YOU LISTED IN Q30 were to you in teaching SCIENCE 5/13 during the trials

	Please insert the number quoted in Q 30	TICK the most appropriate box			
		Very Useful 1	Frequently Useful 2	Occasionally Useful 3	Not Useful 4
Example	1			√	

Q32 - 35 inclusive involve the 4 POINT SCALE mentioned earlier in Q9

Q32 How useful to you was that section of the unit dealing with the Teachers Background Information in teaching SCIENCE 5/13?

Very Useful 1	Frequently Useful 2	Occasionally Useful 3	Not Useful 4

Q33 How useful to you was that section of the unit dealing with OBJECTIVES in teaching SCIENCE 5/13?

Very Useful	Frequently Useful	Occasionally Useful	Not Useful

Q34 How useful was the unit generally in helping you undertake more activities involving Science?

Very Useful	Frequently Useful	Occasionally Useful	Not Useful

Q35 How useful was the unit generally in helping you to develop in the children you were teaching, an "enquiring mind"?

Very Useful	Frequently Useful	Occasionally Useful	Not Useful

Q36 Outline the main changes which you thought necessary so as to make the unit with which you were working more useful to teachers.

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Q37 Tick the most appropriate box

	0-5%	5-10%	10-20%	20-40%	40-60%	60-80%	Over 80
% time during the trials spent on teaching SCIENCE 5/13 relative to whole teaching load. (consider an average week)							
	1	2	3	4	5	6	7

Q38 Tick the most appropriate box

	0-5%	5-10%	10-20%	20-40%	40-60%	60-80%	Over 80%
% time during the trials spend on teaching SCIENCE 5/13 relative to the total amount of Science taught. (consider an average week)							
	1	2	3	4	5	6	7

Q39 Tick the most appropriate box(s)

	Active Discovery Methods 1	Teacher-Directed Activities 2	Formal Method 3
Type of teaching method used with the class during the trials of SCIENCE 5/13			

Answer Q40 ONLY if you TICKED more than 1 box in Q39.

Q40 TICK the most appropriate box.

	Active Discovery Methods 1	Teacher-Directed Activities 2	Formal Method 3
Which method did you use most often in your work with SCIENCE 5/13 during the trials.			

Q41 Was your teaching method different when teaching SCIENCE 5/13 than when you were teaching other areas of the curriculum?

Tick the appropriate box

YES	NO
1	0

Q42 If your general teaching method was different when dealing with SCIENCE 5/13 compared with teaching other material please give details of how it differed.

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Tick the appropriate box

Q43 Did you find that working with SCIENCE 5/13 changed your approach to teaching science?

YES	NO
1	0

Q44 If your approach to teaching science did change, please give details in the space below of the type of changes that took place.

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Tick the appropriate box

Q45 Did you find that working with SCIENCE 5/13 changed your approach to teaching in general?

YES	NO
1	0

Q46 If your approach to teaching in general changed, please give details in the space below of how your approach changed.

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Q47 AND 48 ARE ONLY FOR THOSE TEACHERS WHO USED MORE THAN ONE UNIT (BOOKLET) IN ANY GIVEN SET OF TRIALS.

Tick the appropriate box

Q47 Did you complete the material from one unit before beginning on a new unit?

YES	NO
1	0

Q48. Briefly explain in the space provided below why you used one unit at a time or not.

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Please turn over for SECTION 4

SECTION 4: POST-TRIAL INFORMATION

Tick the appropriate box

Q49 Did you continue using SCIENCE 5/13 directly after the trials ended?

YES	NO
1	0

Q50 Please give details in the space below as why you either continued or not with SCIENCE 5/13 after the trials.

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Answer Q51 ONLY if you TICKED YES to Q50

Q51 How many years have you been teaching along SCIENCE 5/13 lines since the trials?

---------- Years

Q52 Please list in the space below the units used in the post-trial period.

