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ABSTRACT

Science courses designed or adapted for use in developing countries at the upper primary or lower secondary levels of the school system seem rarely to meet criteria of relevance to the future lives of the majority of pupils. The objectives of many new programs that aim to promote the understanding and application of scientific principles are often undermined, which tends to favor the rote memorization of factual information. This research program explores the interrelations between policies to reform science curricula, and examination orientation and other factors which affect the successful introduction of innovative courses in these countries. Charts and figures illustrate the research findings. A select bibliography is included in the report. (Author/MA)

DISCUSSION PAPER

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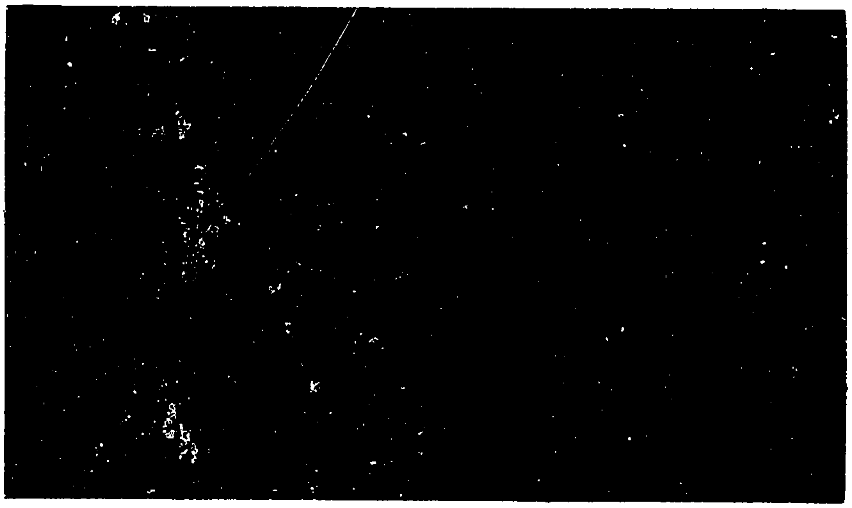

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SCIENCE EDUCATION IN MALAYSIA AND SRI LANKA

IDS Discussion Paper No. 74

July 1975

by

K. LEWIN

SUMMARY

Science courses designed or adapted for use in developing countries at the upper primary or lower secondary levels of the school system seem rarely to meet criteria of relevance to the future lives of the majority of pupils. The objectives of many new programmes that aim to promote the understanding and application of scientific principles are often undermined in the examination orientated atmosphere of the classroom which tends to favour the rote memorization of factual information. This research programme explores the interrelations between policies to reform science curricula, and examination orientation and other factors which affect the successful introduction of innovatory courses.

Preface

The study which Keith Lewin describes in this paper, is a component of a larger programme of research in education, "Qualification and Selection in Educaional Systems." The greater part of the programme is concerned with how employers use school qualifications and with how that use, mediated through examinations, affects teaching and learning in schools. (See I.D.S. Discussion Paper No 70.) There are three complementary studies. One traces how people, whose school qualifications have failed to secure them the employment they had hoped for, adjust their sights and accommodate themselves to the opportunities actually available. (I.D.S. Discussion Paper No 71.) A second is looking at the evolution of the educational reforms in China, where a deliberate attempt has been made to dissociate schooling from selection for employment and further training. The third is Keith Lewin's, which explores the interactions between attempts at curriculum reform in science at the lower secondary level and procedures for selecting young people for more schooling and for the more desirable forms of employment. A feature of this study will be a detailed look at a particular innovatory course to examine the extent to which it has been successful in encouraging pupils to understand and apply scientific knowledge and, where it has not, to establish factors which seem to be associated with this lack of success.

The Ministries of Education of Malaysia and Sri Lanka have agreed to permit this study and to cooperate with Keith Lewin in carrying it out.

The Swedish International Development Authority has provided the funds to enable its execution.

John Oxenham
Coordinator

July 1975

SCIENCE EDUCATION IN MALAYSIA AND SRI LANKA

1. Introduction

Official statements that curricula in primary and lower secondary schools should fit pupils for life outside the formal education system have been widely voiced over the last two or three decades. As part of the effort to realise such intentions there have been many attempts to introduce science courses -- either specially designed or adapted from existing courses -- which would shift the emphasis of learning from the rote memorization of knowledge to a deeper understanding of the principles and processes of science. It seems, however, very difficult to achieve such a shift and succeed in reaching the goal of helping pupils to make use of science in developing hitherto 'traditional' occupations where typically more than half the total number of school leavers are eventually employed. This research seeks to assess the extent to which such difficulty can be attributed to

1. the nature and methods of curriculum development which often seem to have stressed academic considerations at the expense of those relating to likely future occupations and life styles;

2. the framework of internal and external incentives within which school learning and school teaching take place;

3. the physical constraints under which reform is expected to be implemented.

