centre
for
educational
research
and
innovation

EDUCATIONAL TECHNOLOGY

THE DESIGN AND IMPLEMENTATION OF LEARNING SYSTEMS

OECD

.

אַל
הֵר-12.רח

EDUCATIONAL TECHNOLOGY

THE DESIGN AND IMPLEMENTATION OF LEARNING SYSTEMS

This report is based on the work of CERI
in the field of educational technology,
and on the results of a workshop on
" Educational Technology – Strategies for Implementation".
The workshop was organised by CERI
in conjunction with the British, Dutch, German and
Swedish Authorities at Leiden, Netherlands,
from 19th to 25th April, 1970.

The Organisation for _ _ . ion and Development (OECD), which was set up unaei _ _ _nvention signed in Paris on 14th December, 1960, provides that the OECD shall promote policies designed:

— to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries, while maintaining financial stability, and thus to contribute to the development of the world economy;

— to contribute to sound economic expansion in Member as well as non-member countries in the process of economic development;

— to contribute to the expansion of world trade on a multilateral, non-discriminatory basis in accordance with with international obligations.
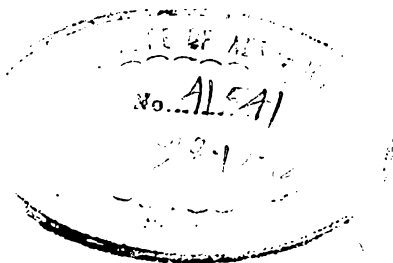
The Members of OECD are : Australia, Austria, Belgium, Canada, Denmark, Finland, France, the Federal Republic of Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

The Centre for Educational Research and Innovation was established in June 1968 for an initial period of three years, with the help of a grant from the Ford Foundation which was later supplemented by a grant from the Shell Group of Companies.

The main objectives of the Centre are as follows:

— To promote and support the development of research activities in education and undertake such research activities where appropriate;

— To promote and support pilot experiments with a view to introducing and testing innovations in educational systems;

— To promote the development of co-operation between Member countries in the field of educational research and innovation.

The Centre functions as part of the structure of the Organisation for Economic Co-operation and Development, under the responsability of the Council of the Organisation and the Secretary-General. It is supervised by a Governing Board of independent personalities appointed by the Secretary-General, in their individual capacities.

CONTENTS

PART I

EDUCATIONAL TECHNOLOGY
THE NATURE AND DESIGN OF LEARNING SYSTEMS

Chapter 1

Chapter 2

Chapter 3

Chapter 4

PART II

WHERE AND HOW TO START
TOWARDS A STRATEGY OF IMPLEMENTATION

Chapter 5

Chapter 6

Chapter 7

APPENDICES

'

PREFACE

In a period when technology has performed such wonders, it is perhaps to be expected that "educational technology" has the magic appeal of a solution to the crowded classrooms, shortages of teachers, continuing education for adults, and so on. The simple lesson of this report is that there is no technological miracle in education. Neither the television camera, nor the computer, nor programmed learning can provide "instant" education. Instead, educational technology has to be seen as part of a persistent and complex endeavour of bringing pupils, teachers, and technical means together in an effective way. Educational technology is not a bag of mechanical tricks, but the organised design and implementation of learning systems taking advantage of, but not expecting miracles from, modern communications methods, visual aids, classroom organisation and teaching methods.

This perspective, however, should not be allowed to cloud the fact that new conditions and opportunities are emerging which justify the preoccupation of OECD countries with the phenomenon of educational technology. The vast commitments of resources to educational growth make absolutely indispensable a more systematic search for new and effective ways of organising the teaching process. New methods of visual and oral communication call for exploitation in the classroom — if not, the child will learn more outside the classroom than within its four walls. The organisation of the education process in the school itself is being transformed in many countries by "individualised learning", team teaching, and the like — the teacher begins to look like a professional manager. The system as a whole must respond to the rapid growth of educational products developed by private firms for sale in the educational market.

All these developments call for a response from educational authorities in the OECD countries. The Leiden Seminar had as its purpose to give meaning to the concept of educational technology, to clarify trends, and to suggest possible policies for dealing with them. The suggestions and recommendations of the Seminar are contained in Part II of the report.

The Secretariat acknowledges with thanks that the Netherlands not only acted as the host country, but also contributed generously both financially and organisationally through the "Stichting voor Onderzoek van het Onderwijs" in The Hague.

J. R. GASS
Director,
Centre for Educational
Research and Innovation.

EDITORIAL NOTE

In adopting the title of workshop for the Leiden conference CERI intended more than a salute to fashionable terminology. Instead of listening to lectures in plenary sessions the members were asked to hammer out in small groups the issues and implications of a systematic approach to learning. Many of these were set out in background papers prepared beforehand partly by staff and partly by outside experts.

As reflected in the two parts of the report the groups considered first the principles underlying innovation, and later the problems of applying these principles in practice. For this purpose the groups were reconstituted in the middle of the week to take the best advantage of the specialist interests and knowledge of the participants. In some cases the groups produced draft chapters de novo: in others the background papers were amended.

Having had uniquely the privilege of observing the groups in turn, I wish to pay a tribute to their passionate concentration on their tasks, to their tolerance of my presence and above all to the devotion of the group chairmen who frequently laboured late into the night to provide the material without which this report could not have been produced.

Apart from this general tribute, I must express my gratitude to particular members: to Mr. L. C. Taylor who is the virtual author of Chapter 1: to Mr. E. Wallin whose background paper is the basis of the first part of Chapter 2: to Dr. K. Hinst of CERI who not only supplied the two background papers upon which Chapter 4 is based but who also contributed immensely both to the professional and social aspects of the workshop by his organisational expertise and by his good humour: and finally to Mr. R. A. Becher both for compiling Chapter 5 and for his invaluable co-operation in conjunction with Dr. Hinst in editing this report.

NOTE ON TERMS USED:

Although an attempt has been made in the chapters that follow to avoid technical language, the use of some terms unfamiliar to the layman, or familiar to him in a different context, is inevitable. Consequently some guidance to a small number of terms, where their meaning is not clear from the text, is desirable.

The idea of a *systematic approach* to the teaching-learning process has already been mentioned and the reader is urged not to equate it uncritically with the procedure of *systems analysis*. The variables operating in education cannot be rigidly controlled as they can be in industry and therefore systems analysis is not directly applicabe. A systems-analogous or systematic study of what occurs in the teaching-learning process — what the

teacher does, how the child reacts, aims and objectives and the result — is, however, feasible and indeed essential for the promotion of effective learning. Chapter 4 is concerned with describing this systematic study in more detail.

As Chapter 1 shows, *learming systems* can take several forms. Sometimes they are complete courses covering the whole of a topic and using several media. Another form is the *core course* which provides the basic materials and ideas for the study of a topic while leaving the teacher free to amplify it in accordance with his own ideas. In either case the system may consist of a *package* of materials intended for the use of individual learners.

Since the teaching-learning process does not take place in vacuo, a systematic approach must take into account all the factors that affect the attitudes of the child, the teacher, the parent, the politician, the general public and the administrator towards what takes place in school. These factors, termed *frame factors,* are identified and discussed in Chapter 4.

George TAYLOR,

*Editor, and Rapporteur
of the Workshop.*

INTRODUCTION

The past twenty years have witnessed the development of new means of communication which have exerted a tremendous influence on professional behaviour and leisure time; although still regarded with some suspicion by the older generation, the various media have become to the younger generation part of their way of life. Education, although essentially a form of communication, has been the undertaking least affected in its mode of operation by recent developments. It is not surprising, therefore, that to the majority concerned with education, educational technology implies little more than gimmickry and gadgetry (and expensive at that) — a fringe activity peripheral to the real task of education. One reason for this attitude may be found in the promotional methods of some producers who oversell their equipment. The main factor, however, is the failure on the part of educators to appreciate that new means of communication require a radical review of the teaching-learning process.

The purpose of this report is to urge the need for a systematic study of the process and for a review of the effects of integrating modern media and technological aids into the work of schools and colleges. Study of the process and the place of new media cannot proceed separately since if the latter affects the former — for example, by a change in the balance of activity between teacher and learner — then the whole process must be looked at afresh.

Contemporary factors other than the emergence of new means of communication suggest that such a review is timely. Every European country faces the problem of a growing number of children and students; many societies are also demanding a compulsorily lengthened school life for children whose greater sophistication is not always accompanied by increased motivation towards learning. Most countries, dissatisfied with the limited results of increased expenditure on education, have relied on structural changes in the educational system to achieve a more truly educated society. Only now are they beginning to realise that quantitative planning, structural reforms and a longer school life will not produce the desired results if the traditional teaching-learning process remains unchanged. Owing to the nature of these factors primary and secondary education remain major areas of concern in European countries; this report, therefore, confines its attention mainly to innovation and reform in primary and secondary schools.

Since education is part of the society in which it functions, ideas about aims, methods and means of teaching and learning inevitably change from time to time. This report takes the line that society is now altering so fast that a deliberate strategy for innovation is necessary if education and society are not to become seriously out of step; and that such a strategy is possible

because new means of communication, and therefore new means of learning, are now available.

The report's main thesis is that innovation designed to improve learning can no longer be left to progressive individuals working alone; that the definition of general aims and specific objectives for children's learning, the methods of achieving them, the appropriate use of media all demand strategic decisions at national and local level combined with teamwork on the part of national and local administrators, teachers, publishers and producers. The report attempts to suggest guide lines for those principally concerned with the strategy of innovation.

EDUCATIONAL TECHNOLOGY
The Nature and Design of Learning Systems

*The first part of this report concentrates
on presenting a general survey of current
issues and trends in educational techno-
logy and of the design and evaluation
of learning systems.*

FROM TEACHER-BASED
TO ENVIRONMENT-BASED LEARNING

1.   Perhaps the most convenient and certainly the most interesting way of introducing the message of the workshop is to look at the basic ideas in action before describing them in theoretical terms.   This Chapter provides an example of applying a systematic approach to the use of means and media at the secondary stage of education.

TEACHER-BASED LEARNING

2.   In most European countries the system of learning is teacher based; though the style of teaching may vary, the system depends on the teacher and on what he is doing.   From the learner's point of view, learning is passive and quietness must prevail in the classroom so that the teacher may be heard.   The lockstep of the class, however homogeneous in ability and attainment it may be, dominates the teaching/learning situation, and determines the content and pace of the lesson.   Furthermore, dependence on the teacher implies a fixed timetable with lessons of equal length.

3.   Consequently, a teacher-based system imposes on an adolescent in his most active years a docility few adults could sustain, a docility enforced by an apparatus of entreaties, threats and commands that constitute an inadequate form of motivation.   Moreover, the fixed timetable discourages individual exploration and personal experience of learning.   The timetable has become a sort of Mad Hatter's tea party.   No matter what/how/where/when the bell sounds we must all move round and be faced in random order with one dish or the other placed before us.   It may be necessary: it is certainly bizarre.   What adult would actually choose to learn in this way?

4.   There is general dissatisfaction among thoughtful teachers with the present system; equal dissatisfaction with the results is felt by those who expected much in the shape of higher standards from an increasing quantity of, and expenditure on, education.   Everywhere there is a demand for better quality education, and an appreciation that, since non-academic children remain at school for a longer period, there must be more activity on the part of the pupils and a less bookish approach.

---

1. This Chapter is largely based on a contribution to the workshop by Mr. L. C. Taylor (see list of background papers Appendix III).

5.   In recent years strenuous efforts have been made to remedy the defects of class teaching: team teaching offers some relief from the year-long isolation and dependence of a class on a particular subject teacher; to the fare the teacher provides, broadcasting adds variety and spice; books for schools have become far more attractive in layout, illustration and colour; filmstrips, tapes and other aids make occasional red letter periods possible; above all, curriculum development teams have produced admirable materials for teachers, and have provided a more genuinely active role for children than was allowed by classroom teaching and conventional laboratory exercises.   There is certainly less excuse for dull teaching now than before.

6.   Yet these improvements leave the essentials of class teaching unaltered.   The source of instruction and interpretation and almost constant guidance remains the teacher, whether live or transmitted, single or multiple. The subject/teacher/class/period structure of the traditional timetable still contains the instructional process, which in general remains passive, communal, externally and closely organised — quite unlike the pattern in nursery school or in the "integrated day" of a primary school or university.

7.   There are pressures — of which external mass examinations are the emblem — which prevent the secondary school adopting primary school or university habits in which (broadly, and with due checks) the child or student is expected to learn actively from an arranged environment made up of books, things and people rather than be gathered hour after hour to be led by a teacher through a required course.   All the same, even in the secondary school, serious attempts have been made to make environment-based learning (familiar in the limited form of homework and projects) the central mode of learning.

8.   What is the essential difference between these attempts and conventional teaching?   It lies in the *relationship of the learner to the source of instruction*.   Put more starkly: "I am taught" (passive); "I learn" (active); when I learn, I go to something; when I am taught, it comes to me.   Normally, of course, if I am to learn rather than be taught, the objects I learn from must generally be *available* when I need them (they will have physical form, be "material") and they must be *intelligible to me* (otherwise I cannot learn from them).   These are necessary but not sufficient conditions: the notion of learning as opposed to "being taught" must also include the concept of *independence*.   Thus, we should regard someone chained to a computer and required to go through paced sequences of available and intelligible work as being taught by the computer rather than learning from it.

9.   In practice, of course, a learner in school does not have to submit to constant instruction about, interpretation of, the world (the process called teaching) nor, on the contrary, is he likely to be left absolutely free to learn independently about it from the books and objects and people around him.   Teacher-based and environment-based are two extreme poles: good sense will lead us to settle in some habitable region between them.   But which of the two ways we tend, the direction we lean in, will have extensive implications.   We have seen how at present our books, classroom arrangements, furniture and equipment, curriculum, streaming and setting, disci-

plinary requirements, timetabling, all reflect and facilitate class teaching: if we shift to an alternative system of learning we shall find all these elements subtly changed.

IMPLICATIONS OF AN ENVIRONMENT-BASED SYSTEM OF LEARNING

10.   By an environment-based system is meant a shift in emphasis from the teacher teaching to the learner learning in an environment where technological aids as well as the teacher are available as resources. It is not helpful at this stage to consider the merits of any particular technique or device, particularly since educational technology has been equated in most people's minds with media gadgets, seen in relation to the existing system of learning (where the market lies) or as a threatening mechanical substitute for the teacher within the existing system.

11.   It is more profitable to illustrate what is meant by taking one example — the use of broadcasting as part of an environment-based system. A broadcast normally used in a classroom is simply part of the teacher-based system. In certain circumstances (for example in Samoa and in Sicily) broadcasting has been used extensively as the prime means of instruction but the mode, the system of learning, is not changed: there has simply been a shift from the teacher on the dais to the teacher on the screen. Suppose, however, broadcasts are made available in recorded form: then with suitable printed accompaniments they may provide excellent "packages" for a radical change in the system, from teacher-based to environment-based learning.

12.   Packages are essentially prepared materials which may involve, for any particular subject, any or all of a variety of media-broadcasts, film loops, strips or slides, tapes, textbooks or booklets. The difference between packages and more sophisticated learning systems is that the former provides only "core" for a learning system together with suggestions for further exploration on related topics. They leave the teacher free to incorporate class lessons in his subject, thus enabling him to use his skill in teaching in the way that the good teacher has always done, to provide the stressing of cardinal points, the extra examples, the illustrations on the board, the parallels with everyday experience, the quizzing of students round the room.

13.   The present scarcity of such packaged materials gives those that exist an air of prescriptive monopoly offensive to those teachers sensitive about their absolute independence in the classroom. This independence — more marked in Britain than in any other country — may have a number of facets: first, a teacher (with others in his department) may be free to choose among alternative syllabuses; second, to choose among textbooks or courses embodying that syllabus; third, to pick bits and pieces from the chosen textbook or course rather than take it neat ; fourth, to create, in effect, a course or text of his own, spontaneously, by his teaching. How do materials for individual learning, especially "packages" of materials externally supplied, affect these freedoms?

14.   It will be appreciated that package courses can take the form of short sequences of material for the teaching or illustration of a specific topic, or alternatively may provide the basis for a learning programme over

17

a period of a term or a year. Ideally, package courses should be prepared in such a form (separate sheets or small booklets in offset litho instead of printed books, separate slides and not film strips) as to enable — and indeed encourage — local modification, thus giving the teacher his customary freedom to alter a course as he wishes.

15.   It is important to realize that a package course, although providing a learning environment richer, more flexible and more varied than a teacher can produce working alone, is only a part of this environment. Care must be taken that "packages" are not used to excess. Pupils can, of course, work through a package on their own but not all will be prepared to do so: in any case, the complete loss of communal and social elements in learning is undesirable.

16.   In practice, materials designed for a more independent style of learning can be handled in a variety of ways. *First*, in a class that needs a lot of teacher-support, they can be used within narrow limits of topic choice and variation of pace — a near lockstep, but with less verbal teaching. *Second*, they may be used part-time, a teacher reserving certain periods each week, or a batch of periods periodically, to cover certain topics in the conventional way, the materials being used for the rest. *Third*, the materials covering a particular topic or limited group of topics can occupy a period of time, a phase, set by the teacher. The teacher can then start the phase with one or more class periods and end it the same way, the students working independently in between. During the phase, the teacher may insert a lesson or two on some matters of interest not covered in the materials, or enlarge and explain something inadequately covered, thereby enriching the whole. *Fourth*, the materials can be used without restriction in continuous progress.