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Tick the appropriate box

Q53 Did you ever use your own ideas and teach these along SCIENCE 5/13 lines?

YES	NO
1	0

Answer Q54 ONLY if you TICKED YES to Q53

Q54 Please give details in the space below as why you used your own ideas rather than those suggested in the SCIENCE 5/13 units (booklets).

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Q55 Are you still employed at the trial school

YES	NO
1	0

FORM B

QUESTIONNAIRE TO COLLECT POST-TRIAL INFORMATION ON THE SCHOOLS COUNCIL PROJECT SCIENCE 5/13

NAME OF SCHOOL:

SECTION 1: INFORMATION FROM HEADTEACHER

Q1 Were you the Headteacher of this school for the complete period over which the trials of SCIENCE 5/13 were conducted?

TICK the appropriate box

Yes	No
1	0

Answer Q2 only if you ticked NO for Q1

Q2 If possible can you give details below of the Headteacher changes which have taken place in your school since the trials began.

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Q3 Please complete the table below to give details of any changes which have occurred in your school since the trial period of SCIENCE 5/13.

Have there been changes in any of the following?	TICK the appropriate box	
	Yes (If ticked please give details of the change involved) 1	No 0
1. Type of school (ie Is the school still a Junior/ Middle/Comprehensive etc type school?)		
2. School Catchment Area (where catchment area can be thought of in terms of urban/ suburban/rural)		
3. School Building (eg Has the school moved into a new building or had an extension built?)		
4. General Environment directly around the school (eg Changes in the number of trees, green areas, new building schemes etc)		

Q3 continued

Have there been changes in any of the following	TICK the appropriate box	
	Yes (give details) 1	No 0
5. Type of intake of children in terms of, (a) numbers		
(b) ability range		
(c) the type of background of the children (where background may be considered in terms of prosperous, average or disadvantaged)		
6. Ability Grouping of the children within the school (where ability groupings may be considered in terms of streamed/partially streamed/mixed ability classes)		

Q4 (a) Did your school continue using SCIENCE 5/13 directly after the trials were over ?

TICK the appropriate box

Yes	No
1	0

(b) If you continued , how was it used (ie. as a resource, the basis for a science course etc.).

(c) If you did not continue, why did you stop ?

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....

Q5 (a) Is your school using SCIENCE 5/13 now ?

TICK the appropriate box

Yes	No
1	0

Answer Q6 - 9 inclusive ONLY if you TICKED YES to Q4

Q6 Is your school still using SCIENCE 5/13 ?

TICK the appropriate box

Yes	No
1	0

Answer Q7 ONLY if you TICKED NO to Q6

Q7 Please give details in the space below of the main reason(s) for stopping work with SCIENCE 5/13

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Q8 Please complete the table below giving details about the various teachers in your school who have been involved with SCIENCE 5/13 since the trials ended.

Name of teacher	Forwarding address (if known) if teacher is no longer at your school	Length of time over which teacher worked with SCIENCE 5/13 after the trials (Express in years)

Q9 Please list in the space below the SCIENCE 5/13 units (booklets) with which teachers in your school worked after the trials.

Q10 Do you consider that SCIENCE 5/13 is a valuable project for use in your school?

TICK the appropriate box

Yes	No
1	0

Q11. Please give details in the space below as to the main reason(s) why you consider SCIENCE 5/13 a valuable project or not for your particular school.

SECTION 2: INFORMATION FROM POST-TRIAL TEACHER

Q1 Please complete the table below giving details about the SCIENCE 5/13 unit(s) (booklet(s)) with which you worked after the trials finished.

Name of Unit	Length of time used for (Express in years)
1.	

Q2 Please complete the table below giving details of (a) the age-group, (b) the ability range, and (c) the type of ability grouping, of the classes with which you have used SCIENCE 5/13 since the trials. An example is given for guidance.