The research will be undertaken in two parts. The first will be a study of the process of curriculum development and will take place in Malaysia and Sri Lanka [1].

The second part will be an investigation, in a sample of schools, of the importance of difference factors in the implementation of an innovatory science course at the lower secondary school level. This study will take place in Malaysia only.

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1. Sri Lanka has agreed to participate, both because of its experience in science curriculum reform and because it is participating in other components of the major research programme "Qualification and Selection in Educational Systems" (I.D.S.. Discussion Paper No 70). The research studies have been accepted by the Malaysian authorities as a result of continuing concern with the evaluation of a recent series of reforms in science teaching and course materials and because the researcher has a background in teaching science in West Malaysia.

2. The Problem

Attempts to improve science education in the secondary school in the past have often revolved around:

1) curriculum reform; new specifications of what is to be taught and how;

2) providing better physical and human resources; improvements in equipment, teacher-pupil ratios and in teachers' knowledge and understanding of teaching methods.

If the curriculum reform fails to live up to expectations (as has often been the case) this is usually attributed to lack of adequate resources. The contention here, however, is that this overlooks important aspects of the situation; specifically:

(a) in so far as curriculum reforms seek to correct traditional over-emphasis on the straightforward absorption of facts and show greater concern for enquiring attitudes, approaches to problem solving, manipulative skills, etc., there is one factor which is always likely to thwart them, even if the resource problem were solved. This is what can be termed the "backwash effect" of the pressure to teach towards examinations, the tendency (for a variety of reasons much worse in developing countries than in Europe) to identify examination passing as the be-all and end-all of schooling;

(b) these same characteristics of the structure of school systems, which define the secondary school as primarily the place where pupils are prepared for the examinations which select for progression through the system and ultimately university entry, mean that the efforts of the curriculum reformers are likely to be less than radical in their specification of goals. Specifically, as between the twin objectives of (i) giving a science training useful to the vast majority of students who will proceed no further in full-time science education than the ninth or eleventh grade, or (ii) preparing a tiny minority for university training as professional scientists, the latter aim is likely to disproportionately influence their efforts.

This research is designed to explore both these aspects. The study falls naturally into two parts which may be referred to for convenience as:

(a) curriculum design; the process of designing and adapting new curricula for use in Malaysia and Sri Lanka;

(b) implementation; the relative importance of different factors for the attainment of the various cognitive educational objectives (particularly the level of recall of information) stressed in recent curriculum innovations in Malaysia.

3. The Malaysian Situation

The Malaysian school system provides for unrestricted access to the first nine grades (the first six in the primary school, designated Standards 1-6, the last three in the lower secondary schools, designated Forms 1-3) with automatic promotion from grade to grade. The structure can best be illustrated with a chart (see Figure 1). Despite the absence of selection barriers, automatic promotion and the extension of free education to most pupils only some 50% of an age cohort attend school for a full nine years.

Although there are no terminal selection points within the first nine grades, in the fifth grade (Standard 5) there is an assessment for allocating pupils places in residential schools. Historically most of these govenment run schools have their origins as educational institutions established to satisfy the need of the former colonial power for local manpower to fill clerical and lower administrative positions. Subsequently they have come to represent 'centres of excellence' within the education system and are much sought after as they tend to assure the future of pupils in high level administrative/professional occupations.

Towards the end of grade nine (Form 3) the first terminal selection examination is held -- the Lower Certificate of Education or Sijil Rendha Pelajaran (LCE/SRP). This serves both as a school leaving qualification and as a selection criteria for grade ten (Form 4). Selection for the upper secondary school -- grade ten and eleven (Form 4 and 5) -- is based on the attainment of a specific total achievement score derived from performance in certain specified subjects. The upper secondary school system introduces streaming for the first time and allocates pupils to Science, Arts or Vocational Technical courses. The streams are differentiated by the allocation of time to subjects of study and by the academic ability of their pupils. Science classes cream off the most able students (approximately 10% of the age cohort), Arts takes most of the rest (approximately 10% of the age cohort) and the Vocational/Technical schools account for the remainder who are allowed to proceed. (approximately 6% of the age cohort). Few students who qualify for Form 4 Science decline the option, as it is perceived to offer a greater likelihood of entrance to a profession. Individual preferences/aptitude are not considered at this stage and the LCE/SRP selection criteria include arts and science subjects. It is officially possible for transfer between Arts and Science streams to occur, but this is quite uncommon. It is interesting to note in passing that although those not accepted for the Science or Arts stream go to Technical or Vocational schools if they are allowed to continue, they do follow courses which are high in academic content and which can be used as an alternative route to higher education.