EFFECTIVENESS

17.   Questions of cost effectiveness and evaluation enter into all proposals for innovation and these are examined in Chapter 3. There are, however, other aspects of effectiveness in relation to package courses which may profitably be discussed here. They are:

1.   Packages of suitable materials could help with staffing difficulties.

   a)   Such materials can be used effectively by those teachers excellent with children but relatively inexpert in a subject or in its latest development.

   b)   Whereas verbal class teaching is necessarily confined to trained teachers, once materials assume a larger role, sub-professional support becomes possible, such as "aides", part-time helpers, teachers in training.

   c)   The proliferation of choices in contemporary schools often leads to very wasteful use of staff. This is particularly the case at the top of the secondary school, in the years between the end of compulsory schooling and university (Swedish new gymnasium, English sixth form, American junior college). At this age, independent learning should present the fewest problems and the greatest immediate returns.

2. Serviced by packages, smaller schools, although comprehensive, could become educationally viable. If every subject has to be constantly class taught then the range of subjects a small school can offer is very limited: supervised independent learning would extend that range. Small schools linked to a resource-supplying centre would be like those small grocer shops that now link together in bulk-buying groups — a very good alternative to the supermarket.

3. The considerations which make packages useful to small schools apply yet more strongly to children who, owing to illness, attend no school at all, or the very large number who suffer too many schools because of their parents' moves. For them and for others without regular schooling, materials imaginatively designed for independent work would be a godsend.

4. So long as children learn chiefly from the lips of a teacher the argument for making the classes in which they are taught as homogeneous as possible is strong. While the snags of streaming are now well advertised, it does not follow at all that unstreaming in itself is enough or even better. If put into an unstreamed class and then taught in the usual way the less able child may well feel more bewildered, exposed and depressed than ever; the more able hindered by "over-learning". Any worthwhile attempt at varying pace in a single class or group depends on suitable materials for more independent work being provided.

5. A central problem in secondary education is motivation. Presumably we shall continue to require that learners pursue certain studies, the pleasure and purpose of which elude them. But the degree of compulsion is, in part, a function of our teaching method. We gather learners into groups of about thirty and take all thirty along the route we lay down, point by compulsory point. By allowing more choice (between subjects or within a subject, in the use of time, in materials, in activities) independent learning can encourage a more responsible and a more active attitude to learning and a more personal involvement.

18.   This is not only desirable as part of learning theory but overdue as part of social practice. As a bastion of adult authority the secondary school has had its walls undermined by changes in the home and in the primary school. Ordered acceptance, on which our conventions of class teaching rest, is a waning asset: the habit of active participation in what they do — rather than a passive attention to what they are told — will not for long be put on and off by learners like a coat, as they pass through the classroom door. Many of the recent curriculum courses recognize the need for a less passive kind of learning: but the change in approach within separate subjects has not been matched by overall organisational change: the new wine is contained in an old bottle. The flexibility, choice, activity, involvement that independent learning permits make it the extension and corollary of much recent curricular reform.

19.   The puzzle is to work out what can be done to ease rigidities of timetabling and teaching in that part of the secondary school curriculum

subject to explicit, imposed academic requirements. We have to work within close limits: it is good assuming a radical transformation in the attitudes of adults inside and outside the school, or a miraculous draught of additional teachers or of cash. What prosaic, practical help can be given to those teachers who think it wise to let those in their care move, some a little, some a lot, out of the conventional class union, towards a greater independence in learning? The little environment-based learning at present visible in everyday use in secondary schools is generally confined by subject (usually just one or two) or by age (usually to the lower forms) or by ability (usually to those of grammar school ability). What is needed now is further sustained "prototype" experiments of a more comprehensive kind. The results could be rewarding.

Chapter 2

PRACTICAL ISSUES IN DESIGNING LEARNING SYSTEMS

20.   The factors to be taken into account in the designing of learning systems are likely to be the same whatever the educational system of which the learning system forms a part; indeed, most of the components of a learning system are identical whether school organisation is traditional or in the process of change.   Such differences as exist arise mainly because there is a lack of definition, in a traditional system, of the long term goals agreed by society and the short term objectives chosen by teachers, and partly because the achievement of these goals and objectives is seen mainly in terms of what the teacher does instead of what the pupil or student should be able to do.   The design of learning systems presupposes, therefore, a definition both of general goals and specific objectives in terms of desired learner performance, as well as a clear analysis of the framework of external factors (constraints) which inevitably affect the design.

Designing a learning system

21.   The development and production of a learning system require a team of specialists working full time on the project.   Experienced teachers, a subject matter specialist together with a psychologist or a teacher with special training in how children learn are all essential members of the team.   Equally essential for the presentation of the system in its most appropriate form is at least one media expert who may be a graphic artist or someone with experience in radio or television.   The selection of media specialists depends on the budget available for the production of the learning system, the nature of the subject, and the technical assistance likely to be available from educational broadcasting teams.   The personal qualities of members of the team are important since they must be able to co-operate not only with one another but also with the schools trying out the material at the development stage.   Furthermore, they must be willing to accept and act on criticism, severe at times, received from trial schools.

22.   The work which must be carried out before the system is ready for large scale production falls into seven stages.

First stage.   *Statement of objectives*

23.   Goals stated in a syllabus are usually too vague and general to be of direct use as a guide to the team for planning the system or to serve as criteria for measuring the effectiveness of the system.
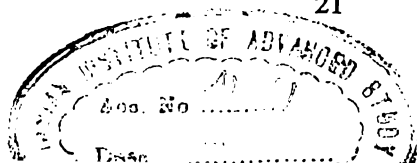
The first stage in planning is, therefore, the formulation of specific objectives and a broad description of the subject matter derived from the more generally stated goals. This process must not be confused with the apparently similar one in industry in which the knowledge and skills for particular situations can be clearly stated. In education the situations are not known; what is required are knowledge, skills and attitudes applicable to a variety of situations. Objectives for the system will be stated in terms of what the learner is expected to do or the action he is to take, which may be precise or open ended depending on the nature of the situation.

Second stage. *Description of target population*

24. Since the planning of a learning system cannot take place in vacuo, the next stage consists of a description of the learners for whom the system is being designed. The description will include the learners' general experience, specific previous knowledge of the subject matter, general ability and study skills (i.e. experience of working alone, in small groups and of open ended problems). Such a description would take individual differences into account and suggest ways of assessing the required entry behaviour in order to find the appropriate starting point for the learner in the system. However, with the present knowledge of individual learning styles and design techniques of learning systems, the description must often stop short of complete individualisation.

Third stage. *Decisions on content and sequences*

25. After the definition of objectives and description of learners derived from the first two stages, a start can be made on the third stage, which is to decide on the specific content to be included in the system and the sequence in which it is to be presented to the learner.

26. It should be noted that, although these three stages are dealt with separately, there is a close connection and interdependence between all three. A decision taken at any one stage may have significant implications for the other two and so may require a repetition of a part, or even the whole, of the initial planning process.

Fourth stage. *Initial preparation of material*

27. Following on the decisions made in the previous stage as to content and sequence comes the preliminary development of materials. This must take fully into account various practical issues which are likely to arise when materials are used in the classroom. An understanding of the work at this stage can best be obtained by stating the questions the designer must answer before he can proceed further.

28. How much allowance is to be made for different rates of learning and how far can the consequent need for elements of independent, individual and/or small group learning be provided?

29. How can the teacher fulfil his role as motivator, planner and general manager of the system? How is the material to be presented — film, tape,

22

textbook, model or by other media? Further questions of cost and availability of equipment in schools arise here.

Fifth stage. *Trial and revision*

30.   The system has now reached the stage at which the help of schools is required for trying out and assessing materials and methods. The team will be in close contact throughout with a small number of schools willing to undertake pretests of the system during the initial preparation and development phase and to supply feedback and evaluation to enable the design team to modify the system.

31.   There will follow field trials in a larger number of schools from which comments, criticism and suggestions will be sought. The resulting modified system, after being subjected to further and more extensive field trials and amended in accordance with the feedback received, will then be ready to go into production for general release to schools. In some cases, however, the process of further trial revision may need to be repeated a number of times before the system is seen to be functioning satisfactorily.

32.   This stage also includes the planning of evaluation on a large scale which may be undertaken by an outsider in order to ascertain how far the original objectives have been achieved. It is important to stress that this evaluation should not be limited to measurable objectives but should also assess the attitudes of the learner and teacher to the system, the effects on school organisation and, where this can be measured, the overall costs of implementing the system.

Sixth stage. *Large scale production and continuing revision of materials*

33.   The process of large scale production follows the completion of field trials and revision. An essential consideration here is the need for continuing improvement of the system. In the same way as textbooks and teachers' lessons become out of date — static rather than dynamic aids to learning — so will learning systems suffer the same fate unless they are constantly revised and replaced. There can be nothing final about a learning system; despite the natural temptation for designers and providers of finance to regard it as a finished product, deliberate provision must be made for the next stage of revision and ultimately of replacement. Unless this is done the fears of teachers about learning systems, that they will lead to a mechanical, stereotyped and inappropriate form of education, will be confirmed.

Seventh stage. *Implementation*

34.   The last stage (which should, in fact, proceed simultaneously with the continuing revision of materials) is the implementation of the system in practice. This involves keeping all schools informed of the progress of the project, outlining the advantage of the learning system compared with traditional methods, and generally encouraging schools to adopt the system. Success will be limited unless schools are informed at the same time what assistance they are likely to receive in the provision of equipment, non-teaching help, special training for teachers, etc. Unfortunately it is this

stage which often receives the least attention, thus bringing the whole idea of learning systems into disrepute.

35.   For a diagrammatic analysis of the design and development of a learning system reference may be made to Figure 1.

36.   It will be appreciated that a learning system may cover the entire work in a subject over a substantial period of time. Examples of this type of system are described briefly at the end of this chapter. Alternatively, learning systems may consist of short term core-courses only, accompanied by suggestions for open ended enquiry and other activities to be carried out by groups and individuals.

Figure 1

```
┌─────────────────────────┐              ┌───────────────────────────────┐
│     SPECIFICATION        │              │  SETTING UP GENERAL TEAMS     │
│     OF OBJECTIVES         │              │  CONSISTING OF MEDIA MATTER   │
│  AND TARGET POPULATION    │              │  EXPERTS, PSYCHOLOGISTS, ETC. │
└─────────────────────────┘              └───────────────────────────────┘

                                                      ┌──────────────────┐
                                                      │   PRODUCTION      │
                                                      │   OF SYSTEMS      │
┌────────────────┐     ┌─────────────────────────┐    │   COMPONENTS      │
│  ORGANISATION   │     │ FORMATION OF SPECIAL DESIGNER │└──────────────────┘
│  OF CONTROL     │     │ TEAM CONSISTING OF TEACHERS,  │
│  AND FEEDBACK   │     │ SUBJECT MATTER EXPERTS        │ ┌──────────────────┐
└────────────────┘     │ AND MEMBERS                   │ │   1ST DRAFT       │
                        │ OF THE GENERAL TEAM           │ │   PRETEST         │
                        └─────────────────────────┘    └──────────────────┘

                        ┌─────────────────────────┐
                        │ ORGANISATION OF 1ST FIELD-TRIAL │
                        └─────────────────────────┘

                        ┌─────────────────────────┐
                        │      2ND DRAFT           │
                        └─────────────────────────┘

                        ┌─────────────────────────┐
                        │ ORGANISATION OF 2ND FIELD-TRIAL │
                        └─────────────────────────┘
                                                      ┌──────────────────┐
                                                      │  LARGE SCALE      │
                                                      │  PRODUCTION       │
                                                      └──────────────────┘
                        ┌─────────────────────────┐
                        │      ORGANISATION        │
                        │   OF IMPLEMENTATION      │
                        │ FOR THE RELEVANT TARGET  │
                        │      POPULATION          │
                        └─────────────────────────┘

                        ┌─────────────────────────┐
                        │ REVISION ON LARGE SCALE  │
                        └─────────────────────────┘
```

37.   Educational technology in its widest connotation covers a wide range of operations and equipment, including the development and testing of programmes forming part or the whole of learning systems, as well as of apparatus to promote or assist learning.   Programmes may consist of small organised units or extended educational and training courses, together with equipment and media which may vary from printing to broadcasting or cable distribution networks including satellite relays.

38.   Methods and media are interdependent in a learning system, and the problem for the designer is to relate the two so that one reinforces the other.   He must not only decide the exact purpose of the information to be conveyed or of the action the learner is desired to take; he must also settle upon the method of communication (for example, by lecture, discussion, visual images, etc.); and finally he must select the medium or media most appropriate to the method.   In the selection of combinations and in the use of multi-media systems it will be realised that one form of presentation may sometimes interfere with another.   Visual information, for example, can result in the blocking of auditory information.

39.   Since it is important that there should be an awareness of the wide range of resources available, a brief résumé of the main types is given below:

— print in all forms,
— moving visual and audio-visual media (film, television, videotape),
— static visual media (slide transparencies, photographs),
— sound media (tape recordings, radio, gramophone discs),
— situational information (as in drama, role playing, educational games, case studies),
— information from physical objects (models, simulators),
— computers (CAI, CMI),
— human resources (teachers and peers).

40.   The process of selection of appropriate media involves an appreciation of the specific things that can be achieved by each group.   For example, moving visual images can effectively convey, probably better than any other form of presentation, emotional conditions and experience from outside the school.   On the other hand, because the visual image is fleeting, it is an inadequate source of information unless backed by print or still graphics.

41.   Media can be more than a means of conveying information;   in combination with a flexibly designed learning system they go some way towards providing opportunities for independent learning and for different rates of learning.   Most important, they release the teacher from his role of instructor for a more creative role.

SOME UNRESOLVED PROBLEMS

42.   All revolutions, by their sudden and excessive promotion of change, carry within them the seeds of their own destruction; new techniques and

new methods in education are in danger of the same fate unless their limitations are overtly stated and understood. Educational technology interpreted in the widest sense cannot be grafted on to existing systems but will lead to fundamental changes whose purpose is the provision of a better education. The difficulty is that, although for example we know what is meant by a better motor car, it is not easy to define a better education. The performance of a car can be measured but the objectives of new learning systems (like those of more traditional ones) that are easiest to measure are often the least important. Many aspects of education — attitudes, ability to solve problems, adaptability to new situations, ability to co-operate with others — follow not so much from the content of the system as from the way in which learning has taken place, that is to say the process. Particular attention, therefore, must be given to ways of assessing what is happening in the course of a pupil's learning over and above the acquisition of skills and knowledge. This may call for a more ecological approach towards assessment and evaluation (i.e. one that is concerned with the interaction between the learner and the learning environment) of which the standard of achievement is only a part. It is not suggested, however, that a concern with less easily measurable goals should lead to the dismissal of those specific objectives which a learning system has set for itself. Knowledge and skills are important and the fault is within the learning system if it fails to impart them as well as, or better than, traditional systems.

43.   In a wholly praiseworthy attempt to promote social justice and equality of opportunity, enthusiasm has developed for individualised learning. This is neither practicable nor desirable if the term is taken to describe a system where individual learners are working entirely on their own, proceeding from one piece of work to another as soon as the former is successfully completed — a system which imposes a rigid straitjacket on the learner in the interests of quality control, and ignores the positive effects of interaction between groups of learners and between learner and teacher.

44.   This is a misleading but widespread interpretation of the concept of individualised learning. It is perhaps less confusing to refer to independent learning — that is, learning taking place in a flexible framework containing some carefully controlled elements and providing a variety of learning opportunities for different individuals. One pre-requisite for independent learning is a learning resource centre from which material can be selected by the learner or the teacher for the individual's most appropriate route towards the stated objectives. There can also be no question that some subjects and some aspects of all subjects are best dealt with by group discussion or co-operative enquiry on a particular topic; undoubtedly the teacher will remain the most important resource of the learning centre and the best guide through a learning system for the individual learner. Independent learning has the advantage that it places upon the learner greater responsibility for his own learning, increases his area of choice and by its variety releases him from the boredom and monotony of one class lesson after another following a similar pattern.

45.   One aspect of independent learning systems that has discouraged teachers is their reliance on the written word; for the substantial proportion

of learners for whom this is not their preferred means of communication, the opportunities offered by other media have not yet been fully exploited. Another source of discouragement is the difficulty of introducing independent learning into old or unsuitable buildings and into schools whose equipment is unreliable, out of date or badly maintained. Under these circumstances, a greater emphasis on independent learning is difficult to achieve.

46.   Finally, the limitations of learning systems appear greater than they need be if they are perceived as infallible and unchangeable ways of ensuring learner success. There is a place for a "closed" system in certain fields where objectives can be clearly defined and measured and where the route to them is straightforward and linear. But the number of such fields is limited. A systematic approach does not, however, preclude an "open" system in which creativity and the solution of open-ended problems form a major part. Such systems may consist of only a "core" of pre-designed materials, leaving scope for the use of additional materials and methods introduced by the teacher, the school, or the learner himself.

Example 1. *Swedish course for the teaching of mathematics* (IMU)

47.   The course, designed for 13-15 year olds, is intended for individualised study and covers approximately three years' work; it is divided into nine modules, each module containing material for about 1/3 of a school year's work.

48.   All learners start with a study booklet at the end of which is a diagnostic test corrected by the teacher who, together with the learner, decides which of 2-4 booklets of differing standards of difficulty should be studied next. The booklet is again followed by a diagnostic test to determine which of a further 2-4 booklets should follow. There is also a special booklet containing material for group study.