	A) AGE GROUP		B) ABILITY RANGE		C) TYPE OF ABILITY GROUPING OF CLA[SS] TICK the appropriate box		
	Age at beginning of school year (average)	Spread of ages within the class (Express in years and months)	Lowest IQ in the class	Highest IQ in the class	STREAMED (Please give details eg top, bottom etc)	PARTIALLY STREAMED	MIXED ABILITY
Example	10.5	9 months	80	110			✓
					1	2	3

Q3 Please complete the table below giving details of the type of "working environment" in operation during the teaching of SCIENCE 5/13 since the trials. An example is given for guidance.

	Details of how the classroom is arranged eg furniture, displays etc	% time in classroom	% time in school building but outside classroom	% time outdoors in school grounds	% time outdoors outside school grounds
EXAMPLE	Desks are arranged in groups of 4–6 facing inwards and the various groups are distributed fairly evenly throughout the room. One wall is available for display work and this is generally well-covered. We have a sink in one corner of the room, and a library area in another corner.	70%	10%	10%	10%
		1	2	3	4

Q4 Please complete the table below giving details of the pre-service training with respect to science.

TICK the appropriate box(s)					
Science degree	Science as main subject in College Course	Science as a 2-year study in College Course	Science as a 1-year study in College Course	Other science training (PLEASE GIVE DETAILS)	No Science in initial training
1	2	3	4	5	6

[redacted]

Q5 Please complete the table below to indicate whether your pre-service training included work with certain science projects. An example is given for guidance.

TICK the appropriate box(s)

	Pre-service training involved a consideration of		
	A) SCIENCE 5/13	B) NUFFIELD JUNIOR SCIENCE PROJECT	C) OTHER SCIENCE PROJECTS (Please give details)
EXAMPLE	✓	✓	
	1	2	3

Main aim(s) of course/ meeting(s)	Date(s) of meeting(s) (month and year)	Total period over which all meetings extended if it was a series of meetings (Express in months)	Length of meeting where more than 1 day at any one time (Express in days)	TICK THE APPROPRIATE BOXES																	
				Location					Type of Meeting				Organiser					Usefulness of the meeting to you in teaching science-based activities			
				Local teachers centre	College of Education	University	School-based meeting	Other (Please give details)	National[1]	Local	Residential	Non-residential	Local Authority Adviser[2]	College of Education staff	University staff	Teacher(s)	Other (Please give details)	Very Useful	Frequently useful	Occasionally useful	Not useful
To investigate "discovery methods" in the primary school	4/74		3 days		✓				✓		✓			✓					✓		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

NOTE: 1 This refers to the type of course where you meet teachers from other areas in Great Britain
2 The appropriate term in some areas is organiser or local authority Inspector

Q7 Please complete the table below giving details of the various meetings on SCIENCE 5/13 both nationally [1] and locally which you have attended since the ending of the trials

Main aim(s) of course/ meeting(s)	Date(s) of meeting(s) (month and year)	Total period over which all meetings extended if it was a series of meetings (Express in months)	Length of meeting where more than 1 day at any one time (Express in days)	TICK THE APPROPRIATE BOXES																	
				Location					Type of Meeting				Organiser					Usefulness of the meeting to you in teaching science-based activities			
				Local teachers centre	College of Education	University	School-based meeting	Other (Please give details)	National	Local	Residential	Non-residential	Local Authority Adviser	College of Education staff	University staff	Teacher(s)	Other (Please give details)	Very useful	Frequently useful	Occasionally useful	Not useful
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

NOTE: 1 See page 10 for details

Q8 Please complete the table below giving details of the type of help received on SCIENCE 5/13 since the trials ended.

Did you receive help from any of the following?	TICK the appropriate Box		If YES please give details in the space below
	Yes	No	
1. SCIENCE 5/13 project team (this includes literature sent)			
2. Local advisory service[1]			
3. H M Inspectorate			
4. College of Education Staff			
5. University Staff			
6. Staff within your school			
7. Other (Please give details)			
	1	0	

NOTE: 1 See page 10 for details

Q9 Please complete the table below to indicate how useful you considered the post-trial help received from the various agencies listed in Q8 to you in your teaching of SCIENCE 5/13 after the trials. (Please leave blank if no help received).