At the end of grade eleven (Form 5) there is a second terminal selection examination -- the Malaysian Certificate of Education or Sijil Pelajaran Malaysia (MCE/SPM). Approximately 11% of the Grade ten (Form 4) intake are successful in reaching the Grade twelve (Form 6) Science and Arts streams (about 3% of the age cohort) whilst the rest commence the search for a job or some other form of education or training, usually specifically job orientated. The final selection examination in the formal school system comes at the end of grade thirteen with the Higher School Certificate or Sijil Tinggi Pelajaran (HSC/STP). About half of those sitting the examination are accepted to universities and they represent approximately 1·5% of the age cohort (This includes all disciplines)

It is pertinent here to translate these selection stages into terms of probable earnings and life-styles. Pupils who leave school before grade nine, ie. without even the LCE/SRP certificate are likely to become self or family employed workers, mainly agricultural, on very low incomes. The closest they are likely to come to modern sector employment are peripheral jobs at the lowest levels. Access to modern sector employment is still possible for LCE/SRP graduates and this is usually the minimum qualification level for government clerks/office boys etc. but it is becoming increasingly difficult to successfully compete for these jobs as the ranks of grade eleven (Form 5) leavers swell. The MCE/SPM gradually seems to be replacing the LCE/SRP as the necessary qualification to have to be certain of white collar employment. Whilst the MCE/SPM is clearly worthwhile currency in the labour market, holders must usually be content witn starting salaries typically of the order of one quarter of those offered good honours graduates from the universities and correspondingly smaller opportunities for advancement and salary increments. Thus a 45% increment in time spent in formal education(16:11) leads to an increment in starting salary of approximately 400%. In short, formal qualifications, the examinations they involve and the learning styles they call for are substantial determining factors in the allocation of life opportunities -- the more so since the private sector tends to follow government service in its use of educational qualifications to select job applicants.

The responsibility for developing curricula for schools lies with the Curriculum Development Centre (CDC) which was established in 1973. Prior to this, curriculum development work was undertaken by the Curriculum Section of the Education Planning and Research Division of the Ministry of Education. Curriculum planning is centralised and is regarded as a federal responsibility and, although the opinions and suggestions of headmasters, parents and employers are solicited with varying degrees of frequency, the task of preparing curricula is left almost entirely to the CDC.

Several new science courses have been introduced into Malaysian schools in the last few years based largely on UK curriculum development projects. They have been adapted for use in Malaysia by the CDC with expatriates assisting local staff. Implementation has been on a limited scale initially, followed by quite widespread usage in the second and third years after their introduction.

The rapid spread is in part a result of pressures generated on schools by parents to provide the new courses as soon as possible so they can be seen to be "progressive" and give pupils the greatest opportunity of succeeding in the competition for modern sector jobs. As a result there has been little in the way of controlled pilot studies on which to base decisions to implement courses on a large scale.

Name	Level	Basis	Year of Introduction
Integrated Science for Malaysian schools	Forms 1-3	Scottish Integrated Science	1969
Modern Physics/ Chemistry/Biology for Malaysian Schools	Forms 4-5 Science Streams	Nuffield Physics/ Chemistry Biology 'O' level	1972
Modern Science for Malaysian Schools	Forms 4-5 Arts Streams	Nuffield Secondary Science	1974

The progressive implementation of these courses can be seen from Figure 2.

Currently traditional and new science courses are being taught in schools prior to universal adoption of the latter. Traditional courses are assessed by Cambridge[1] approved papers largely using classical structured questions which have tended to stress recall at the expense of other objectives. The integrated science course is terminally assessed by a 75-question multiple choice paper, approximately 50% of questions being at the recall level and the remainder testing higher cognitive objectives (i.e. comprehension, application etc.). Pre-testing and full item analysis are performed on these papers. The Nuffield based courses use multiple choice questions (40% of the total marks and predominantly recall type questions) and a selection of free response, semi-structured and structured questions aimed more particularly at higher cognitive level objectives. (50% of the marks). A practical exam is still conducted (10% of the marks) though this is likely to be dropped for administrative reasons. The form 6 science curriculum is based on the Cambridge 'T' syllabus alone and is assessed with the usual written and practical papers.

4. Science Education in Sri Lanka

The formal education system in Sri Lanka was restructured in 1972 with the expressed aim of providing a more relevant general education for the majority of school leavers, rather than catering for the needs of the small number of pupils likely to obtain modern sector jobs. Part of this restructuring has involved the introduction of science teaching into all junior secondary schools (grades 6-9) and the writing of a new

1 The Cambridge University Examination Syndicate.

science course to replace the locally produced 'Ordinary' level course.