49.   On the completion of the diagnostic test at the end of the last booklet, there is an optional course of study containing, in addition to exercises, three fairly extensive problems which learners can work through by themselves or in groups. The problems often consist of applications of mathematics to everyday situations. At the conclusion of this stage, learners proceed to the next module on a different mathematical topic.

50.   To this brief description a few comments may usefully be added. The diagnostic tests (i.e. evaluation of the learner's progress) are an integral part of the course since the shortcomings revealed of the learner's understanding must be remedied. In some cases a spoken comment by the teacher is sufficient, but in others more help is required in a simpler form and this can be supplied by study of an easier booklet. Some learners may need more practice, in which case appropriate exercises in the optional part of the course will be suggested by the teacher; alternatively, the teacher may take a group of learners encountering the same difficulty.

51.   The first version of the course was prepared in 1966 when the possibilities of using various media were not appreciated. More recently,

sections have been added using the spoken word and illustrations to help with revision of the most important points: other media will be more extensively used in future versions. The first version was tested on 75 learners, the second on 8,000 learners and the current version which is to be revised as described above is being used by 15,000 learners.

52.   Accompanying the course is a methods booklet dealing with the whole system, a teacher's handbook for each module and a pamphlet for parents indicating the methods and curricula content of the system.

53.   The Swedish Board of Education which in co-operation with the publishers, Hermod's Foundation, initiated the research and development work for the course in 1964 are not yet satisfied with the effectiveness of the course; further revisions are proposed to include greater use of various media, more group work, more material for the teacher and more variation of content to accommodate the slow learner and the mathematically gifted.

54.   Other Member countries have shown interest in this system and are anxious to make use of the research and development carried out in Sweden. In view of the fact that the content of science and mathematics curricula have no national boundaries, there seems no reason why learning systems prepared for these subjects in one country cannot be modified and adopted in other countries thus reducing the overall cost of research and development.

Example 2: *Swedish course in applied electronics*

    Description

55.   The course was prepared in Spring 1969 to meet a big demand for material in the teaching of electronics at gymnasium level. Designed to cover a period of study of approximately 240 hours for the fourth form of the gymnasium (the same level as first year at the university), the course was taken by 50 classes (1,000 students) in various parts of the country.

56.   The course is divided into three parts, each consisting of 5 to 7 weekly packages covering about twelve hours work in each week. Figure 2 shows how the part on digital circuits is arranged and Figure 3 gives the breakdown of one weekly package.
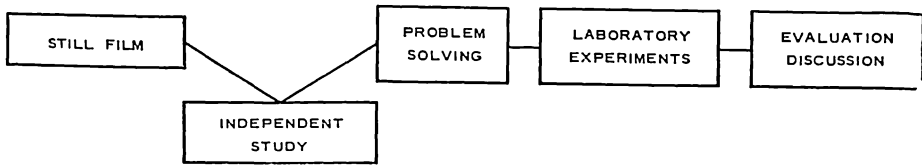
Figure 2

Section on digital circuits divided into 7 weekly packages
plus one week for revision work

DIAGNOSTIC TESTS
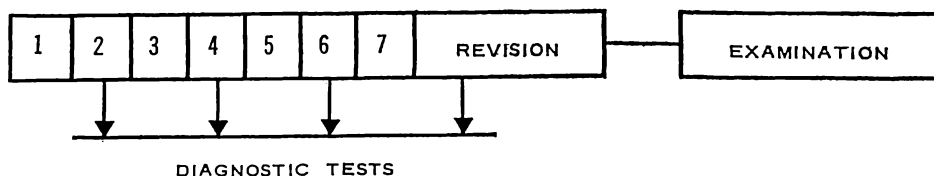
Figure 3

Breakdown of the weekly package into various activities

Choice of media

57.   Owing to cost, neither films nor television were practicable; instead, radio and coloured slides with typed comments were chosen. Although moving images in the introductory programmes would have been better than slides, the latter have the advantage that any slide that is ineffective can easily be replaced by a better one when course revision occurs.

58.   The text material comprises a textbook, work book and teacher's guide. The textbook covers the theoretical background together with revision questions and suggestions for further reading. The work book includes calculation exercises and detailed instructions for the weekly laboratory experiments. Each section lists the objectives (four to eight points) for the student and these also form the basis of the diagnostic tests. Hints about the use of the course, solutions of some of the exercises and indications about the difficulty of the experiments together with a summary of the radio commentary are contained in the teacher's guide.

59.   During the preparation of the course, the aim of the designers was to maintain a close connection between theory, the solving of problems and practical applications. As far as possible, each weekly package is built round a laboratory experiment demanding a certain amount of problem-solving as preparatory work.

Diagnostic tests

60.   These tests, marked by the teacher immediately upon completion and then discussed with the class, reveal to student and teacher the points that have not been fully understood. They are, therefore, an integral part of the course providing systematic feedback. The course, however, makes a further and interesting use of the tests. Individual student's responses to each question are sent for central statistical analysis; a week later the class receives a summary list of individual, class and average results of each question for all students taking the course. The feedback thus provided has a dual purpose. Firstly, students and teachers can learn, and be comforted by, the fact that other classes as well as their own are finding certain concepts difficult to grasp. Secondly, the designers of the system are alerted to shortcomings in the weekly packages: incidentally, in the case of a class consistently performing badly, they are also alerted to what may prove to be a faulty use of the system.

Comments upon the course

61.   The course is new but even at this early stage the opinions and attitudes of teachers and students involved are worth noting.   Particularly interesting is the fact that both teachers and students found the course a great stimulus to learning.   Although it was anticipated that a media course containing a large amount of material intended for self tuition would permit students to absorb most of the essence of the material unassisted, the test questions show that this is not the case.   The teacher's role in the media course proved to be essential but his duties were different.   Course material in the form of packages ready for immediate use saves so much time and work for the individual teacher that he can accept it without hesitation, though it may restrict his own influence as regards the choice of material on the subject.   Through diagnostic and attitude tests, both teachers and students have the opportunity to influence the course in the long run. The teacher does not find that the comprehensive teaching material available to him restricts his role as teacher.   On the contrary he finds it a valuable form of assistance which leaves him free to give each pupil more individual attention.   The teacher's attitude towards the course material can best be illustrated with the following question, "If similar material was placed at your disposal on related subjects, would you also use that?", to which the reply was a convincing "yes".

Responsibility for the course

62.   The following list is given to indicate the variety of institutions concerned in the preparation and production of the course:

Production .... Royal Institute of Technology, Stockholm et alia.

Radio programmes, colour slides students' work book and teacher's guide .... Swedish Broadcasting Corporation

Statistical analysis .... National Swedish Office for Administrative Rationalisation and Economy.

Laboratory experiment sets .... Terco A. B.

Textbook .... Laromedelsforlagen

Collaborators in drafting tests ...... Stockholm School of Education.

APPRAISAL, EVALUATION AND COSTING

APPRAISAL AND EVALUATION

63.   We evaluate because we must.   Even daily life involves a constant appraisal of data before decisions as to subsequent action (however trivial) are made.   Appraisal, evaluation, assessment and measurement have, how-ever, acquired specialist meanings to many workers in educational and other social fields.   It is not proposed to discuss here the precise meanings of these terms although it is obvious that, in any systematic approach, measurement should be based on judgments that are not wholly subjective. It is often difficult to reconcile the desire of research workers to reach perfection with the need for decision makers to receive reliable guidance in a reasonable time.   Consequently decisions are often arrived at without any systematic consideration of empirical data.

64.   At what points in the educational system evaluation takes place depends on the nature of that system.   A centralised system may, for example, decide both on objectives and on the way they are to be achieved; in such a case evaluation will be external (the baccalaureat in France and the Abitur in some states of the Federal Republic of Germany) and may fail to take into account a large number of relevant factors.   In a more diffuse system, decisions will be taken by the local authority, the school or the teachers ; such decisions are, in general, based largely on subjective assessment.   In neither case is the purpose of evaluation fully appreciated. Ideally it should serve two purposes; firstly, to measure the extent to which objectives have been achieved, taking into account external factors that affect achievement, and secondly to provide feedback for the modification of objectives and methods of achieving them.   Evaluation at its best is not a means of judging individuals but a form of feedback indicating progress to the learner and suggesting possible revisions of objectives and of the learning system itself.

65.   The scope of evaluation is not sufficiently realised, nor admittedly are its procedures adequately developed.   To assist in an understanding of the role of evaluation, an attempt is made in the following paragraphs to indicate its range and significance at all stages of the teaching-learning process.

OBJECTIVES

66.   These should be explicitly stated.   High level and general aims are not difficult to formulate; more detailed objectives require clear thought

demanding courage rather than intellectual sophistication, plain language rather than jargon. They must, of course, be enunciated before evaluation can start, though the skilled evaluator can often be of great help in ensuring clarity of definition. He should, if possible, therefore, be involved in the project from its inception.

67.   One of the difficulties in defining objectives, as in the measurement of performance, is that both are much easier to achieve in the cognitive and psycho-motor areas than in the affective domain. Consequently, there is a tendency to concentrate on defining and measuring what can be readily defined and measured and to ignore the more difficult but no less important elements such as creativity and attitudes. Since it is unlikely that better definition and measurement of these elements will become possible or even desirable, evaluators and those they advise should always be aware of the limitations of evaluation and the advice derived from it.

68.   In considering objectives, particularly at national and regional level, attention must be given to their feasibility and practicability in the actual learning situation. It is useless, for example, to include independent learning in a list of objectives in a situation where the necessary material resources for this type of learning are not available.

Entry behaviour

69.   Before a learner embarks upon a particular learning system, assessment should be made of his present knowledge and the mode of study to which he is accustomed. The result may indicate that the system is either too advanced or too elementary in its initial stages or that he is insufficiently experienced in independent methods of learning. Evaluation at this stage enables the teacher to decide upon the best course of action for the individual learner, but he will only be able to do so if the evaluation tests of entry behaviour have been carefully prepared by the designer of the system and have been based on a clear statement of what a learner must be able to do before embarking on the system.

Terminal behaviour

70.   Pupil performance expected (i.e. terminal behaviour) is derived from the objectives of the system: its assessment depends upon the degree of precision with which it can be measured or observed.

Internal evaluation and feedback in design

71.   The designers and producers of a system are responsible for internal evaluation during the course of preparation. They will, for example, evaluate, the relative effectiveness of different media and modes of presentation and they will obtain evaluation and feedback from schools during field trials.

External evaluation

72.   Empirical evaluation of a system when it is in general use is expensive in terms of time and money. Without it, however, there is no

true measurement of the effectiveness of the system. A subjective judgment such as "the opinion of those involved is that this learning process is effective" may be made quickly and cheaply but it is not evaluation. Even though the opinion and attitudes of those using a system are important in assessing its effectiveness (see, for example the note on attitudes in the account of the Swedish electronics course at the end of Chapter 2), they should if possible be supplemented by more objective methods.

COMPARATIVE EVALUATION

73.   Teachers are inevitably more dependent on professional evaluation of multi-media systems and packages than they are in the selection of textbooks which they can themselves examine and assess. In some cases the necessary independent guidance may be supplied through a central assessment agency; in others a more practicable approach may be through the publication of information on how to assess the evaluation data which the producers of systems themselves provide. It is desirable that producers should formulate their own ethical code for educational materials covering objectives, target population, pupil entry and terminal behaviour, so that products carry some valid indications of their educational value.

74.   In view of the importance of evaluation at all stages of the learning process, the need for training staff — teachers and evaluators — in the principles and methods of evaluation cannot be over stressed. Professional evaluators must be prepared to convey in simple language to teachers, administrators and politicians their conclusions, their reasons for them and their recommendations for action.

COSTING

75.   Because the science of educational measurement is not, and never can be precise, cost effectiveness techniques cannot be applied directly to education. Nevertheless, the application of the concept to the planning and evaluation of alternative approaches to educational strategy is not impossible. However, it is necessary first that accounting practices should be altered so that the required data are produced in a meaningful form. For example, it is not generally realised that in most advanced countries no more than 4 per cent of their large educational budgets is devoted to books, equipment, instructional materials etc. while 60 per cent is spent on teachers' salaries. As long as this balance continues it is unlikely that in such a labour intensive undertaking, capital expenditure for technology will be made available. But as wages and salaries in industry and commerce rise owing to increased productivity (often accompanied by decreasing prices for their products), there will inevitably be demands from teachers for comparable salaries. In the long term these demands can be met only if technology is called in aid to convert education from a labour intensive to a capital intensive service. Such a policy would not reduce the present number of teachers but would prevent the number rising in proportion to the growing number of learners.

76.   A planning, programming, budgeting system (PPBS) on the lines being developed in the United States is one means of ensuring that objectives of the educational system are reviewed regularly, that studies are carried

33

out to ascertain the effectiveness of what is being done and that alternative policies are costed and considered. However, this technique is far from being perfected: in the meantime, certain considerations relevant to the cost effectiveness of learning systems and of alternative methods of organising schools should be noted and are briefly summarised below.

EFFECTIVENESS SAVINGS

77.   Different learning systems from those at present in operation may increase the chances of reaching desired levels of achievement. If, for example, as a result of a system more learners leave school with a greater knowledge of mathematics, decision makers may think that additional expenditure incurred in adopting the system is justified.

EFFICIENCY SAVINGS

78.   If learners have the opportunity to progress through a learning system at a greater speed, thus increasing the scope and range of their learning in a given period of time instead of cooling their heels while others catch up with them, the system is economic of learner's time — an item that fails to appear in any form of educational accounting. "Package" and "independent" learning systems may well prove cost effective on this basis.

DIRECT COST SAVINGS

79.   In subjects such as science and engineering where quite expensive items of equipment may be required even in a conventional teaching programme, certain costs may be dramatically reduced by eliminating the requirement that every student should reach a particular point in the course at a particular time. Instead of needing a large laboratory or workshop equipped with microscopes or practice tools sufficient for a class of thirty students to use simultaneously, a more independent type of learning system can be equipped on a "cafeteria" basis with no more than four or five student stations for simultaneous use by students who have reached the appropriate stage in their learning programme. Apart from a reduction in the capital costs of equipment required, there would also be a reduction in total laboratory space needed when a building is designed or converted. Since these facilities represent a higher than average cost in floor space, the savings could be significant. In addition, this economy would mean that expensive plant could be used more intensively and the amount of "down-time" when plant lies idle will be considerably lessened. Co-operation between schools in the use of expensive equipment would also lead to savings in capital expenditure.

SAVINGS ARISING FROM BETTER UTILISATION OF THE PROFESSIONAL CAPABILITY OF TEACHERS

80.   The use of package courses and independent learning systems could bring about a reduction in the day-to-day work of teachers, by relieving them of routine duties. A consequent relative increase in the number of pupils per teacher would be possible.

34

81.   The equipment used by schools, designed in many cases, for non-educational purposes contains refinements not required by schools.   By writing specifications for what schools actually need and producing equipment specifically for them on a large scale (possibly the same for all OECD countries), a significant economy would result.   A known demand, for example, for video tape recorders would substantially reduce their price.

82.   For effectiveness in design and economy in cost, the development of major new learning systems can only be undertaken at national or large regional levels and paid for at that level.   But greater responsibility for budgeting placed on the school would lead to greater cost-effectiveness. Schools would be encouraged to examine the way in which they are organised, to consider alternative methods of achieving the same or better results and to explore the possibilities of co-operation with other schools.   Once an understanding of the idea of cost effectiveness is grasped at school level it could prove a powerful influence not only for economy but also, and more importantly, for innovation.

A SYSTEMATIC APPROACH
TO THE TEACHING-LEARNING PROCESS

CHANGES IN THE CONCEPT OF EDUCATIONAL TECHNOLOGY

83.   For some time now it has been common practice to apply the term Educational Technology to the introduction and operation of various kinds of technological devices.   This conception of the term has been propagated by those who are concerned with such machines technically and commercially and who are less concerned with the educational implications of their use. However, as the number of educationists concerned with the use of such media has grown, a shift to a wider understanding of the term has taken place.

84.   Consequently, some more recent thinkers have conceived educational technology as a *systems approach to the teaching-learning process* centering around the optimal design, implementation and evaluation of teaching and learning.   As such it is understood as an inseparable part of curriculum research and development and cannot be seen in isolation from it.   This striving towards a fuller understanding of the problems involved makes "hardware" but one aspect among many to be considered in the teaching-learning process.   To understand this change to a wider concept of educational technology, one must consider the main factors involved in its emergence:

i)   Given the availability of hardware, the practical concern of the educationists is with the production of adequate software and with the problems of content and presentation of the message.

ii)   The "gadget" approach of the last twenty years, which was confined to promoting the technical possibilities of media, catering for a minimum of software, has, in the last analysis, failed.   This failure has led, despite some individually successful efforts, to a considerable resistance to a second breakthrough in educational technology.

iii)   The problems of mass education, the increasing numbers of students, the large number of drop-outs, the dissatisfaction with the present efficiency of learning, and the cry for individualisation and democratisation of the teaching-learning process have all led educationists to question the adequacy of the traditional way of learning.   The result is an increasing preoccupation with, and a fundamental reconsideration of, the teaching-learning process in order to see which new ways will better correspond with the

37

individual, social and economic needs of education of our time. It is against this background that questions about media-utilisation are nowadays to be seen.

iv) This widening of the concept coincides with a general trend towards a more scientific and methodological approach to education — a trend which has been observed in other social fields such as sociology, psychology and politics.

WHAT ARE THE IMPLICATIONS OF A SYSTEMS APPROACH?