Agency giving help	TICK the appropriate box			
	Very Useful 1	Frequently Useful 2	Occasionally Useful 3	Not Useful 4
1. SCIENCE 5/13 project team				
2. Local advisory service				
3. H M Inspectorate				
4. College of Education Staff				
5. University Staff				
6. Staff within your school				
7. Other (Please give details)				

Q10 If you had received more support after the trials do you think that you would have undertaken more work on SCIENCE 5/13?

TICK the appropriate box

Yes	NO
1	0

Answer Q11 only if you TICKED YES for Q10

Q11 Please complete the table below to indicate the type of help which you think would have been most useful to you in the post-trial period.

Do you consider that the following type of help would have been useful?	TICK the appropriate box		
	YES	NO	DON'T KNOW
1. Meetings to introduce new[1] SCIENCE5/13 units (booklets).			
2. Meetings to go over problems which might arise when trying our a new unit			
3. Visits to your classroom by persons with some expertise in SCIENCE 5/13 to give advice			
4. General encouragement			
5. Other (Please give details)			
	1	0	2

1 By "new" is meant units with which you are unfamiliar

Q12 Did you make any contacts with teachers in other near-by schools as far as SCIENCE 5/13 was concerned?

TICK the appropriate box

Yes	No
1	0

Answer Q13 and Q14 ONLY if you TICKED YES for Q12

Q13 Please give details of how such contacts developed

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Q14 Do you consider that this contact was useful to the teaching of SCIENCE 5/13?

TICK the appropriate box

Yes	No
1	0

Q15 Do you consider that this contact was useful to teaching generally?

TICK the appropriate box

Yes	No
1	0

Q16 Please give details in the space below as to why you undertook post-trial work with SCIENCE 5/13 (for example, was it because you a) had done work, b) were influenced by the Head or another teacher, c) attended a course, etc)

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Q17 Are you still undertaking work with SCIENCE 5/13?

TICK the appropriate box

Yes	No
1	0

Answer Q18 ONLY if youTICKED NO to Q17

Q18 Please give details in the space below as to why you are no longer teaching SCIENCE

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Q19 Please complete the table below giving details of the type of time-table you followed when teaching SCIENCE 5/13 in the post-trial period.

TICK the appropriate box			
Type of time-table followed			
a) Fully Integrated 1	b) Block of time for subject areas 2	c) Short Set Periods 3	d) Other (Please give details) 4

Q20 Please complete the table below giving details of the TEACHING METHOD you used in the post-trial period for a) activities concerned with SCIENCE 5/13 and b) teaching generally.

TICK the appropriate box(s)					
A) Teaching Method for SCIENCE 5/13			B) Teaching Mehtod generally		
Active Discovery Methods	Teacher Directed Activities	Formal Method	Active Discovery Method	Teacher Directed Activities	Formal Method
1	2	3	4	5	6

Q21 Did you find that your teaching method with regard to science based activities changed at all after teaching SCIENCE 5/13 in the post-trial period?

TICK the appropriate box

Yes	No

Answer Q22 ONLY if you TICKED YES to Q21

Q22 Please give details in the space below as to how your teaching method with regard to science based activities did change.

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Q23 Did you find that yourteaching method with regard to teaching generally changed at all after teaching SCIENCE 5/13 in the post-trial period?

TICK the appropriate box

Yes	No

Answer Q24 ONLY if you TICKED YES to Q23

Q24 Please give details in the space below as to how your teaching method generally changed.

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Q25 Considering an average week, what % of all teaching was generally devoted to work on SCIENCE 5/13? (If the % varied from unit to unit please give details).