Initial entry into the school system is now at age six years and primary school extends to grade 5. (See Fig 3). The junior secondary school (grade 6-9) completes the open access span of the system with a terminal selection examination, the National Certificate of General Education. (N.C.G.E.) in ten subjects including Mathematics, Science, Social Studies, Pre-Vocational Studies. The last, as well as seeking to encourage awareness of local occupations and use of local expertise in the classroom, also specifically hopes to encourage an awareness of the use that can be made of mathematics and science in local occupations.

1975 will be first year of the N.C.G.E. and the intention is to keep the proportion of students permitted to continue to grades 10 and and 11 approximately the same as it has been in the past. About 40% [1] of an age cohort entering grade 1 succeed in reaching grade 9 and of these only 10-12% of the number sitting the terminal examination (now the N.C.G.E.) proceed to higher grades. (i.e. some 4-5% of the age cohort.)

The N.C.G.E. will be followed by a Higher National Certificate of Education (G.N.C.E.) in grade 11, the details of which have yet to be finalized. In the science subjects it is likely that a core course in the first year (grade 10) will be followed by more specialized options in the second (grade 11). The proportion of those taking H.N.C.E. who proceed to university is likely to be of the order of 10-15% (i.e. about 0·5% of the age cohort). These figures cover all disciplines at university level. About one third of the university students study in science related subjects.

Unemployment rates in Sri Lanka are very high, and are concentrated particularly in the younger age groups.

<u>School leavers and youth unemployment rates for various levels of education in 1970.</u>

Level of Education	% in group aged 15-24 years unemployed.
No education	18
Grades 1-5	28
Grades 6-8	47
Grades 9-10	72
Grades 11-12	84
University Science	2
Arts	50

Although the figures above have to be interpreted with caution (since 'unemployed' is a term which often only has meaning to those who <u>expect</u> to be employed in modern sector

1. This figure is calculated from current drop out rates ~~and is not very reliable.~~ The situation is confused by the

occupations) they have lent weight to the argument that the sort of skills the formal education system has encouraged have not been those for which there is a high demand. The extension of science teaching to all lower secondary schools has been seen both as a way of embracing educational equalty of opportunity and also providing the basis for a wider scientific literacy to increase the efficiency of local occupations and develop worthwhile skills.

New curricula for schools are developed by the Curriculum Development Centre in Colombo, an organization whose origins date back to 1959. Most of the changes in science courses before 1972 resulted from the activities of the CDC which has considerable experience in the writing and implementation of innovatory courses. The programmes produced in 1972 and subsequently, though not resulting from the CDCs initiative, have been produced largely by CDC staff writing groups.

The present grades 6-9 science programme was produced locally by CDC staff with the intention of providing a course suitable for teaching in all lower secondary schools(previously science was taught only in about 20% of the lower secondary schools). The programme is specifically intended to cater for the need for widespread understanding of simple scientific processes and concepts, rather than the more detailed and specific requirements of academic high flyers who have a chance of becoming professionals. Although some of the activities in the 6-9 programme are based on those found in British courses (e.g. Nuffield Secondary Science) much of the content has been locally produced.

Since the beginning of the implementation process in 1972 year by year evaluation exercises have been undertaken and the final examination, based in part on perceptions gained through the evaluation, will be taken for the first time in 1975. This will consist of a one hour multiple-choice paper and a separate three hour longer answer paper.

5. The Research

The research will take place in two phases. The first phase will be common to Malaysia and Sri Lanka and opportunities to compare the characteristic features of the methods of curriculum development in each will be taken where and when they arise. It is likely to be particularly instructive to consider the operational differences between a well-established indigenous curriculum development capacity (as in Sri Lanka) and a recently organized curriculum centre with a legacy of curriculum adoption (as in Malaysia).

The second phase will be confined to Malaysia and will concentrate specifically on the Integrated Science for Malaysian Schools programme.

Phase 1: Curriculum Design

The first phase of the research will have three specific components:

(a) Institutional analysis of the Curriculum Development Centre: (CDC)

(b) examination of the process of curriculum reform;

(c) analysis of the exam system as it relates to the process of curriculum reform.

(a) Institutional analysis of the Curriculum Development Centre to provide a framework against which to view the development of specific courses. This will examine the Curriculum Development Centre in terms of:

(i) Status: What is the position of the organization in the educational bureaucracy and what priority have its activities? In which fields does it operate and what is the extent of its activities? What authority do its recommendations carry and are they ever over-ruled? In particular, what are the relations, formal and informal, with the examination authorities?