85. In science and technology, engineering problems are usually solved by means of systems analysis and systems development. In these cases, the preconditions for the application of systems thinking are usually met in full: systems can be isolated from one another, their elements and the functioning of the elements are known, and their reaction under different conditions can be defined, manipulated, reproduced at will, controlled, and the output quality can be evaluated against input quantities. But this technological concept cannot of course be applied in any straightforward way to the very different context of social problems in general and educational problems in particular. The difficulties implicit in a rigid application of a mechanistic systems thinking to educational problems are:

i) In technical systems, the elements or variables and their functioning can be determined and controlled. We are not in a position to do this with social systems. For example, the behaviour of an individual in a teaching-learning interaction sequence or the cognitive processes during a task performance cannot be entirely determined or controlled.

ii) Technical aggregates cannot function outside their own suprasystem, neither can they function simultaneously in another system. In contrast to this, social systems are extremely open. Individuals in a teaching process, for example, act in a plurality of social systems and are influenced by them. So in a social situation, the precondition that a system must be independent does not hold.

iii) The reliability and validity of analytical methods and test instruments are not such as to allow us to isolate and measure the complex interdependent relationship within and between social systems.

iv) The attempt to apply systems analysis and development and to control and evaluate it rigorously has, in the past, required such an expenditure of time and of human and financial resources that most educational authorities have not regarded it as cost-effective in relation to the solution of problems in practice.

86. Scientifically-based systems thinking may well be desirable for basic research, but educational technology is fundamentally concerned with application to educational practice where it is more appropriate to speak of a systems-analogous or simply a systematic approach to designing, producing, implementing and evaluating learning systems [1]. Against this background,

---

1. Educational technology in the context of this report relates to practice rather than theory. For this reason the report adopts a different emphasis from the scientific and research oriented approach which stresses the following :

recognising the constraints and limitations of the systems concept in educational technology, the usage of the term is justifiable. In practice, a systematic approach in education involves reconsideration of all the elements in the teaching-learning process when one of these elements is changed, taking into account the uniqueness of an educational environment. The systems concept is thus a plea for strategic thinking in relation to the teaching-learning process.

87. Strategic thinking was not a factor in the gadget approach phase of the first generation of educational technology; but it is a direct consequence of the systematic approach which characterises the second generation. Systematic analysis identifies the elements of the teaching-learning process and their inter-relationships; the development and implementation of new methods of learning which follow from this analysis call for a plan of action, that is to say a strategy. The absence of an adequate strategy has led to the failure to introduce media into schools and universities effectively; for example, given the resistance of teachers towards using audio-visual aids in teaching, it is remarkable that the introduction of media was not accompanied by any systematic attempt to bring about a change in these attitudes.

88. Strategic thinking is needed at all levels today: by the teacher in the classroom where learning actually takes place and where new methods of learning are to function: at the school or college level which has to provide for their functioning: at the levels responsible for curriculum development, for the design and preparation of course material and for their large-scale dissemination: and, last but not least, at the decision making level which draws up long range policies.

89. Decisions at all these levels can come only after the consideration of a multitude of factors, their functioning and interrelationships and their various effects in different situations. Before a strategy can be developed, the variables involved must be identified and their relationship to the objectives must be analysed. The identification of significant variables in the teaching-learning process is one of the major problems in planning a strategy in advance and it is here that a systematic approach has its greatest impact. Systems thinking in education serves as a constant reminder that everything is interrelated with everything else, and that it is dangerous to neglect this interdependency. In other words, when introducing major

---

a) educational technology is not a discipline but represents an inter-disciplinary approach to the whole process of teaching and learning.
b) Like all forms of technology, educational technology assumes that theoretical knowledge and scientific principles can be applied to problems that arise in a social context; furthermore it assumes that the process of application can be controlled and repeated at will.
c) for the purpose of scientific research, the heuristic assumption is valid that educational and pedagogical problems are amenable to a rational and scientific form of investigation.
d) Insofar as educational technology equates to the systems analysis approach, its field of application is not only confined to the teaching-learning process, but also represents a viable approach to the whole of educational planning, management and administration.

As valid as these postulates are for scientific investigations, their limitations are recognised when they are applied to everyday educational practice and compromises will have to be found between scientific exactitude and social reality — hence the difference in emphasis in this report.

changes, it is necessary to be aware of the effect they will have on other elements in the system and provide at the same time for the necessary consequential changes. If not, the end result may well be worse than the original situation.

THE NEED FOR A SYSTEMATIC APPROACH TO POLICY DECISIONS

90. There is an increasing preoccupation in many countries of the western world, at both research and decision making levels, with educational technology and with ways of applying it. Until recently, however, governments have found it difficult to develop any definite policy, mainly because of the inconsistency of the information available as a basis for drawing up long term plans.

91. To understand the policy implications of educational technology, one has to see its impact in the general context of reforms and innovations which are at present taking place in education. Concern for the teaching-learning process constitutes one of the elements in the combined efforts to update education to the needs of modern society. Educational technology is aimed at the interaction process between teacher, media and learner, upon which all other systems are dependent. All our educational planning, educational management and curriculum development have in the end to justify themselves by the effectiveness of the learning outcome i.e. the effectiveness of the teaching-learning process to meet the needs of both the individual and society.

92. Moreover, educational technology must be seen in a chain of efforts which shift our innovative activities from a concern merely with the quantitative and structural changes in education to an emphasis on the qualitative aspects. This change of focus — the necessity of which has been widely publicised by recent student unrest — is only beginning now, but there can be no doubt that it is a trend which is spreading rapidly. It is not only educationists who are becoming increasingly involved in these problems but also national governments which will have to take the necessary decisions to bring about far reaching changes in educational practice.

93. A systematic approach to the teaching-learning process assigns to educational technology the design, organisation and evaluation of learning systems, thus operationalising curriculum research. Learning systems involve the production of course materials which when used by the student are more independent of the constraints of time, space and staff than conventional forms of teaching. Course materials can contribute directly to:

i) Individualising instruction; for example, printed learning packages for individual use in conjunction with audio-visual aids and/or other material assignments tailored to meet different learning styles. The material allows the student to progress according to his own motivation and knowledge, stimulating enquiry behaviour and creativity (though existing material often still fails to meet the latter conditions).

ii) Coping with mass student enrolments and contributing to the equality of educational opportunity: for example, learning systems which imply the use of mass media (such as television, radio or computer) in conjunction with printed material can serve innume-

rable students at the same time over great distances, and they can be constantly repeated. Computer-managed information systems may also in the future expeditiously undertake administrative and counselling tasks for a large number of students.

iii) Democratising the learning situation: there are three aspects to this. In the first place, the procedures for developing course materials necessitate defining the educational objectives to be achieved by the learner. In current practice, not only are objectives vaguely conceived, but they are also approached without the active involvement of students: discussion between both partners in the process about the importance and worthwhileness of objectives would give older students a better understanding of what and why they are to learn and also a greater insight into the goals of education. Secondly, self-contained learning packages, aimed at active student participation in the learning process, also give students responsibility for the timing of their learning, a responsibility which they so far have not enjoyed. Lastly, these learning systems assign new functions to the teacher while freeing him from old ones: they are likely to reduce, to a great extent, the old autocratic relationships in the classroom.

94. It is also claimed that educational technology can contribute to the cost-effectiveness of learning, bridge the gap between teacher demand and supply and improve the quality of the learning/outcome. No conclusive data are yet available to support such claims. But if the contribution of educational technology results only in an equal education for a greater number of students in possibly a shorter time and at a reasonable cost increase, we shall have surmounted many of the problems faced in education today.

95. To date, very little has been done to analyse the consequences of the adoption of new learning systems. Reforms in education are still carried out in a piece-meal fashion which, as has been shown in the past, leads more often to failure than to success. To improve the chances of the success of innovation through such systems, concomitant changes will have to be introduced in related aspects of the teacher-learning process.

AN EXAMINATION OF FRAME FACTORS

96. The educational system of any country, operating as it does within the framework of society, is subject to a wide variety of constraints and influences which, directly or indirectly, affect the learning process within the schools. A systematic study of methods of learning cannot neglect these internal and external factors; for convenience they will be termed frame factors. To assess their impact on innovation in education they must be identified and understood. Depending upon their nature they may be psychological, social, political, economic, technical or organisational. A second way of looking at them is to distinguish between those that are *inherent* in the learning process (e.g. the learner's motivation or the teacher's attitude) and those that are *external* to the process (e.g. the financial allocation to the institution in which learning takes place, teacher supply and teacher training).

97.   Yet another way of regarding frame factors is to classify them as either alterable or unalterable. This may often turn out to be a misleading division because in a practical situation factors that are, in theory, alterable may prove impossible to change. To illustrate, suppose a new learning system is introduced into a school where the teachers lack the necessary experience and skill to work it. Theoretically their inexperience and lack of expertise can be eliminated, but in practice owing to the time factor, finance and lack of facilities for the re-education of teachers, this particular frame factor may have to be regarded as unalterable and the introduction of the learning system might have to be postponed, rejected or adapted.
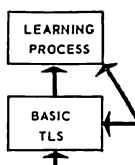
98.   The accompanying Table I is offered as a basis for identifying frame factors. This particular analysis takes the actual teaching-learning process as a point of departure and proceeds inductively to indicate the factors operating at various levels. Its purpose is to provide a check list for the innovator which he can use when dealing with the design and implementation of learning systems. Since decision making takes place at three broadly distinguishable levels (at the teaching-learning level, at institutional/community level and at regional/national level), the table adopts a three fold approach. It will be appreciated that the relative importance of a specific frame factor depends on the level at which it is being considered. For example, the teacher preparing course material assesses the factor "student participation" in a different way from the official working at regional or national level; the student himself may well regard this factor from quite a different angle from those of the teacher or official. The same frame factors, therefore, appear at different levels and the fact that they do so serves to remind decision makers that a strategy prepared at one level must take into account the relevant factors at other levels.   In the table those frame factors are underlined which are likely to be the crucial ones at present and to provide the best starting points for more detailed investigation.   In order to demonstrate the complexity and flexibility of the relationships shown in the table, the position of the teacher is briefly discussed as it is affected by internal and external factors.

FRAME FACTORS IN RELATION TO THE TEACHER

a) *In the basic teaching-learning system* (second column of the table)

99.   Clearly, the introduction of new learning systems affects the function of the teacher in the classroom and any strategy of innovation must, therefore, consider the motivation, or lack of it, offered to the teacher to enlist his support for change. It is obvious that he needs the relevant knowledge and skills to be able to adapt to the new situation and it is vital for him to understand that his role, although different, is no less important.   As teachers are just as conservative as other professional men and women, a sensible way of overcoming obstacles arising from conservative attitudes (see the entry for social behaviour in the table) is to find and encourage those teachers willing to adopt a flexible approach. With regard to social relations outside the school, it has always been an unquestioned belief that teachers should be dedicated to their profession. Desirable as this is, there is little doubt that the belief is largely a myth; moreover, it is difficult to justify an assumption that it should be otherwise. More realistic think-

TABLE 1. FRAME FACTORS OF THE LEARNING PROCESS

		FRAME FACTORS INHERENT IN THE BASIC TLS	FRAME FACTORS INSTITUTIONAL/COMMUNITY LEVEL	FRAME FACTORS REGIONAL/NATIONAL LEVEL
Teacher		Motivation Knowledge and skills Social behaviour Social relations outside school	Planning In-service training Ancillary staff – knowledge, skill, training, recruiting Teacher union activity within institutions and in community	Social status Teacher supply and teacher training Teacher unions Ancillary staff supply, recruiting and training
Student		Student participation Entry behaviour Motivation Learning styles and techniques Social behaviour Social background	Student participation in school planning and management Relation to other institutions Relationship to adults	Student participation in educational planning Student organisations and organisations embracing students
Curricula and media		Educational goals of society Curricula Presentation of content – Planning – Teaching methods – Accrediting of learning material – Examinations and continuous assessment – Co-operation and co-ordination with parties concerned outside TLS – Type of media – "Appeal" of media (appropriateness) Ordinary classroom teaching and/or preproduced systems	Educational planning Co-operation and co-ordination within and between schools Course material available Equipment available Maintenance and service Material storage/access Facilities/distribution service Material production facilities	Educational goals of society Curricula and curriculum material production – Research – Revision of goals – Planning and providing for co-operation and co-ordination Equipment production Service distribution and consulting functions
Environment		Space Equipment of learning environment Time	School management – Planning organisation including innovative mechanisms – Financial allocation systems – Space and room allocation – Time scheduling (yearly, termly, monthly, weekly, daily) – Routine administration – Co-ordination Entry requirements Examination Systems Expectations of parents Expectations of Community	Educational planning Financial allocation system Educational routine administration Entry requirements Examination system Management training Feed-in, parallel, and end-on educational institutions
			Research Occasional tests, tryouts, experiments in TLS	Empirical and longterm research projects Laboratory experiments Design and tryout of new systems Empirical evaluation International co-operation

ing about the role of the teacher would remove this imbalance between an overloaded value concept and the realities of the profession. Influences from the various social groups to which he belongs determine to a large extent

43

his attitudes and beliefs; commitments to personal or community activities may limit the time he is willing to devote to up-dating his knowledge and skills. Prepared course material is one way of overcoming constraints imposed by teachers' outside interests.

b) *At institutional/community level* (third column of the table)

100.   While the planning and introduction of new learning systems is in the final event a matter for the institution or the local community, it is self-evident that the teacher must be actively involved at all stages.   At the present time, innovation is very largely confined to individual schools so that training in new methods and techniques is either non-existent or very limited; at this level it is unusual for any consideration to be given to a systematic analysis of the concepts and methods that underlie a new approach.

101.   The problem of in-service training could be overcome to a certain extent if a number of adjacent schools joined to undertake a common assault on the training aspect of change.   Alternatively, or in addition, designers of learning systems might include a self-tuition course for teachers on the lines of "packages" for pupils discussed elsewhere in the report.
    Although an important matter for teachers at the institutional and community level, the remaining two factors (i.e. the place of ancillary staff and the influence of teacher unions) can be more profitably discussed in relation to the next and higher level.

c) *Frame factors at regional/national level* (fourth column of the table)

102.   The supply of teachers and the nature of their training are matters in which decisions can be made only at national or regional level; new learning systems require long range decisions on the number of teachers required, their standard of education and the provision of in-service training. So far there is no evidence that new or different systems or the advent of educational technology will lead to a reduction in the number of teachers though there may be a smaller demand for highly qualified subject matter specialists coupled with a greater need for teachers skilled in the pedagogical aspect of education.

103.   In all changes that affect teachers, teacher unions have a close interest; consultation with them and the enlistment of their co-operation will be essential in any strategy for change that is to succeed.   In particular, it is important to reassure teachers that the employment of non-professional staff will in no way lessen their social status and may well enhance it.

104.   Although the number of teachers is not likely to decrease, it is certain that the demand for non-teaching staff will increase.   On the one hand, technical staff will be required for the servicing of equipment of all kinds; on the other hand, non-professional staff will be needed for the additional routine work arising from the introduction of new learning systems. Problems of the training, number and methods of recruitment of ancillary staff have not received the attention they deserve at national or local level. This is an important aspect of strategy which should be urgently considered by policy makers.

105.   In order to complete the picture of the teaching/learning system as it affects the teacher it is necessary to read down the first column as well as across the top lines of the table. This is, in effect, to consider the work of the teacher in the school.

106.   The school environment, e.g. the space available, the nature of the equipment, the way in which the school is run, examinations, the interest of and the pressures from parents, affect the day to day activities of the teacher in the classroom and his attitude to innovation; however enthusiastic his approach to change, if the environment is inflexible his opportunities for the selection of appropriate curricula and media are strictly limited.

107.   Interaction between the student and the teacher is a phenomenon of great complexity; environment, curricula and media influence the relationship and this in turn is affected by the extent to which the student participates in his own learning and the skill of the teacher in motivating the student's learning. New learning systems alter the balance of the relationship in many directions; it is, for example, impossible to maintain formality if a teacher replaces an authoritarian attitude by a partnership with the student in learning activities. It is equally unlikely that a partnership will develop if environment and curricula remain unchanged.

108.   This brief discussion of factors, operating inside and outside the school, as they affect teachers should be paralleled and cross-examined by similar analyses of those influencing students, curricula and media, and the environment.

.

PART II

WHERE AND HOW TO START
Towards a Strategy Implementation

Against the background of Part I, the second part of this report goes on to deal with some practical issues on which guidance is offered to those concerned with educational innovation.

Chapter 5

THE PRODUCTION
OF TEACHING-LEARNING SYSTEMS

INTRODUCTION

109.   The term production is taken to cover the whole process of develop-
ing, manufacturing and distributing educational material (including appa-
ratus and equipment where this needs to be specially developed or modified
for educational use).   Production is clearly distinguishable from research
into human learning, although a strong case can be made for more effective
connection between the two.

110.   While there must continue to be scope for creative enterprise on
the part of individual authors, producers and publishers three features in
particular differentiate between traditional textbooks and the teaching/learn-
ing systems discussed in this Chapter :
   a)   such systems are developed not by single individuals working in
         isolation but by interdisciplinary teams including experts in both
         design, evaluation and production techniques;
   b)   they may contain a variety of types of material as mentioned in
         page 25, including texts, work sheets, laboratory kits, tapes, slides
         and film loops;
   c)   they are subject to systematic field trial followed by revision and
         re-trial: the stage of final publication is not reached until this cyclic
         process has been satisfactorily completed.