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Q26 Did you find that as work with SCIENCE 5/13 progressed during the post-trial period, the % of time allocated to SCIENCE 5/13 increased <u>or</u> decreased <u>or</u> remained constant? (If the answer varies according to the unit used please give details where possible).

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Q27 Considering an average week, what % of science taught was generally devoted to work on SCIENCE 5/13? (If the answer varies according to the unit used, please give details).

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Q28 Did you find that as you became more familiar with SCIENCE 5/13 the amount of preparation time decreased <u>or</u> increased <u>or</u> remained constant? (If the answer varies according to the unit used, please give details).

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Q29 <u>Please complete the following grid to indicate if you either did or did not become more confident in certain aspects as you taught SCIENCE 5/13 in the post-trial period</u>.

	<u>TICK</u> the appropriate box		
	Became more confident 2	Did not increase or decrease in confidence 1	Became less confident 0
1. To bring science into my work			
2. To use "objectives" in science-based teaching			
3. To use "objectives" generally			

Q30 Please complete the following grid to indicate if you found "teaching by objectives" useful for a) teaching science based activities and b) teaching generally in the post-trial period.

	TICK the appropriate box	
	Found objectives useful 1	Did not find objectives useful 0
a) For teaching science-based activities		
b) For teaching generally		

Q31 In the space below please give reasons for the use or non-use of objectives.

Reasons for use of objectives	Reasons for non-use of objectives

Q32 Did you try out your own ideas for topics along SCIENCE 5/13 lines in the post-trial period?

TICK the appropriate box

Yes	No
1	0

Q33 Please give details in the space below as to why you did or did not use your own ideas for topics along SCIENCE 5/13 lines.

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Answer Q34 ONLY if you TICKED YES for Q32

Q34 Please give details in the space below of the type of topics covered.

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APPENDIX D : Guidelines for Interviews

Local Authority Adviser/Inspector

1. Role in relation to the trials and the post trial period
2. Views about the progress of Science 5/13 in the trial schools during the trial period (including pre-trial preparations). The following points were given special attention :
   - (a) Type of support available to trial teachers and schools generally e.g. visits; courses (national and local); meetings between schools; equipment etc
   - (b) Progress in the trial schools during this period
   - (c) Factors affecting the progress of Science 5/13 in the trial schools during this period e.g. attitude of teachers to the materials.
3. Views about the progress of Science 5/13 in the trial schools in the post trial period. The following points were given special attention
   - (a) Type of support available to trial teachers and schools generally e.g. visits, courses and meetings.
   - (b) Progress in the trial schools during this period.
   - (c) Factors affecting the progress of Science 5/13 in the trial schools in this period, including for example:
     - (i) local authority policy decisions;
     - (ii) competition from other innovations;
     - (iii) constraints, e.g. restricted time available to local authority Adviser/Inspector to concentrate on primary science after the trials, headteacher and teacher attitude towards Science 5/13 and science generally, effect of educational cuts etc.

APPENDIX D (continued)

(d) Development work connected with Science 5/13

4. Names of key personnel and institutions involved (a) during the trials and (b) in the post trial period and details of how these linked together. (Much of this should appear in sections 1 and 2 earlier).

5. Location of documentary evidence and permission to examine relevant documents.

Other key personnel

Other key personnel included College of Education staff, staff at specialist centres such as the Maths and Science Centre in area 2 and the Science Centres in area 4. teachers' centre wardens, H M Inspectorate and area representatives (they acted as a link between the local education authority and the central Science 5/13 team and on occasions were the local authority Adviser /Inspector responsible for Science 5/13, but on other occasions they were a headteacher in one of the trial schools). The guidelines described earlier for the local authority Adviser/Inspector interviews were used as a basic outline for interviews with other key pernonnel but because their role in the support system had often been more specific (for example staff at the specialist centres dealt essentially with courses for teachers) some sections of the guidelines were more relevant than others.