(ii) Objectives: What are the explicit/implicit objectives of the organization in science education and where does the responsibility lie for defining them? What are the general objectives of the curriculum developers in science subjects and in what ways have these been modified in the light of recent experiences? What are reforms in science courses expected to achieve?

(iii) Personnel: How is the organization staffed? What is the normal method of appointment (short term/ long term)? What proportions of the staff are practising teachers/consultants/administrators etc.? How often are contract advisors from abroad utilized and what role do they play?

(iv) Orientation: Which areas of science curriculum development are considered priorities (for the academically gifted, for school leavers, etc.)? Is there a bias towards any particular kind of work e.g. improvement of coursecontent, introducing new teaching techniques, attempting to change teacher attitudes? What sort of educational philosophy underlies the work of the organization?

(v) Mode of operation: How are the science personnel in the institution organized -- subject groups, interdisciplinary teams etc? Whatare the lines of authority? Where has the stimulus for new work come from in the past -- the Ministry of Education, teachers, employers, Universities? What channels of communication exist between the organization and others? Who is regularly consulted? In particular how do the examination authorities fit into the pattern of consultation and exchange?

The analysis will start with a documentary survey of published government papers/annual reports/commission reports to provide data for sections (i) and (ii); staff lists and appointments board reports and records will provide information for section

(iii) if available and insights into section (iv) can be gained from the nature of the published output of the organization; section (v) will be approached through the annual reports, internal reports and memoranda and file information where available. The documentary survey will be backed up by a systematic series of semi-structured interviews with staff members to provide data on the informal structure of the institution and the perceptions of its staff.

(b) Examination of the process of curriculum reform.

The emphasis here will be on the processes by which new courses are actually produced. By following the progress of courses from conception to implementation it should be possible to chart the most important factors influencing their final form. The answers to a series of inter-related questions will be sought to this end, viz.

(i) What initiatives, stemming from what pressures, led to the conception of a curriculum development project? To what extent was its initiation due to a need to meet projected manpower needs of the economy; an assessment of the likely future occupational circumstances of pupils and to the extent this is true, which pupils; a result of pressure from professional interest groups; a need to satisfy the aspirations of pupils and parents; other political considerations?

(ii) How, and on what criteria, was a decision arrived at to accept/reject existing source material as a basis for a new course? How much of the material was generated locally and how was the inclusion/exclusion of new teaching material justified?

(iii) What were the constraints on the introduction of new teaching methods perceived to be? How were changes in teaching techniques justified?

(iv) How was the course development accomplished -- entirely within the institution, with assistance from practising teachers, with assistance from overseas? What sort of consultative procedures were adopted and what organizations or groups of individuals were consulted? To what extent do course materials reflect the consulting procedures adopted.

(v) What processes of approval and assessment have new curricula gone through before being accepted? What form has pre-testing taken and what effects have the results of pre-testing had on courses? What provisions are there for on-going evaluation programmes once a course has been implemented? Do the course developers feel they have to modify their proposals substantially before they reach the classroom, and if so do they have any strong reservations about the implementation of their courses?

(vi) What provisions are made for the training of staff for the implementation of new curricula and how successful are the curriculum developers in getting their ideas across? To what extent are key personnel used to propagate techniques etc. for new courses? What role does the inspectorate play in curriculum reform and what criteria do they and the Curriculum Development Centre use in assessing the performance of curriculum changes?

(vii) How far have the exigencies of the existing public examination system and the importance of selection techniques influenced the development of courses? In particular to what extent have they led to development constrained by the need for courses to be examinable? How much evidence is there to support the notion of 'backwash' from examinations exerting pressure at the design stage of new curricula?

(viii) How far has the need to provide a preparation for entrance to the next cycle of education determined curriculum content? How far has this been treated as a fixed or as a variable constraint? Whose interpretation of the nature of the "preparatory" requirement has been accepted as authoritative?

Material for this study will be collected through extensive semi-structured interviews with curriculum development staff, practising teachers, school inspectors and educational administrators. The focus will be on the development of the Integrated Science Course (Forms 1-3) and the Modern Science Course (Forms 4-5) in Malaysia and on the Grade 6-9 Science programme in Sri Lanka. In addition documentary evidence will be sought from the files, reports, minutes of meetings etc. which record significant aspects of the development of these courses supplemented by close examination of course materials (teachers - guides, pupil - texts , training course materials).

(c) Analysis of the examination system as it relates to curriculum reform.

A dominant objective of recent curriculum reform attempts has been to increase the effectiveness of teaching in developing understanding and problem-solving capacity rather than encouraging mere rote memorization. A major problem is to design methods of assessment which adequately test the success of the course in reaching these 'higher' objectives, (it being in the nature of many types of examination that memory is easier to test).