111.   At present the initiation of new programmes is random and unsys-
tematic.   While it is in the interests of commercial publishers to avoid
excessive duplication of effort, emphasis inevitably falls on those areas,
such as mathematics and science, where a very obvious market exists for
new types of material.   Other equally important areas, where the market is
smaller or more specialized, tend to be neglected.   There is a need for
more careful and co-ordinated scanning of the requirements for production,
based on a detailed study of educational objectives.

112.   With the creation of national and international mechanisms for
qualitative planning (such as those described in Chapter 7), the hope is that
the initiation and management of production will become more systematic.
The detailed arrangements will, of course, vary from country to country,
but all of them are likely to involve new combinations of governmental,
non-profit and commercial production agencies, and to require closer com-
munication with policy makers, researchers, teachers and the general public.

113.   In many cases a specially chosen curriculum or advisory committee·
may be an important element in managing the production and installation
of new systems.   Such a committee would normally consist of teachers,
local and national administrators, subject matter specialists (usually from
universities) and others to whom the production team could turn for advice·
and support.

SOME INITIAL MANAGEMENT DECISIONS

114.   Once the requirement for a particular production programme has
been identified, and the appropriate management structure has been worked·
out, the responsible agency will need to begin by preparing detailed esti-
mates for the time span and costs of the exercise.   The timing must take
into account the scope of the field testing programme, the period necessary
for revision, and the complexities of mass production and marketing.   The·
budget will inevitably be limited by the likely size of the market and the
expected length of life of the materials.

115.   Within the constraints of available time and money, certain key·
questions relevant to production have to be considered at an early stage,.
and certainly long before the production of materials on a substantial scale..

116.   The choice of *forms* of presentation of given ideas (whether as·
static diagrams, moving visual images with or without audio accompani-·
ment, written text, etc.) itself limits the range of available *media* of presen-·
tation (photographic slide or line diagram, 8mm loop film or video-tape,
textbook or work sheet, etc.) and may have major cost implications.   Other
logistic problems may also have to be borne in mind such as storage of·
equipment and materials (here note the case of some science schemes in
the United Kingdom sponsored by the Nuffield Foundation, where the total·
quantity of laboratory apparatus far exceeded the school norms for storage·
space).   In general the successful implementation of any programme will·
depend on a realistic assessment at the outset of such factors as availability
of equipment, competence of teachers, and the prevailing climate of educa-·
tional opinion.

117.   Early attention must be given to copyright arrangements.   The
picture here is a complex one.   Practices vary from country to country
and the basic international conventions are not necessarily suitable for the·
effective development of teaching/learning systems.   But whatever the par-
ticular circumstances, certain general considerations may be noted.   The
ownership of copyright must be determined at the outset — in the case of·
team materials this will usually be the sponsoring agent rather than the·
individual members (the publication of a promising East African science
curriculum programme in Kenya, Malawi and Tanzania was for some years
held up because of copyright disputes).   The *assignment of the licence* to·
produce copyright material (i.e. the choice of publication agent) should also·
be made as early as is practically possible, so that arrangements for large-
scale distribution can be planned well in advance, and a running check·
kept on likely unit costs of materials.   A single agent, or a named consortium,
should be identified: early United States attempts to create a "free market"·
by putting curriculum materials in the public domain (i.e removing copyright
restrictions) resulted in a refusal by any publisher to invest risk capital in·

50

manufacturing and marketing on a non-exclusive basis. However, a vital safeguard for any sponsor is to limit the period during which a license is assigned (in the Nuffield projects a period of seven years from first publication was chosen). This limits the risk of creating a permanent monopoly for a particular producer and makes it possible eventually to transfer to another agent if the initial choice was seriously unsatisfactory. It also enables the sponsor to retain control of the preparation of new editions or to decide that the materials have come to the end of their educationally useful life.

118.   Once the publication agent has been chosen, it is a matter for subsequent decision whether the agent should grant *permission* to *reproduce* the materials at the level of the individual school, college, or university — this point is discussed further in the paragraphs dealing with long term implications.

TRIAL AND REVISION

119.   The trial stage of any set of teaching/learning materials can be seen as an early phase in the process of publication and dissemination. Two main questions pose themselves, both with important cost implications.

120.   The first is whether the initial development costs (possibly including the costs of producing trial materials) are to be written off, or whether an attempt is to be made to recover them from the proceeds of sales of completed materials. Usually, if the sponsor of the programme is a government agency or a non-profit making Foundation the former strategy is adopted to avoid cost levels higher than the market is likely to bear; but if the sponsor is a commercial enterprise this choice is not usually available, and other ways must be sought of limiting total expenditure. A few exceptional cases already exist where a private producer receives funds from public sources to meet the costs of a trial programme (see for example the Hermods "Delta" Mathematics Project in Sweden). An extension of the principle of partnership between the private and public sectors is likely to be educationally desirable, and deserves encouragement.

121.   The second question concerns the extent of the trial programme itself. There is an inevitable tension between the educational researcher, who is concerned with obtaining convincing evidence about effectiveness and ensuring adequate quality control, and the producer, who is concerned with developing a marketable product with the minimum possible delay. The larger and more elaborate the trial becomes, the greater is the likelihood that the resulting published materials will meet market requirements, and the wider is the circle of schools already committed to reform; but equally, the higher are the overall costs of producing and revising trial materials and the smaller is the scope for individual teachers to feel justified in introducing their own creative variations to the resulting system. Normally a mixed strategy is adopted, with small-scale initial trials followed by extensive revision, and much larger-scale final trials followed by limited revision, [the Swedish IMU Mathematics Scheme provides an exemplary model of this process of "formative" evaluation[1]].

1. See also Chapter 2.

122.   Although the idea of testing out prototype materials before final production has now become widely accepted, those concerned with educational radio and television have been slow to adopt it.   Local CCTV installations ·and local radio facilities provide an ideal basis for controlled testing, and every encouragement should be given to national broadcasters to try out at least a sample of their educational programmes in selected local networks, and to collect detailed feedback information, before revising them for general dissemination.   This is all the more necessary where the ·broadcast material is seen as an integral part of a multi-media package whose other components have been subject to systematic trial.

LARGE-SCALE PRODUCTION AND DISTRIBUTION

123.   As has already been suggested, many decisions crucial to the large-scale production and distribution of materials must be made quite early, and those chosen to take responsibility for this aspect of the programme should therefore become involved at the earliest practicable stage.   Even where this happens, prototype materials often have to be redesigned for mass production (e.g. tape materials may need to be re-recorded using professional performers, and illustrative materials redrawn for large-scale printing).   This may introduce certain characteristics which were not present in the trial materials, and such changes need to be carefully monitored to ensure that there is no radical departure from the original specification.

124.   In making its choice of producers, a public sponsoring agency will need first to decide whether to exercise direct production control and buy in the necessary expertise, or whether to contract out the work to one or more existing organisations (both strategies have been adopted successfully: the Educational Development Center in the United States, for example, runs its own specialist film unit; the Schools Council in the United Kingdom, in contrast, farms out its work to appropriate commercial firms). This decision may also be linked with the important question of quality standards.   Clearly, with materials likely to command a very large market and to be used over a substantial period of time, the highest professional standards of presentation can justifiably be demanded: but such demands often become unreasonable in cost-benefit terms where the market is more limited.   Compromise solutions may need to be adopted (such as the use of tape/slide rather than film, or litho reproduction of typescript rather than print), particularly where the material is ephemeral or local in its application.   Locally produced materials designed for a particular audience may in any case be more highly motivating than those produced centrally, and lower quality standards may therefore be acceptable: but even so, there will be an advantage in some professional guidance on production, possibly from an appropriate regional centre.

125.   Methods of financing production may also differ with circumstances.   Thus, even when a sponsoring agency decides to contract out its large-scale production, it may decide to underwrite the costs in full and merely pay the producer a commission fee; or alternatively the producer may be invited to take a financial risk in return for a major share of the proceeds from sale.   In many cases the producer also undertakes the distri-

bution and marketing, but this is by no means inevitable. As teaching/
learning systems become more complex and include more varied forms of
presentation, conventional educational book publishers find it increasingly
difficult to provide the necessary finance and know-how for large scale pro-
duction and may have to limit their activities to marketing. Consequently
the *distribution* function may in future be separated more often than in
the past from the *production* function.

126.   When it comes to distribution, a sponsoring agency may again
choose between setting up its own organisation and contracting with exist-
ing agencies. Because a successful marketing operation will usually depend
on close contact with educational purchasers, which any major educational
publishing company will already possess, the general tendency for public
sponsors has been to contract out of this work. The arguments in favour
are, briefly, (*a*) avoidance of an unnecessary duplication of resources, (*b*)
promoting a useful partnership between the public and private sectors,
(*c*) encouragement of the publishing industry to sponsor its own develop-
ment programmes on the basis of this experience.

127.   Where such a system of contract is adopted for either production
or distribution, it may be important from a national point of view to
assign contracts for different development programmes to different produc-
ing or publishing concerns, so as to avoid creating a monopolistic situation.
However, in some centralized systems, the arguments in favour of setting
up a national production agency may be strong (see for example the
publically owned educational publishing firm, Utbildningsförlaget in Swe-
den). There is, of course, the even more radical possibility (not apparently
taken up so far) of regarding both development and production-distribution
costs as a charge on the central education budget, so that materials may
be supplied free of charge to all user institutions from an official source.

128.   The foregoing comments are intended to apply to any distribution
methods involving the bulk transfer of materials from producer to user.
This has in the past been the normal method of distributing educational
materials. However, the more complex packages which are now being
developed demand more sophisticated distribution mechanisms. Quite new
problems are presented, for example, by the distribution of audio-visual
material by broadcast television in "off-peak" hours which is then video-
recorded for use by an individual school; by the distribution of written
material by sending each user institution a single copy for multiple photo-
copying; and by the dissemination of a whole system of material by com-
puter link. Such methods of distribution, if they become increasingly wide-
spread in the future, will have major implications not only for marketing
concerns (such as publishers) but also for production agents (such as prin-
ters). This point is developed further in the concluding paragraphs of this
Chapter.

INSTALLATION AND USE

129.   The production process cannot be regarded as complete until the
materials are adopted in practice by those for whom they were primarily
intended. This should not be seen as a matter of prescribing what teachers
should do, but of putting them in a position where they can make informed

choices between available alternatives. This implies among other things a greater public scrutiny of the methods of quality control adopted in the production of learning materials. The eventual aim should be to reach a climate of professional knowledge in which a paternalistic attitude towards teachers is unnecessary.

130. There is, in the first place, a need to ensure that individual user institutions are not presented with serious difficulties in acquiring desired materials. Partly, this is a matter of the efficiency of the marketing agency in promoting a good flow of information about the materials in question. The range of such information needs to be widened beyond the usual advertising and mailing of prospectuses, to include exhibitions, demonstrations of materials in use, distribution of sample materials and sets "on approval ": to achieve this may demand close collaboration between publishers and official agencies concerned with information and training. There is already a strong case in some countries for supplementing the normal commercial information channels from publishers, film producers and manufacturers of audio-visual "packages" by setting up a comprehensive national information service, possibly based on an existing central bibliographic system (ultimately, it may be possible to design and organise an international data bank of learning materials, but this possibility is at present remote).

131. The ordering procedure should also be as simple as possible (the user should, ideally, be able to order a complete "package" from a single source), and delivery must obviously be prompt. The problem of cost of materials has already been referred to from the sponsoring agency's point of view. From the standpoint of the user institution it may present a major barrier to implementation. Two methods of helping to surmount this barrier may be briefly mentioned:

    a) giving schools a considerably larger budgetary provision than in the past for the purchase of equipment and materials, or giving each school the freedom to decide within its overall budget what percentage to spend under this heading;

    b) reducing marketing costs by purchasing equipment and materials through a large consortium of educational buyers.

132. If marketing is not itself tightly controlled by the sponsoring agency (i.e. if any school is unconditionally entitled to acquire and use the materials in question), there may arise serious problems of misuse. Where a school does not ensure that its teachers are suitably qualified — if necessary by attending a special course — these teachers may possibly produce such poor results that the material concerned falls into disrepute. This is less likely to be a problem in a highly centralised system; but in a decentralised one, special measures may need to be taken (compare some United States projects where course attendance for users is mandatory with United Kingdom projects, such as the Nuffield Primary French scheme, where some damage has been caused by "freelance" implementation). We may indeed be moving towards a situation in which operating instructions and individualised materials for retraining teachers, as well as special guidance information for administrative personnel, students and (where appropriate) parents, are seen as integral parts of a systems-based package.

133. A further problem, mentioned briefly in the preceding section,

is how far teachers adopting a set of extensively tested materials may be free to introduce their own creative variations on it. Clearly, the more comprehensive and fully validated the package, the less is the scope for local adaptation. But the less the individual teacher can feel personnally involved in the implementation process, the less enthusiastic a user he may prove — and there is ample research evidence to show how powerfully teacher attitudes can affect student performance. The ideal solution would seem to be to build in from the outset the possibility of teacher participation in nation-wide schemes at the regional as well as the local level: the centrally-produced "packages" (which may require official sponsorship) would serve as a basic framework upon which ancillary materials (often produced in association with independent publishers) could be developed both regionally and locally. This would also, in suitable cases, give teachers the opportunity to use existing materials, with which they are already familiar, as part of a flexible package.

134. Another factor affecting teacher motivation may be the degree of choice available between differing approaches to a given subject area. In decentralised systems this choice has been traditional in relation to textbooks, but since package materials are both more expensive to produce and more recent in origin, there is often only one available package at most. There may well be advantages in producing alternative packages based upon genuine differences in approach, thus giving teachers scope for selection (but the differences must be signifiant ones — in the United Kingdom there is a multiplicity of relatively small-scale "modern mathematics" schemes, but because they are all closely similar to one another in content and approach, teachers have merely become confused). In all except very large and wealthy educational systems the number of major packages which it is financially possible to produce may be quite limited (for example the IMU case study indicates that Sweden could not sustain more than three alternative mathematics packages for grades 7-9). Here, surely, there is considerable scope — and a strong economic argument — for international cooperation, where different countries might each develop one agreed approach and the results could then be made available to other countries for relatively inexpensive modification and small-scale testing before being put on the market to compete with different systems developed elsewhere. Even in cases where cultural and educational differences may rule out the possibility of straight forward adaptation, it may be possible for one country to draw on the experience of another by exchanging production personnel rather than the products themselves.

135. Finally, there is the major question, often overlooked, of how far materials need to be continuously developed, rather than being regarded as suitable, in their validated and revised form, for a long period of use (this is, of course, related to the question of «summative evaluation", which is perhaps itself too often seen as a once-and-for-all process). Again, there may be a case for compromise, in deferring major revisions of any package until the sponsors and the users have been able to write off initial investment costs over a reasonable period, while yet making sure that the constantly-changing educational background does not make obsolete the objectives, methodology and subject content of the materials themselves. (This point is, of course, relevant to the remarks made earlier on the desirability of limiting the assignment of copyright licence to a specific period.)

136. When the appropriate time arrives for preparing a new revision of a programme, the process of collecting relevant feedback from existing users must be carefully planned, and a new sequence of redesign, field testing and evaluation in pilot schools must be organised prior to large-scale production.

LONG-TERM IMPLICATIONS

137. The multi-media teaching/learning package is still a relatively new phenomenon: but as experience of developing such package materials grows, a number of changes may be expected in the structure of educational publishing.

138. First, and most obvious, many of the individual educational authors and the specialized educational publishers of today will have evolved into professional scripting teams (often officially sponsored, and perhaps working from some national, regional or local centre for educational development) and large publishing corporations or consortia (bringing together production expertise in a wide range of media). Indeed, the need for script writers and producers to work closely together may lead eventually to a fusion of the two groups, such as has already taken place in educational television.

139. Various other specialisms will also be demanded, including mediators between research and production, evaluators specializing in field testing procedures, and supporting staff concerned with dissemination and implementation. New training programmes are likely to be required if groups of people with the appropriate combination of such skills are to work together effectively in devising, testing and distributing complex learning packages.

140. The facilities necessary for production will be more complex than before. Producers will require not only new kinds of staff but new types of buildings and equipment, including studios for film and tape production, and also perhaps "laboratories" where early drafts of materials can be pretested on small samples of the intended learning population. In some countries, such changes may come about gradually by the consolidation of small firms of producers and publishers into larger units; in others where central government plays an active part in educational planning special production units along these lines might well be set up under official sponsorship.

141. The nature of investment in educational materials is also likely to change. With a package consisting of audio and video tapes, slides, film material and photographic reproduction of typescript, the unit cost of reproducing small numbers of copies is not very much higher than the unit cost of reproducing a large number of copies. Items can therefore be manufactured more or less on demand — there is no need to go to the expense of preparing and storing very large numbers of copies at each printing. This will have the effect of reducing the need for warehouse space, and may also mean a growth in direct mail order sales without the need to go through a wholesale and retail distribution system.

142. Because single copies of many of the materials in a package can

be cheaply reproduced, it will be increasingly difficult to retain the present copyright system. Once a single copy of any package is available in any institution, it will be difficult to prevent that institution making its own additional copies rather than buying them from the marketing agent (this is already happening with language laboratory tapes and photocopies of extracts from printed materials, although it is officially illegal). One possible outcome, as suggested earlier, may be for the bulk transfer of materials from producer to user to be superseded by electronic transmission through computer and/or broadcast links; another, less far reaching, may be for the producer to increase the cost of each package enough to allow for subsequent copying on a large scale by the user. In either case, the future pattern of distributing educational materials will be very different from the familiar print-oriented pattern today.