The focus of the research on the examination system here will be to discover:

(i) How far the design of appropriate assessment methods was an integral part of the development of innovatory science courses and what constraints were deemed over-riding

(ii) How far there is explicitly seen to be a conflict between the use of exams for

(a) prediction of future educational performance with the ensuing selection for further education opportunity

and (b) supporting the educational objectives of the curriculum reforms

(iii) If any such conflict is perceived, how is it resolved?

The procedure here would be based on interviews with examiners and curriculum developers and would develop to include consideration of the channels of communication between the examination boards, curriculum developers, and schools. Much could be learnt from the way exams have been set in the past, what the mark schemes have been, what the proportion of questions at different cognitive levels has been, what importance is attached to the results each year and how styles of examination have or have not been altered to suit new objectives for curricula.

Phase 2: Curriculum Implementation.

The second part of the study will concentrate on the implementation of the "Integrated Science for Malaysian Schools" curriculum of Forms 1-3 (Lower Secondary School) in Malaysia. The main reason for this choice is as follows:

As figure 1 shows, of the children who complete Form 3 only 1 in 4 (approximately) actually proceeds to Form 4 (Science) and about 1 in 15 to Form 6 (Science) and presumably employment in science based fields. It is at the Form 3 level that the argument is strongest for insisting that the provision of a 'terminal' science education for the great majority of children who reach Form 3 should have precedence over the preparation of future specialist scientists. It is at this level, therefore, that distortion of 'higher' level learning objectives by examination pressure and other factors is most serious.

The Integrated Science Course is specifically directed towards the attainment of cognitive objectives above the level of recall (whilst still maintaining substantial elements of recall amongst the objectives) and it is this, and its explicit statements of desired affective objectives which distinguish it from its 'traditional' predecessors. The major educational justification given for its introduction in the Malaysian context has been the assertion that it is more effective in attaining these objectives than the courses it replaced.

Successful implementation of the Integrated Science Course demands a more 'heuristic' pupil-centred approach by teachers and less didactic exposition than has commonly been the case, and this is thought to help pupils in attaining higher-level cognitive objectives. In many practical learning situations in Malaysia, however, the teaching of science has remained very much teacher-centred and didactic and the multiple-choice assessment exams seem to have encouraged continuing concentration on rote learning techniques since the questions are often perceived as testing recall ability alone (though in fact they are constructed to test cognitive achievement at other levels).

The procedure in outline for this study will be as follows:

(1) To develop a measure of the success of different schools in achieving cognitive objectives at different levels.

(2) To isolate within a sample of schools the factors which appear to be associated with differences in achievement at the different levels.

Likely associated factors are:

(a) Selectivity of pupil intake;

(b) Training, experience and attitudes of teachers;

(c) Teaching styles of teachers;

(d) Availability of physical resources in the schools;

(e) Differential strengths of the pupil/teacher concern with examination success;

(f) Other socio-economic and cultural factors.

Development of the Measure of Cognitive Achievement.

Measurement of the differential success of schools in achieving cognitive objectives in three categories will be approached through the analysis of public examination results in Integrated Science (LCE/SRP). The following procedure has been agreed with the Examination Syndicate in Malaysia where data for the last four years are stored and a preliminary study has already been undertaken along these lines.

(i) Categorization of the 75 items on the multiple-choice paper into

(a) Knowledge - recall of useful information.

(b) Comprehension - ability to extend a principle to a known classroom or textbook situation where it is obvious to the pupil which principle should be used.

(c) Application - ability to apply a principle to a new situation where the pupil must first select the appropriate principle.

(ii) Selection of 10 representative items from each category from the LCE/SRP test paper.

(iii) Analysis of the results of particular schools in terms of responses to the selected items to establish the pattern of achievement and its distribution between the three categories identified.

(iv) Identification of any inter-school variation in the pattern of achievement.

The categorization of items in (i) will be done by referring to classification tables prepared independently by the Examination Syndicate; the CDC; the researcher. Only those items on which there is a high degree of agreement will be considered for selection. Selection of test items to be used will be accomplished by rejecting items which are poorly constructed or not clearly classifiable and taking from those remaining a spread of subject matter throughout the course.

The analysis to establish different patterns of achievement between schools, where it exists, depends on the computation of a coefficient indicating the extent to which achievement in one category predominates over other categories. From a record of the mean raw scores of schools on the 10 items in each category identified (i.e. Knowledge (K), Comprehension (C), Application (A)), three simple expressions can be used to indicate the extent to which achievement on Knowledge type items predominates. They are

$$X = K - C$$

$$Y = K - A$$

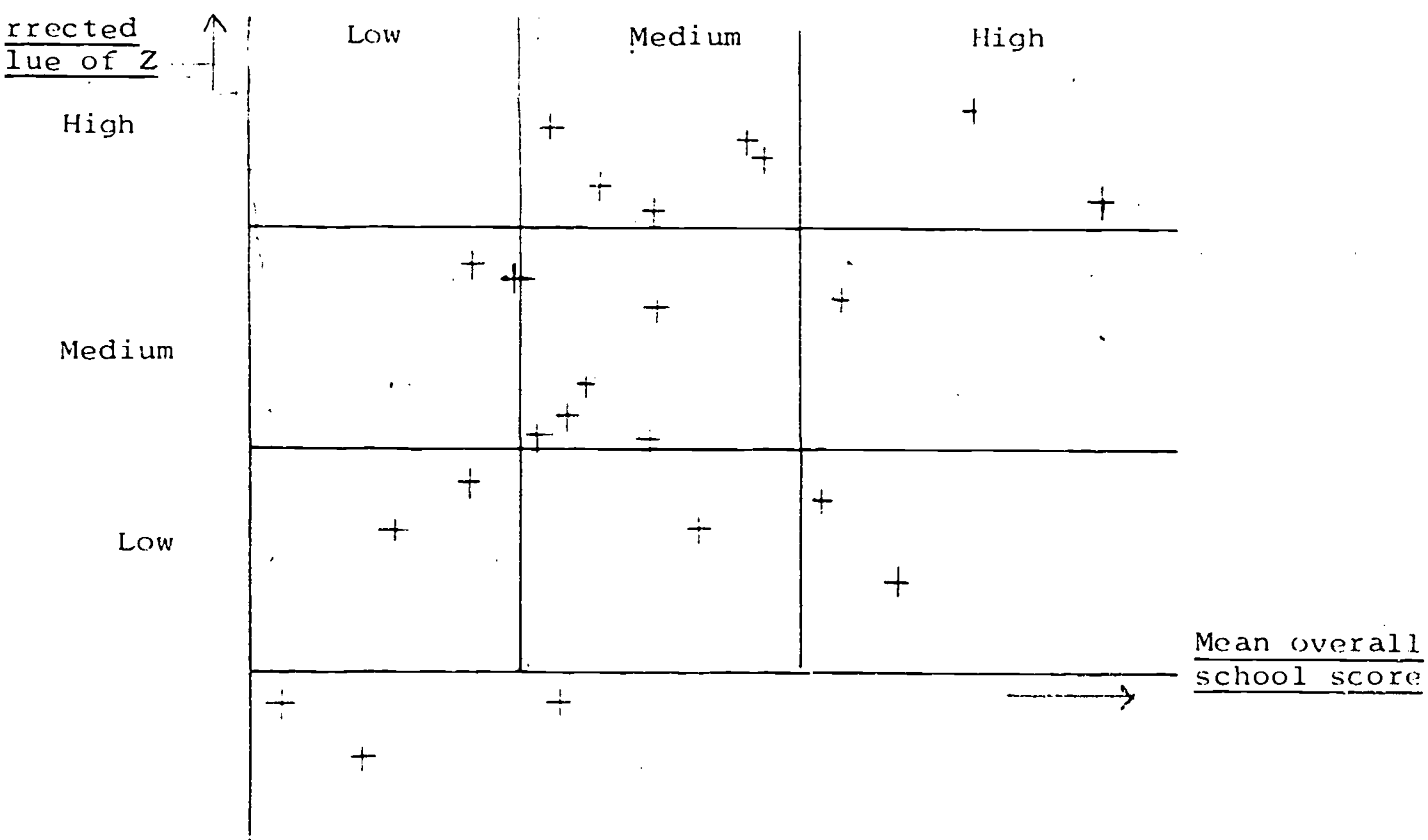
$$Z = K - \frac{C + A}{2}$$

where X, Y, and Z are the indicating coefficients and K, C and A represent the mean scores for a particular school on the 10 items selected in each category. Since the value of these coefficients is clearly related to the facility[1] values of the items selected for the K, C, and A groups a correction has to be made to the raw scores before calculating X, Y and Z. The variations in facility which may arise between the K, C, and A items can be controlled for simply by measuring achievement in these categories above or below the mean scores of the population of schools on these questions.

In considering the magnitude of the coefficients X, Y, and Z it is clearly necessary to consider simultaneously the overall levels of achievement in Integrated Science with which they are associated. Schools with similar overall achievement which exhibit variations in X, Y, and Z are likely to be the ones towards which most effort is justified in attempts to find factors associated with high or low

1. facility refers to the percentage of candidates correctly responding to an item.

coefficient values. The results of a preliminary study indicate that there is likely to be a definite positive correlation between overall achievement and coefficient scores though there is clear evidence of variations in X, Y, and Z for similar overall achievement. Below is a representation of results achieved from the preliminary study for the coefficient Z.