143. Finally, with the advent of new methods of distribution, the educational market is likely to be extended beyond the institutions in which learning has traditionally taken place. The possibilities of home study will be greatly increased, and more private individuals may wish to participate in appropriately devised programmes. This is already beginning to happen: in Yugoslavia, for example, many householders now view the educational broadcasts originally intended for schools; in the United Kingdom, the Open University deliberately aims to cater for the needs and interests of those outside the formal educational system. The implications for production of this change are likely to be considerable.

CONCLUSION

144. The production of teaching/learning systems will present a whole range of new problems; it will demand the re-examination of many traditional assumptions; and it will necessitate the breaking down of the present barriers between educators and educational administrators on the one hand, and publishers and producers on the other. If production is to be effective, it must be systematically organised and planned. To achieve this, there may be in many countries a call for a new type of central agency providing a range of expert services, including the following:

a) the identification of needs and possibilities for developing new learning systems,

b) the provision of funds to support development work,

c) assistance in the organisation of trials, and in setting standards for quality control,

d) co-operation with producers in disseminating the resulting materials and in creating an informed body of consumers.

THE NEED FOR STAFF TRAINING

145.   Special training is required for those concerned with the intro-
duction and use of learning systems. The nature and extent of this train-
ing will vary according to the degree of involvement in the new learning
system. It may be advisable, therefore, to set out the categories of men
and women who may be affected. Clearly a teacher who is vitally concern-
ed with change requires a more thorough and detailed training than the
administrator or politician who, having been convinced of its value, has
only to give encouragement and to approve expenditure.

1. INITIAL TRAINING OF TEACHERS

146.   It is likely that the need to acquire an understanding of the syste-
matic approach and to acquire competence to put it into practice will
profoundly modify the teacher training system itself. In addition to know-
ing their subject, students will need more than ever before to grasp the
principles and concepts that inform their subjects and the curriculum content
that is relevant to the children for whose learning they are to be respon-
sible. If students are to be expected to use a systematic approach when
they enter the profession, they must themselves learn by a systematic
approach of the same nature. It would be futile to tell students about
individual and small group learning solely by means of a lecture process.

147.   It is essential that a teacher's training should give him a first hand
knowledge of designing a learning situation: he should have the opportunity
of trying and evaluating (however crudely) his efforts during the practical
part of his course. It follows that the assessment of the student's practical
work should be on the total system he has devised and the way he has
handled it rather than on his powers of exposition to a class as at present.
(Incidental schools which are already operating new systems involving indi-
vidual or group work can absorb considerably more students than schools
teaching in the traditional manner.) As some schools will be slow to
respond to new ideas, it is advisable that students should have practical
experience both in a school which has adopted new techniques and in a
school which has not.

2. TEACHER/TUTORS IN TEACHER TRAINING INSTITUTIONS

148.   The introduction of the new ideas implicit in a systematic approach
involves the re-training of college lecturers, who owe their appointment in
colleges to their success in handling quite a different situation.

149.   It is worth making the point here that in the period of continuous change that undoubtedly lies ahead, the concept of life appointment of lecturers to these colleges must be questioned. It is suggested that one of two systems should be introduced. The first is that all appointments should be secondment from teaching for five years and should be followed by a compulsory return to the classroom for five years. Secondly, if this is too drastic, at least they should return to the classroom for a year after five years, their places for the year being taken by practising teachers who would also help to keep the training college linked to reality. Though in itself desirable, it is not felt that the practice of lecturers teaching for one afternoon a week in schools is sufficient — their position is artificial, their task too easy.

150.   An important function of teacher training institutions will be the production of new materials both for use in the college and in the schools. In this way students will acquire experience in the theory and practice of preparing new materials.

3. PRACTISING TEACHERS

151.   The keystone of any policy of implementation must lie in the retraining of the teachers themselves. The problem here is to break down the innate opposition to change, particularly to a change in role, that exists among most teachers. It is clear too that they need a knowledge of the systematic approach not only to enable them to understand the reason for new systems when they are introduced, but also to modify these intelligently and to create at least parts of new systems themselves.

152.   To undertake the retraining of teachers is really to design a learning system, the objective of which is the encouragement of teachers to examine what they are doing and to consider other and possibly more effective ways of doing it .

153.   Six lines of approach appear possible.

a) *Within the school itself*

  i)   Either by the introduction of a trained "outsider" who joins the staff and works with a small group of teachers for a term of a year, using a process by which the teachers are first asked to work out what they really think their objectives are, evaluate whether they are achieving them and then consider methods by which they could more successfully do so, including the making of necessary materials. If this is successfully done with one section of the school and if it has support from the administration their methods may well spread to the remainder;

  ii) or by turning the whole staff, with pupil representatives, and under the guidance of an outside non-directive leader, into a two or three day workshop to carry out the same process as in (*i*). This has been tried successfully in Norway.

b) *The involvement of the teacher in making curriculum materials*

    This can be at three levels:

60

i) Within a school, but helped by advice and backing services from some regional organisation which also could see that in fact a basically systematic approach is applied. This involves the essential understanding that a teacher's salary is not tied to the hours *he teaches:* in many countries a new payment system may be needed.

ii) Within a region, where a regional organisation is set up, with adequate premises and services, to which full or part-time teachers are seconded from a small group of schools to make curriculum materials agreed upon by all of them: two such organisations exist in Oxfordshire and Leicestershire in England.

iii) At a national level, when the material developed by a national team is tried out and modified at a local level. This involves training teachers in the use of the material and, incidentally, in understanding the system behind it.

c) *Identifying and disseminating good examples of new parts of learning systems within schools*

The technique here is to find out where good work is being done, to support it with money or services, to get the teacher to write up his work, and to disseminate it by sending a news-sheet to the *private* address of all relevant teachers. This method which has been used in Belgium, acts as a reward to enterprising teachers, and also makes it much more probable that other teachers will read about new methods — incidentally the news-sheet is free.

d) *The introduction of new curriculum materials*

This can be a potent method of retraining only when linked to other retraining methods or where the material assumes a *method* and role not too different from the existing one. This approach is more likely to be acceptable the less rigorously the material is presented as a compulsory whole. If the teacher is told he may use bits, or leave bits out, he will feel free — even if in fact he uses 95 per cent of it in the end!

e) *By short courses outside the school*

Logistically it is impossible to give all teachers a long period of retraining. Short courses for the whole teaching body may not be as effective as much longer courses for a selected minority who will influence the rest, particularly if those chosen for the longer courses are the next generation to occupy positions of power — the potential headmasters, advisers, teacher trainers. But, whoever the courses are for and however long they are, they should be concerned with the practical making of learning systems which are to be tried out in practice. As with teachers' initial training, it is essential that the method used on the course is systematic itself; this means there is little place for the information lecture but much for small group discussion and practical workshop sessions.

Where numerous really short courses are envisaged, the making of a central "package" which leads people through the process could be of help to local organisers. One such package, which can also be used as an

61

individual learning system by a teacher is being constructed in Sweden. A possible organisation for a short retraining course has been used at the Harvard Department of Education. This consists of hiring a school and children — who are paid — for a three week period in a holiday. Teachers are divided into three groups; each group spends a week preparing materials, a week teaching them, and a week evaluating another group's materials. This is linked with initial preparation before the course.

f) *The forcible change*

There are situations, particularly when the basic role of the teacher is not threatened, when a forcible change, carried out as sympathetically as possible, and backed as much as possible by some reward to teachers in terms of ease of hours or additions to salary for retraining, can rapidly become effective. Such a method will always cause a temporary drop in efficiency but there are circumstances when this is acceptable. It is necessary to remember that the sound and fury produced at the thought of a change may in fact come from fear of inadequacy in a new situation: when the situation is faced and overcome, a process of identification with the new system begins. There are many examples of this, including the introduction of new mathematics in Belgium or the introduction of comprehensive education in many parts of England.

One overriding consideration must always be how radical any change proposed is to the recipient: evolution is relatively easy, revolution requires power: however, such power need not always come from above — as the students have shown, it can come from below as well!

4. HEAD TEACHERS, INSPECTORS AND ADVISERS

154.   This is a most neglected area in most countries: training for these highly influential posts consists of nothing more than experience of classroom teaching. It is in fact those who have been successful in teaching who are promoted — despite the fact that their new role is quite different. Some countries do have an examination before an applicant can be considered, but these are rarely backed by actual training. In these times, it is felt that not only initial training is required, but refresher training at least every five to seven years.

155.   The two main goals of such training should be:
   i)   The understanding of new learning systems and how they are designed — the goals, the system itself and the evaluation of it;
   ii)   the application of a systematic approach to the management of the institution itself — the establishment of institutional objectives, possible systems of organisation, and evaluation of the total institution. This also involves a knowledge of administrative and management techniques, and understanding of the possible role of machinery, including computers, in such management. Such knowledge will be necessary even where an additional administrative assistant is appointed — as he certainly should be in all large institutions — to handle the non-professional administration. It is essential to realise that the system of management is in itself a teaching system. Children will learn more about government

and relationships from this than from any course on civics. Thus an authoritarian management will teach an authoritarian attitude, a participatory democracy a quite different attitude.

156.   All courses that are set up for the purpose of training head teachers, inspectors and advisers should be of reasonable length as a process of rethinking cannot be too fast — it is suggested that it may demand anything from a term to a year. All such courses should allow ample time for case study and role playing methods, and should involve students in attempts to plan real or imaginary institutions. Again the lecture element should be limited.

157.   The retraining after five or more years is equally vital, but this could perhaps take on the nature of a sabbatical term or year in which the student follows a line of study of his own for much of the time. Above all, he needs to stand away from his own institution and to see it from a new point of view.

5. ADMINISTRATORS

158.   It is common in many countries for administrators to have no real understanding of education: in others, they have been recruited from the profession but have no retraining after this. In the administration of a static educational system, this deficiency was of little importance: but now that they have to make decisions on a rapidly changing spectrum, they are inadequately equipped. The training that they need is much the same as for the previous section but with less detail on institutional management and with an additional section on the systematic approach to larger sub-systems of the total educational system of the country itself. It would probably be of value for such courses to be run in conjunction with those for the training of headmasters and inspectors; again there will be need for refresher courses every five or more years. Basically, the value of training of administrators will be to enable them to encompass innovation and to take policy decisions in co-operation with teachers. This group will derive benefit from interregional and international contacts and seminars.

6. ANCILLARIES

159.   The use of non-professional staff is likely to increase with new teaching/learning systems. If these "support troops" (technicians, resource librarians, and non-professional teaching staff) are to contribute effectively to the work of teachers in the front line, they will need appropriate training and a career structure. Their training should include, apart from particular skills, an introduction to the objectives and processes of education so that they can appreciate how their work fits into the school environment. Arrangements for retraining after a number of years in order to learn new techniques will be essential.

160.   To be fully effective, a co-ordinated programme of training at all these different levels (student teachers, qualified teachers, trainers of teachers, heads, administrators and ancillary staff) must be planned on a national basis by the responsible government department, and should involve the co-operation of all relevant training agencies and institutions.

Chapter 7

NEW AGENCIES FOR INNOVATION

161.   Major changes cannot be made overnight, least of all in an educational system one of whose purposes in any community is to preserve traditional culture and whose teachers are conservative in the best sense. One of the main dangers in the promotion of change — however inevitable and necessary in face of the demand for increased quantity of education accompanied by limited financial resources — is to think that structural changes in the overall organisation of the system are necessary and sufficient to achieve the change desired. A massive organisational upheaval may, in fact, be disadvantageous since the larger the units of the educational system, the greater the inertia arising from a hierarchical structure in educational institutions; moreover, in change imposed from above, teachers tend to concentrate their energies on preserving their own status and security rather than on appreciating the reasons for change.

162.   It is even possible that had more consideration been given earlier to a systematic approach to the teaching-learning process such as outlined in chapter 4, some of the present need for major re-organisations at school and college level would have proved unnecessary. Educational technology could have overcome some, at least, of the shortcomings of smaller institutions while retaining their less formal structure.

163.   Although suggestions are made later in this chapter for the extension of existing institutes and the establishment of new ones, it must not be thought that the networks proposed are sufficient to effect significant change. More important is the climate of opinion within educational institutions and the motivation and support they receive. To get innovation going, the selection of the right institutions to co-operate in experiments, and especially in the testing of learning systems, is essential. Selection will depend on the existence of favourable conditions, among the most important of which is a staff open to new ideas not only in relation to curricula but also to fundamental changes in organisation. Newly opened schools where staff and equipment can be geared to innovation provide obvious opportunities for experiment, but more will be achieved more quickly if change can be promoted in older schools that are respected by the local community.

164.   Equally essential is the selection of teacher training institutions willing to change radically their methods of teacher education; selection here will also be based on the proximity of innovative schools. One would assume that if the partnership between colleges and schools was soundly

based, the staff of each, the students and the pupils would be so organised as to form one single enterprise; one would also anticipate that students from the colleges would be in great demand from schools anxious to join in innovation but whose staff needed strengthening.

165.   If partnerships of this nature could be formed they would fit in well with development institutes which could provide the practical research, development and monitoring they would need.   But none of these undertakings can get very far without financial support — for research, development, for equipment and minor alterations to buildings.   Perhaps the quickest way of achieving results would be to give a budget for innovation to an institute, a laboratory or a partnership between schools and colleges and to say "this is what can be spared for this purpose, now do the best you can with it.   You may, however, also use for this purpose part of your budget received for other purposes if you wish to do so".

NATIONAL INSTITUTES FOR PLANNING AND INNOVATION IN EDUCATION (NIPIE)

166.   It is recommended that national governments make provision to establish national institutes for planning and innovation in education (NIPIE), or if such institutes exist already, to extend their mandate in the light of present changes and developments in society and education.   The creation of such institutes took place in some countries during the '50s and '60s when they were suddenly confronted with problems which they had not foreseen.   Reflecting the nature of these problems, these institutes were primarily charged with quantitative and economic planning, i.e. with the forecasting of student flows, teacher and equipment demands.   A second set of activities in the early '60s was oriented towards structural changes in some universities, research institutes and schools.   The shortcomings of this quantitative and structural orientation are only now becoming obvious: in recent years, partly as a result of student unrest, there is a growing awareness of the need for a new emphasis on qualitative educational problems, on questions about the goals of our educational systems, on the curricula we introduce, and the methods through which we try to achieve educational goals.

167.   At present, then, educational ministries, national boards and committees tend to be absorbed in quantitative planning and in logistic provision.   Indeed, organisations charged with qualitative considerations sometimes find themselves increasingly preoccupied with the problems of implementing in quantity their qualitative innovations.   *Qualitative planning needs,* therefore, to be protected by deliberate *institutionalisation.*   Moreover, quality planning needs a much clearer priority than it gets at present, since it should precede rather than follow quantitative planning.   It seems highly unlikely that the quality of educational outcomes can be improved unless changes in the structure of educational institutions are preceded by reconsideration of the goals of education, and by the adoption of the methods necessary to achieve these goals.

These considerations apply as much at the regional and local as at the national level.   Of course, the stress on the need for qualitative planning must not lead to a new imbalance in which quantitative issues are neglected: the two are essentially complementary.

168.   The functions of a national institute for planning and innovation in education in relation to the qualitative aspects and to the incorporation of development products into practice might usefully include:

— promotion of basic long term educational research where necessary;
— conducting and commissioning research and development and application (RDA) of learning materials and systems;
— co-ordinating evaluation and carrying out research work insofar as this is essential to its other functions;
— establishment of an information centre and network;
— co-ordination of R and D work carried out by other institutions;
— provision of information and advice on educational reforms for the guidance of political decision makers, and educational administrators.

169.   In some Member countries institutions similar to the one suggested, already exist, namely the National Board of Education in Sweden, the Council of Innovation in Norway, the Schools Council for England and Wales. The differences between them are great: whereas the NBE is highly influential, often being regarded as a Ministry in its own right, the Schools Council of England has relatively less political influence. This is partly due to the fact that Sweden has a centralized educational system while the English system is decentralized. None of these existing models is entirely satisfactory, and it is recommended that new models should be introduced in the light of the above-listed functions.

EDUCATIONAL DEVELOPMENT INSTITUTES (EDI)

170.   Whereas the recommendations as to national institutes for planning and innovation in education apply to any educational level (pre-school, primary, secondary, higher and further education), the following suggestions focus more on the pre-school, primary and secondary school levels.
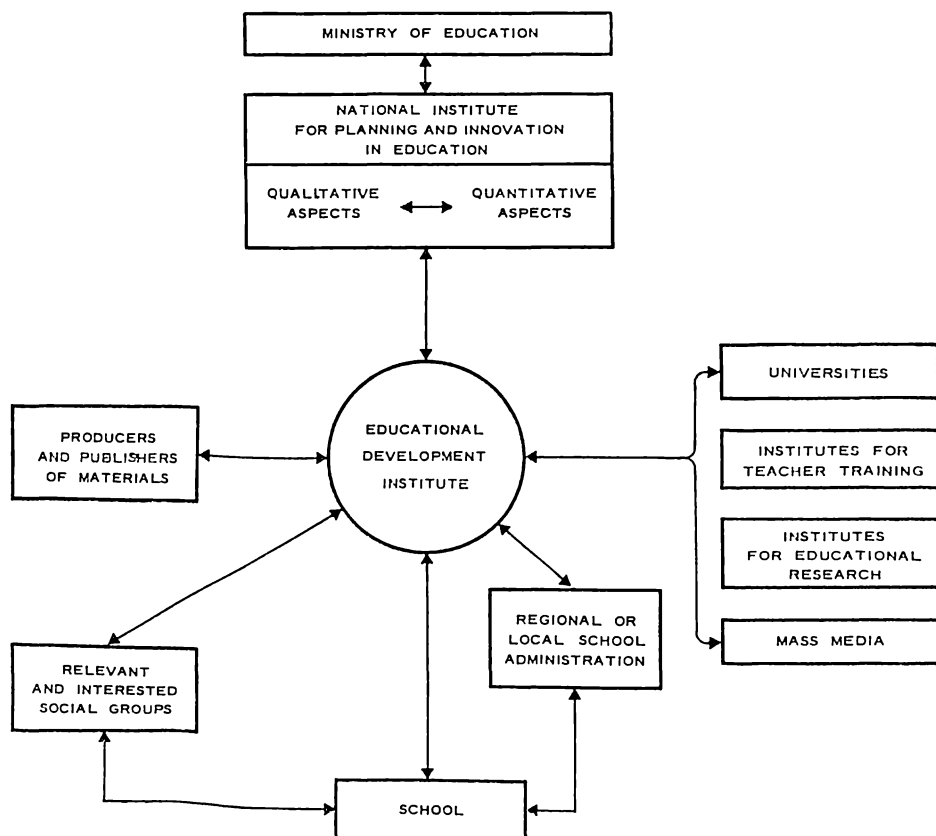
171.   It is recommended that educational authorities in co-operation with the NIPIE provide for the creation of educational development institutes (EDI) on a regional or local level. This concept has already been developed within the context of the USA in terms of the Regional Educational Laboratories, a number of which have functions similar to those proposed below:

— undertaking of curriculum programmes, i.e. design, development, prototype production and evaluation of learning systems;
— appropriate collaboration in marketing and distribution of learning systems;
— co-operation with schools and local educational authorities to promote the implementation of learning systems;
— provision of information, help and assistance to schools which participate in educational innovations (changes in school administrations, ad hoc in-service training for teachers, school management advice);
— carrying out of R and D appropriate to the functions of the institute.

172.   Table 2 sets out the communication network such an institute might need to establish in order to conduct its work, and to facilitate a mutually beneficial information flow within the educational system.

173.   It is essential that such institutes for educational development establish a close link and co-operate with the National Institute for Educational Planning on all matters of mutual concern.   Apart from the fact that the National Institute will probably finance regional institutes, or at least certain of their projects, its function would include the co-ordination of the work of the regional EDIs.

TABLE 2.   COMMUNICATION NETWORK OF AN EDI

MINISTRY OF EDUCATION

NATIONAL INSTITUTE
FOR PLANNING AND INNOVATION
IN EDUCATION

QUALITATIVE   QUANTITATIVE
ASPECTS   ASPECTS

EDUCATIONAL
DEVELOPMENT
INSTITUTE

UNIVERSITIES

INSTITUTES FOR
TEACHER TRAINING

INSTITUTES
FOR EDUCATIONAL
RESEARCH

MASS MEDIA

PRODUCERS
AND PUBLISHERS
OF MATERIALS

REGIONAL OR
LOCAL SCHOOL
ADMINISTRATION

RELEVANT
AND INTERESTED
SOCIAL GROUPS

SCHOOL

174.   Depending on the nature of the work of the regional institutes, they should co-operate with, and inspire, interaction with a variety of other institutions and social groups such as universities, teacher training and research institutes which should be seen both as intellectual and human resources.   Liaison and co-operation among these bodies could be either permanent or temporary.   To take an example of a permanent association, a university department, being the basic research organisation, can feed its findings into the regional institutes for development and application.   Alternatively, where the link is on a temporary basis related to individual pro-

jects, the university, and institutes for teacher training or research can act as a consultant seconding some of its own members for a period of time to assist in the development of the project. Similar contact would have to be established with mass communication institutes, public organisations and social groups for the development of certain projects.

175.   Co-operation with publishers and other producers of learning equipment is also of great importance. Thus the marketing and distribution function of educational development institutes should receive close attention: it should be regarded as an integral part of the Research, Development and Application (RDA) processes. Unless the distribution system is properly monitored and the same channel is used to provide evaluation and feedback on the effectiveness of learning systems, there is no guarantee that the products of the development institutes will have any significant impact.

Chapter 5 argues that it is possible and, in some cases, desirable for new material to be supplied directly by the publisher to the school or local authority. Where this happens, special arrangements must be made to ensure direct feedback to the development institute.

176.   Equally as important as the contacts with producers and publishers is the connection between the Educational Development Institute and the Schools.

177.   If qualitative planning and the work of educational development institutes are to be effective, the contribution that teachers and students can make must be fully utilized. Probably the most practical way of exploiting new ideas coming from schools is through *resource centres* serving a single school or a small local group of schools. In addition to serving as a library for books, films and material of all kinds, a resource centre can usefully undertake the following activities:

— acting as contact agency with development institutes;
— co-operating with the local educational administration in the servicing functions for the school;
— receiving, storing, forwarding (within school) learning systems and information about them;
— assembling and forwarding to other institutions, especially the EDI, evaluative data;
— occasional production of learning material (minor modifications, additional material, film/photo and slide laboratory, technical workroom, etc.);
— in-service training within school.

178.   There are different models for establishing educational development institutes. They could take one of the following forms:
1.   independent institutions of a non-profit making nature;
2.   linked to and co-operating with teacher training colleges;
3.   attached to a university.

179.   Of these models, it may be remarked that the last would appear to be the least desirable. The institute would be far likely to exceed the

normal size of university institutes. Apart from size, it would call for procedures and methods not normally adopted in academic research. The second model has the advantage over the first that communication and co-operation between developers and users can be very close. Where the first model is adopted contact can be established in relation to a specific project with a particular university or college which may be interested in it. Whatever model is selected it is recommended that the institute should be set up as a non-profit making enterprise with limited liability and that any profit should be ploughed back into research and development.

180.   In conclusion it may be said that in education, as in industry, though communication from the top downwards is easier to organise, one-way traffic of ideas is as over-rated as it is inefficient. Thus the impact of innovations will to a large extent depend on whether upward and horizontal communication channels can effectively be introduced or not. A failure to establish feedback mechanisms in the proposed network will not only call into question the concept of a system itself but will also result in innovations being outdated even before they are fully introduced. Without two way communication we shall never succeed in narrowing the gap between present shortcomings and future needs.

SUMMARY OF CHAPTERS

Part I. EDUCATIONAL TECHNOLOGY

The Nature and Design of Learning Systems

Chapter 1. FROM TEACHER-BASED LEARNING TO ENVIRONMENT-BASED LEARNING

181.   The distinction between learning and being taught is significant: it involves a change of emphasis to active learning associated with the provision of resources to which the learner has direct access. These resources can take the form of "packages" (consisting of texts, tapes, slides, recorded broadcasts, etc.) which will form the core of a learning system to be supplemented by class lessons, group work, discussions and additional material under the guidance of the teacher. It is recommended that schools should be equipped with resource centres and with individual study carrels provided with headsets, slide projectors, etc.

182.   Apart from the greater independence of learning that accompanies the use of packages, they have other advantages. For example, they assist children who have been absent through illness or whose parents are mobile: they enable small schools or small units in the senior part of the school to overcome the problems of the wasteful use of staff and the shortage of certain specialist teachers.

Chapter 2. PRACTICAL ISSUES IN DESIGNING LEARNING SYSTEMS

183.   The design of learning systems requires the statement of general goals, the definition of specific objectives and a method of ascertaining that the goals and objectives are being achieved. The first is a matter for decision at community level: the second can most effectively be undertaken by the teams who are actually designing the system in consultation with teachers. To ensure that objectives are being met, feedback and evaluation are essential elements in the design. As no learning system can ever be final, there must be frequent revision and continuous adaptation of any completed system. Few learning systems will be complete in themselves: most will take the form of a "core" to which open-ended elements can be added by the teacher. His role will change from that of a purveyor of information and an instructor to that of manager, motivator and guide. Methods and media are inseparable and a clear understanding of what the latter can achieve is an important element in the design of a learning system.

71

Chapter 3. APPRAISAL, EVALUATION AND COSTING

184.   It is recommended that more attention should be given to appraisal and evaluation: they are the means not only of determining whether objectives have been achieved but also of improving the learning process (feedback). Evaluation should become an integral part of our daily work in education, and it should be given special consideration in our thinking about content of new curricula for teachers and when assigning functions to new institutions.

185.   The techniques of evaluation of cost-effectiveness in education are at present severely limited and there is need for further investigation of planning, programming, budgeting systems and of more advanced techniques being developed in the United States and elsewhere. Meanwhile certain general arguments can be advanced to demonstrate that new learning systems are capable of achieving greater effectiveness in terms of what learners can do and of more economical use of time (both of learner and teacher), equipment and space.

186.   If new systems result *only* in an education up to a given level for a greater number of learners at a reasonable cost increase, many of the problems facing education today will be surmounted.

Chapter 4. A SYSTEMATIC APPROACH TO THE TEACHING-LEARNING PROCESS

187.   Because all Member countries are experiencing the need for more and better education, it is recommended that a systematic approach be adopted. Central to such an approach is the design of learning systems which seek to improve the quality as well as increase the quantity of education: and which enable the learner to assume a more active role and the teacher a more creative one. A systematic approach also demands a re-examination of managerial functions in schools and in the administration of education at local, regional and national levels.

188.   The application of educational technology is one important part of a systematic approach, affecting the whole relationship between teacher, media and learner, as well as the surrounding institutions.

189.   It is recommended that a check list of constraints (frame factors) be drawn up within which a systematic approach must operate. Though the significance of these factors will vary at different levels of decision making their interaction constitutes the essential point of departure for any strategy of implementation. A check list of frame factors is suggested and a brief illustration of how it can be used is given.

Part II.   WHERE AND HOW TO START

Towards a Strategy of Implementation

Chapter 5. THE PRODUCTION OF TEACHING-LEARNING SYSTEMS

190.   The identification of needs for development and production programmes should be more systematised. This inevitably involves closer

collaboration between commercial publishers, producers and educational agencies.

191.　　Minimum standards should be set for quality control in terms of testing and revision of learning systems before they are published.

192.　　The dissemination of learning systems should be carefully planned as an integral part of the production process and should involve improved methods of distributing information and of training teachers.

Chapter 6. THE NEED FOR STAFF TRAINING

193.　　New learning systems cannot be introduced without a systematic approach to training: it should embrace not only teachers and trainers of teachers but also heads, administrators and ancillary staff. Various strategies especially for in-service training are suggested but a fully effective policy can be determined only at national level.

Chapter 7. NEW AGENCIES FOR INNOVATION

194.　　Major advances can come about only if more attention is given to qualitative planning. To achieve this, it is recommended that every Member country should establish a department of qualitative planning linked with educational development institutes at local and regional level. The relationship between these institutes, publishers, teacher training and research agencies and schools needs to be carefully mapped out and some models are suggested.

195.　　It is recommended that resource centres in schools should also play a part in qualitative planning and should be closely associated with development institutes. Changes will take time: the rate of progress will depend on the climate of opinion within educational institutions, on the motivation they are given, and on the support they receive.

.

SUMMARY OF MAIN CONCLUSIONS

The following are not recommendations, but merely an attempt to summarise the essential conclusions which can be drawn from this report.

196.   Educational Technology must be looked upon as having departed from the rather narrow concept linked to the use of technologies and having begun to represent a lasting and viable approach to the operationalisation of curriculum research, thus contributing to the improvement of the quality of learning outcomes. Moreover, it must be understood that it has wide implications in terms of its impact on the whole educational system. To assure the correct measures in its institutionalisation, thorough analyses of the' "frame factors" of the learning process should be carried out in order to supply the necessary background information for any strategy of actions. (Chapters 1, 2 and 4).

197.   To warrant the efforts of the educational development institutes, suggested below and to bring aspects of quantitative and qualitative educational planning into the right balance, concomitant changes will have to be introduced at all levels of the national educational system. In this respect, the strengthening or creation of new National Institutes for Planning and Innovation in Education (NIPIE) seems inevitable. (Chapter 7.)

198.   The demand for continuous innovation in schools could best be met through the establishment of regional or local Educational Development Institutes (EDI) whose task would be to promote curriculum research and its operationalisation through educational technology, i.e. the design, implementation and evaluation of learning systems. (Chapters 7 and 4.)

199.   To implement the product of Educational Development Institutes and to establish an effective communication system, each school should have a Resource Centre, which would act as an intermediary between them and the Development Institutes. Schools and Development Institutes should co-operate closely in the establishment of the Resource Centres in order to specify their functions and to bring them into line with the activities carried out by the Development Institutes. (Chapter 7.)

200.   The introduction of new curricula and learning systems will necessitate changes in teacher performance and school management. In fact teachers will play a decisive role in the success or failure of introducing new qualities into school life. It is therefore necessary that initial and in-service training programmes for teachers be set up. In-service training

programmes should especially be devised for head teachers, inspectors and administrative personnel. (Chapter 6, and chapters 1 and 4.)

201. The introduction of new learning systems will probably entail increased employment of para-professional staff such as technicians, resource librarians and teacher aides. To identify the exact nature of this development and its implications for changes in resource allocations, study groups would have to look further into the problem at a national level and elaborate suggestions as to the recruitment of personnel, career structures and training programmes. (Chapter 6.)

202. The large-scale production and distribution of learning systems requires new forms of co-operation between developers of such systems, producers, publishers, users (i.e. teachers and students) and educational authorities. The increased readiness on the part of industry to involve itself in educational projects is not met by a similar degree of activity from educationists, and it is highly desirable that they become more aware of the problems implicit in such multilateral co-operation. This could be achieved by setting up ad hoc working groups to study the production problems of new learning systems, standards of quality control, and possibilities of co-operation in development projects. As many countries are at a similar level of development in this respect, international organisations could facilitate an exchange of information between countries and help bring about international co-operation in development projects and in the transfer and adaptation of learning systems from one country to another (Chapter 5.)

203. Topics such as evaluation and appraisal, costs of programmes and learning systems, cost-benefit and cost-effectiveness analyses, and PPBS-systems have become prominent issues in educational discussions, yet little information or experience is available about them, and no procedures, techniques or methodology exist which could readily be applied in practice. Research and development needs to be sponsored by grant commissions and national authorities to help overcome the gap between the needs of practitioners and researchers and the availability of appropriate instruments. (Chapter 3.)

LIST OF PARTICIPANTS AT THE WORKSHOP "EDUCATIONAL TECHNOLOGY - STRATEGIES FOR IMPLEMENTATION"

Belgium

Mr. DECAIGNY

Inspecteur
Ministère de l'Education Nationale
Organisation des Etudes, Centre Administratif
Arcade, Bruxelles

Mr. MERTENS

Inspecteur
Ministère de l'Education Nationale
Organisation des Etudes, Centre Administratif
Arcade, Bruxelles

Denmark

Mr. Bent GREGERSEN

Chief Engineer
Institute of Technology,
Hagemannsgade 2, 1607 København K

Mr. Sven HESSELHOLT

Deputy Head of Department,
Denmark's Teachers College
Emdrupvej 101, DK 2400 København NV.

Finland

Mr. Erkki AHO

Ministry of Education
Rauhankatu 4, Helsinki 17

Dr. Harry KRONQVIST

Ministry of Finance
Aleksanterinkatu 36 B, Helsinki 10

Germany

Mr. August KEIL

Gymnasialprofessor
Leiter der Zentralstelle für Programmierten
Unterricht an den Gymnasien in Bayern
Gymnasium bei St. Anna, Augsburg

Mr. Reeb

Oberstudienrat
Bremen, Rablinghauser Landstrasse 70

Mr. Th. Wachsmann

Koordinierungsstelle für EDV—Anwendungen im Bildungswesen
Stuttgart, Königstrasse 32

Italy

Dr. I. de Lotto

Centro Studi per l'interazione, Operatore-calcolatore
University of Bologna
Via Risorgimento 2, Bologna

Dr. Aldo Romano

University of Bari, CSATA
Istituto di Fisica
Via Amendola 173, Bari

Netherlands

Mr. A. J. Dûermeyer

Ministry of Education and Science
Prins Hendrikstraat, 33 The Hague

Drs. H. J. Jacobs, Jnr.

Pedagogical Centre, Amsterdam
Buitenveldertselaan, 106 Amsterdam

Drs. D. de Jong

Department of Education
State University of Leiden
Karel Doormanlaan, 80 Oegstgeest

Mr. W. C. M. van Lieshout

Principal Technical College
Sansovinstraat 1, Eindhoven

Dr. A. G. de Man

Wolters-Noordhoff, N.V., Publishers
Goeman Borgesiuslaan, 13 Groningen

Prof. Dr. E. Velema

University of Nijmegen
Karekietstraat, 27 Velp-Zuid (Gld.)

Norway

Mr. Olav Lindal

Consultant
Forsøksradet for Skoleverket
Sandakervn 56 (vi), Oslo-Dep

Mr. Arne Solstad

Research Consultant
Forsøksradet for Skoleverket
Sandakervn 56 (vi), Oslo-Dep

Spain

Mr. A. DE LA ORDEN HOZ

Directeur du Cabinet d'Evaluation, Méthode et Moyens Audiovisuels
Ministry of Education
Alcala 34, Madrid 12

Mr. J. M. PAREDES GROSSO

General Secretary of the Centro Nacional de Investigaciones
para el Dessarrollo de la Educación
Ciudad Universitaria - Madrid

Sweden

Eskil BJORKLUND

Avdelningsdirektor,
Universitetskanslersämbetet
Box 16 334 — 103 26 Stockholm 16

Anne Marie FURUMARK

Rektor
Utbildningsförlaget
Fack, 104 22 Stockholm 22

Dr. B. HOLMBERG

Verkställande direktör
Hermods,
205 10 Malmö

Esse LÖVGREN

T. f. avdelningsdirektör
Skolöverstyrelsen
Fack, 104 22 Stockholm 22

Gunnar MARKESJÖ

Universitetslektor
Tekniska Högskolan
Fack, 104 44 Stockholm 70

Dr. N.-E. SVENSSON

Universitetskanslersämbetet
Box 16 334, 103 26 Stockholm 16
Drotninggatan 7-9

Erik WALLIN

Universitetslektor
Pedagogiska Institutionen
Mölndalsvägen 36 — 412 63 Göteborg

Switzerland

Mr. Hans U. BAUMANN, Dipl. Math. ETD

Gymnasiallehrer
Pestalozzistrasse 24, 8032 Zürich

Prof. Hardi FISCHER

Swiss Federal Institute of Technology, Department of Psychology
Pestalozzistrasse 24, 8032 Zürich

Turkey

Mr. Yusuf Oner TOY

Directeur pour l'Enseignement technique
Ministry of Education, Ankara

United Kingdom

Mr. G. HUBBARD

National Council for Educational Technology
160 Great Portland Street, London, W.1

Mr. J. G. MORRIS

H.M.I. Scottish Education Dept.
8 George Street, Edinburgh, EH2 2PF

Miss J. LITTLE

Longmans Green and Co. Ltd.
Longmans House, Burnt Mill
Harlow, Essex

Mr. L. C. TAYLOR

The Nuffield Foundation, Resources for Learning Project
Tavistock House South
Tavistock Square, London, W.C.1

Mr. R. A. MACDONALD

Chief Inspector
Ministry of Education for Northern Ireland
Dundonald House
Upper Newtownards Road, Belfast 4

United States

Prof. Ray CARPENTER

University of Georgia
New Psychology Building
Athens, Georgia, 30601

Dr. Andrew MOLNAR

Instructional Materials and Practice Branch
Dept. of Health, Education and Welfare
Office of Education
Washington, DC 20201

Yugoslavia

Prof. Dr. Dragutin FRANKOVIC

Directeur de l'Institut pour l'Enseignement
Beograd, Ul. Draze Pavlovica 15

Dr. Ivan FURLAN

Counsellor
Institute for Advancement of Elementary Education
Tig. yoze Vlahoviča 6, Zagreb

CERI

Dr. Klaus HINST

Mr. Per DALIN

Technical experts

Mr. R. A. BECHER

The Nuffield Foundation
Nuffield Lodge
Regent's Park, London, N.W.1

Mr. T. McMullen

Countesthorpe College
Countesthorpe near Leicester

Mr. George Taylor

604 Stonegate Road, Moortown, Leeds 17

Observers

Mr. Michael Hubermann

Dept. of Higher Education, UNESCO
16, place Fontenoy, Paris (7e)

Mr. H. J. L. Jongbloed

Direktor Dutch Institute for Audio-Visual Teaching Aids
Sweelinclplein 31-33, The Hague

ALLOCATION OF PARTICIPANTS
TO SMALL-GROUP DISCUSSIONS

Topic 1: Possible Combinations of Means and Media for Learning Systems: Implications and Consequences of their Use.

Members

CARPENTER	MACDONALD
DECAIGNY	MERTENS
FRANKOVIC	PAREDES GROSSO
FURUMARK	TAYLOR
KRONQVIST	

Topic 2: Techniques and Procedures for Designing Learning Systems.

Members

BAUMANN	JONGBLOED
BECHER	LITTLE
BJÖRKLUND	MARKESJÖ
DE LOTTO	REEB
DÛERMEYER	ROMANO
JACOBS	WACHSMANN

Topic 3: Frame Factors of the Teaching/Learning System and their Meaning for a Strategy of Implementation.

Members

AHO	HOLMBERG
DE MAN	LIESHOUT
FURLAN	McMULLEN
GREGERSEN	MOLNAR
HINST	SOLSTAD
HESSELHOLT	

Topic 4: Problems of Appraisal and Evaluation.

Members

DE JONG	LINDAL
DE LA ORDEN HOZ	LÖVGREN
FISCHER	MORRIS
HUBBARD	VELEMA
KEIL	WALLIN

Topic 5:   Problems of Implementation in Relation to Personnel.

Members

AHO
DE LA ORDEN HOZ
FISCHER
GREGERSEN
HESSELHOLT
KEIL
LIESHOUT

MACDONALD
MCMULLEN
MARKESJÖ
MERTENS
WACHSMANN
WALLIN

Topic 6:   Organisational Aspects and Problems of Institutionalisation

Members

BJORKLUND
HINST
HUBBARD
HUBERMANN
JACOBS
JONGBLOED

MORRIS
REEB
ROMANO
SOLSTAD
TAYLOR

Topic 7:   Problems of Implementation in Relation to Production

Members

BAUMANN
BECHER
CARPENTER
DECAIGNY
DE LOTTO
DE MAN
DÛERMEYER
FURLAN

FURUMARK
HOLMBERG
LITTLE
LÖVGREN
ONER TOY
PAREDES-GROSSO
SVENSSON

Topic 8:   Economic Considerations: Cost-Analysis and Cost-Effectiveness.

Members

DE JONG
FRANKOVIC
KRONQVIST

LINDAL
MOLNAR
VELEMA

84

Appendix III

LIST OF BACKGROUND PAPERS
(available at request from OECD-CERI,
2, rue André-Pascal, Paris-16e, France)

No.	1	CERI/CT/70.40	A Systematic Approach to the Teaching/Learning Process	K. HINST
No.	2	CERI/CT/70.41	Frame Factors of the Learning Process and their Meaning for a Strategy of Implementation	K. HINST
No.	3	CERI/CT/70.42	Planning of Teaching/Learning Systems	E. WALLIN
No.	4	CERI/CT/70.43	Problems of Implementation in Relation to Production	R.A. BECHER
No.	5	CERI/CT/70.44	Organisational Aspects and Problems of Institutionalisation	G. HUBBARD
No.	6	CERI/CT/70.45	Design Techniques for Integrated Feedback	G. MARKESJÖ and P. GRAHAM
No.	7	CERI/CT/70.46	Implications of a Shift from Teacher-based to Environment based Learning Systems	L.C. TAYLOR
No.	8	CERI/CT/70.47	Problems of Evaluation in Education	E. VELEMA
No.	9	CERI/CT/70.48	Pedagogy and Economy	E. BJØRKLUND
No.	10	CERI/CT/70.50	Individualised Teaching of Mathematics	L. SVENSSON
No.	11	*CERI/CT/70.51	Incorporating the Products of Educational Development into Practice	JAMES W. BECKER

* Reprinted by permission of the Journal of Research and Development in Education, University of Georgia, for use at the Workshop.

No. 12	**CERI/CT/70.52	Computer Administered Instruction versus Traditionally Administered Instruction-Economics	FELIX KOP-STEIN AND R. J. SEIDEL
No. 13	CERI/CT/70.54	Problems of Implementation of Educational Technology in Relation to Personnel	W. ZIFREUND
No. 14	***	On the Economic Analysis of Educational Technology	H.J. KIESLING
No. 15	***	Cost Analysis of Instructional Technology	J.E. DIETRICH and F.C. JOHNSON
No. 16	***	Cost Effectiveness Evaluation on Instructional Technology: The Problems	H.M. LEVIN

FROM THE CATALOGUE

« REVIEWS OF NATIONAL POLICIES FOR EDUCATION » series :

IRELAND (February 1970)

142 pages   £ 1.10s. (£ 1.50) $ 4.20   F 17   Sw. fr. 17   DM 14

AUSTRIA (February 1970)

54 pages   11s. (£ 0.55) $ 1.50   F 7   Sw. fr. 6   DM 4.90

NETHERLANDS (March 1970)

78 pages   15s.6d. (£ 0.78) $ 2.20   F 19   Sw. fr. 9   DM 7

SYSTEMS ANALYSIS FOR EDUCATIONAL PLANNING/METHODES ANALYTIQUES APPLIQUEES A LA PLANIFICATION DE L'ENSEIGNEMENT.

Selected annotated bibliography (September 1969)

220 pages, bilingual   £ 2.2s.6d. (£ 2.13) $ 6   F 25   Sw. fr. 25   DM 20.80

MATHEMATICAL MODELS IN EDUCATIONAL PLANNING (April 1967)

296 pages   £ 1.2s.6d. (£ 1.13) $ 3.80   F 15   Sw. fr. 15   DM 12.50

« EDUCATION AND DEVELOPMENT » series :

BUDGETING, PROGRAMME ANALYSIS AND COST-EFFECTIVENESS IN EDUCATIONAL PLANNING/LA PROGRAMMATION BUDGETAIRE ET L'ANALYSE COUT-EFFICACITE DANS LA PLANIFICATION DE L'ENSEIGNEMENT (October 1968)

306 pages, bilingual   £ 1.10s. (£ 1.50) $ 4.20   F 17   Sw. fr. 17   DM 14

EFFICIENCY IN RESOURCE UTILISATION IN EDUCATION/L'UTILISATION EFFICACE DES RESSOURCES DANS L'ENSEIGNEMENT (March 1969)

388 pages, bilingual £ 1.17s.6d. (£ 1.88) $ 5.50   F 22   Sw. fr. 22   DM 18.30

SOCIAL OBJECTIVES IN EDUCATIONAL PLANNING (September 1967)

312 pages   £ 2 $ 6.50   F 26   Sw. fr. 26   DM 21.60

DEVELOPMENT OF SECONDARY EDUCATION. Trends and Implications (May 1969)

186 pages   £ 2 $ 6   F 24   Sw. fr. 24   DM 20

DESIGN FOR TECHNOLOGICAL EDUCATION.

The Escuela Técnica Superior de Ingenieros Industriales of Seville (March 1969)

314 pages   £ 1.11s. (£ 1.55) $ 4.50   F 18   Sw. fr. 18   DM 15

« APPLIED MATHEMATICS FOR ENGINEERS » series :

MATHEMATICS AND ENGINEERING APPLICATIONS. Some selected examples (November 1967)

704 pages   £ 2.2s. (£ 2.10) $ 7   F 28   Sw. fr. 28   DM 23

MATHEMATICAL EDUCATION OF ENGINEERS (September 1966)

208 pages   £ 1.12s. (£ 1.60) $ 5.50   F 22 Sw. fr. 22   DM 18.30

« NEW THINKING IN SCHOOL SCIENCE » series :

MATHEMATICS TODAY. A Guide for teachers.

Proceedings of an International Working Session on New Teaching Methods for School Mathematics, Athens, 17th-23rd November 1963, by Howard F. Fehr (October 1964)

420 pages   17s.6d. (£ 0.88) $ 3   F 12   Sw. fr. 12   DM 10

OECD SALES AGENTS
DÉPOSITAIRES DES PUBLICATIONS DE L'OCDE

ARGENTINE
Libreria de las Naciones
Alsina 500, BUENOS AIRES.

AUSTRALIA - AUSTRALIE
B.C.N. Agencies Pty, Ltd.,
178 Collins Street, MELBOURNE 3000.

AUSTRIA - AUTRICHE
Gerold and Co., Graben 31, WIEN 1.
Sub-Agent : GRAZ : Buchhandlung Jos. A.
Kienreich, Sackstrasse 6.

BELGIUM - BELGIQUE
Librairie des Sciences
Coudenberg 76-78, B 1000 BRUXELLES 1.

BRAZIL - BRÉSIL
Mestre Jou S.A.,
Rua Guaipà 518, SAO PAULO 10.
Rua Senador Dantas 19 s/205-6, RIO DE
JANEIRO GB.

CANADA
Information Canada
OTTAWA.

DENMARK - DANEMARK
Munksgaard Boghandel, Ltd,, Nörregade 6,
KOBENHAVN K.

FINLAND - FINLANDE
Akateeminen Kirjakauppa, Keskuskatu 2,
HELSINKI.

FORMOSA - FORMOSE
Books and Scientific Supplies Services, Ltd.
P.O.B. 83, TAIPEI,
TAIWAN.

FRANCE
Bureau des Publications de l'OCDE
2, rue André-Pascal, 75-PARIS 16e
Principaux sous dépositaires :
75-PARIS : Presses Universitaires de France,
49, bd Saint-Michel, 5e
Sciences Politiques (Lib.). 30 rue Saint-Guil-
laume 7e
13 AIX-EN-PROVENCE : Librairie de l'Uni-
versité.
38 GRENOBLE : Arthaud.
67 STRASBOURG : Berger-Levrault.
31 TOULOUSE : Privat.

GERMANY - ALLEMAGNE
Deutscher Bundes-Verlag G.m.b.H.
Postfach 9380, 53 BONN.
Sub-Agents : BERLIN 62 : Elwert & Meurer.
HAMBURG : Reuter-Klöckner ; und in den
massgebenden Buchhandlungen Deutschlands.

GREECE - GRÈCE
Librairie Kauffmann, 28 rue du Stade,
ATHÈNES 132.
Librairie Internationale Jean Mihalopoulos et
Fils, 75 rue Hermou, B.P: 73, THESSALONIKI.

ICELAND - ISLANDE
Snæbjörn Jónsson and Co,, h.f, Hafnarstræti 9,
P.O.B. 1131, REYKJAVIK.

INDIA - INDE
Oxford Book and Stationery Co. :
NEW DELHI, Scindia House.
CALCUTTA, 17 Park Street.

IRELAND - IRLANDE
Eason and Son, 40-41 Lower O'Connell Street,
P.O.B. 42, DUBLIN 1.

ISRAEL
Emmanuel Brown,
35 Allenby Road, and 48 Nahlath Benjamin St.,
TEL-AVIV.

ITALY - ITALIE
Libreria Commissionaria Sansoni :
Via Lamarmora 45, 50 121 FIRENZE.
Sous-dépositaires :
Editrice e Libreria Herder,
Piazza Montecitorio 120, 00 186 ROMA.
Libreria Rizzoli, Largo Chigi 15, 00 187 ROMA.
Libreria Hoepli, Via Hoepli 5, 20 121 MILANO.
Libreria Lattes, Via Garibaldi 3, 10 122 TO-
RINO.
La diffusione delle edizioni OCDE è inoltre
assicurata dalle migliori librerie nelle città
più importanti.

JAPAN - JAPON
Maruzen Company Ltd,,
6 Tori-Nichome Nihonbashi, TOKYO 103,
P.O.B. 5050, Tokyo International 100-31.

LEBANON - LIBAN
Redico
Immeuble Edison, Rue Bliss, B.P. 5641
BEYROUTH.

MALTA - MALTE
Labour Book Shop, Workers' Memorial Build-
ing, Old Bakery Street, VALETTA.

THE NETHERLANDS - PAYS-BAS
W.P. Van Stockum
Buitenhof 36, DEN HAAG.
Sub-Agents : AMSTERDAM C : Scheltema
and Holkema, N.V., Rokin 74-76. ROTTER-
DAM : De Wester Boekhandel, Nieuwe
Binnenweg 331.

NEW ZEALAND - NOUVELLE-ZÉLANDE
Government Printing Office,
Mulgrave Street (Private Bag), WELLINGTON
and Government Bookshops at
AUCKLAND (P.O.B. 5344)
CHRISTCHURCH (P.O.B. 1721)
HAMILTON (P.O.B. 857)
DUNEDIN (P.O.B. 1104).

NORWAY - NORVÈGE
Johan Grundt Tanums Bokhandel,
Karl Johansgate 41/43, OSLO 1.

PAKISTAN
Mirza Book Agency, 65 Shahrah Quaid-E-
Azam, LAHORE 3.

PORTUGAL
Livraria Portugal, Rua do Carmo 70, LISBOA.

SPAIN - ESPAGNE
Mundi Prensa, Castelló 37, MADRID 1.
Libreria Bastinos de José Bosch, Pelayo 52,
BARCELONA 1.

SWEDEN - SUÈDE
Fritzes, Kungl. Hovbokhandel,
Fredsgatan 2, STOCKHOLM 16.

SWITZERLAND - SUISSE
Librairie Payot, 6 rue Grenus, 1211 GENÈVE
11 et à LAUSANNE, NEUCHATEL, VEVEY,
MONTREUX, BERNE, BALE, ZURICH.

TURKEY - TURQUIE
Librairie Hachette, 469 Istiklal Caddesi, Beyo-
glu, ISTANBUL et 12 Ziya Gökalp Caddesi,
ANKARA.

UNITED KINGDOM - ROYAUME-UNI
H.M. Stationery Office, P.O.B. 569, LONDON
S.E.1.
Branches at : EDINBURGH, BIRMING-
HAM, BRISTOL, MANCHESTER,
CARDIFF, BELFAST.

UNITED STATES OF AMERICA
OECD Publications Center, Suite 1207,
1750 Pennsylvania Ave. N.W.
WASHINGTON, D.C. 20006. Tel. : (202)
298-8755.

VENEZUELA
Libreria del Este, Avda. F. Miranda 52,
Edificio Galipan, CARACAS.

YUGOSLAVIA - YOUGOSLAVIE
Jugoslovenska Knjiga, Terazije 27, P.O.B. 36,
BEOGRAD.

Les commandes provenant de pays où l'OCDE n'a pas encore désigné de dépositaire
peuvent être adressées à :
OCDE, Bureau des Publications, 2 rue André-Pascal, 75 Paris 16e
Orders and inquiries from countries where sales agents have not yet been appointed may be sent to
OECD, Publications Office, 2 rue André-Pascal, 75 Paris 16e