Schools tend to be clustered around a line running from Low Z/Low Score to High Z/High Score though there is clearly variation in Z values unrelated to overall score. Correcting the overall score for achievement due to the selected items (i.e. subtracting K, C, and A values from overall score) produces little variation in the rank ordering of schools.

Isolating the Factors Associated with Success in Achieving Objectives above the Level of Recall

1. Selecting a Sample of Schools

There are two constraining factors to be met; the resources available to the researcher and the fact that the researcher is non-Malay. The former limits the sample of schools which can be studied intensively to approximately 15 in the State of Selangor (West Malaysia), the latter limits the sample to schools using English as the medium of instruction in grade nin (Form 3) in 1975. Accordingly all Enlish medium schools in Selangor State which entered candidates for the 1974 LCE/SRP Integrated Science examination will constitute the population from which a sample will be drawn.

Whilst it is possible that results from the preliminary study may not be reflected in the complete analysis of 1974 LCE/SRP Integrated Science results this seems unlikely, since the preliminary sample was chosen to be representative of the population of acceptable schools in Selangor State. Assuming the preliminary results are reliable the procedure for selecting the school sample will be as follows.

(i) Calculating values of Z (a measure of the predominance of recall of knowledge over other type of achievement) and plotting them against measures of overall achievement for all schools in the population.

(ii) Extracting by random selection a proportionate number of schools from each cell, produced by dividing overall score and Z values into Low, Medium and High ranges, until the sample is of the required size. (Some cells may, of course, have no schools in them.)

In addition to the care taken in selecting the sample, it will be necessary to check whether the schools have changed in significant way since the 1974 LCE/SRP Integrated Science examination. In each school, accordingly, the following points will be investigated.

(i) Are the same teachers teaching grade nine (Form 3) as did in 1974?

(ii) If so have they received any additional training since the 1974 LCE/SRP in Integrated Science?

(iii) Has there been any change in the nature or volume of supplementary instructional resources?

(iv) Does the overall achievement and Z value differ significantly for 1975 results?

2. Observing the Factors

(a) Selectivity of Pupil Intake: The residential schools mentioned above allocate places in grades 6-9 (Form 1-3) mainly on the basis of the results of an assessment of ability made in grade 5 (Standard 5), and tend therefore to select more able pupils who are likely to score above average on the LCE/SRP. If there appears to be some association between selectivity and non-selectivity and Z values then either (i) both types of school will be studied and selectivity regarded as an independent factor or (ii) if the sample of selective schools is too small, the selectivity factor will be controlled by concentrating only on non-selective schools. If no association is apparent then it will be possible to include both selective and non-selective schools.

(b) Training, Experience and Attitudes of Teachers: Information will be collected on the training, experience and attitudes both of teachers involved in teaching 1974 examinees in the sample studied and of teachers involved in teaching 1975 examinees in the same schools. (Where teachers have been transferred they will be contacted for interview if local, or sent postal questionnaires if not). The following steps will be taken after the observations described in (c) below:

(i) Semi structured interviews probing opinions on the objectives of the Integrated Science course, preferred teaching styles, the perceived shortcomings of the course and recommended methods, the prevailing measures of assessment and selection and their influence on teaching and learning.

(ii) Questionnaire to elicit more concise responses to the questions listed in (i) and to record factual information on sex, age, schooling, training, range of teaching experience, etc.

(c) Teaching styles: Teaching styles of teachers will be categorized through the use of a time-based observation schedule. Each teacher in the sample will be observed on three occasions, including periods which are recommended by the course materials as predominantly pupil activities. The schedule will be used to build up profiles of teachers which will enable them to be classified broadly into styles (for example, exemplified by didactic, teacher centred behaviour or by the heuristic, more pupil centred behaviour explicitly recommended in the Integrated Science materials). Indications of the extent and nature of classroom activities and pupil/teacher interaction over time will also be sought from analysis of completed pupil worksheets and any other pupil produced materials available.

(d) Supplementary Training Resources in Schools: The availability of physical resources will be determined through questionnaire evidence and if necessary, school surveys. There is clearly a case for utilizing existing data on equipment usage (as well as possession) to interpret the significance of data collected.

(e) Concern with success in Examinations: Differential strengths of pupil concern with examination success is probably best measured initially through simple pupil questionnaires and/or essay writing assignments. An assessment of teacher examination orientation will be made by including suitable questions in the questionnaire and interviews to establish, for example, how far classroom activities are directed towards the needs of the public examination, how far the examination is considered to be the raison d'etre for teaching the course, how much practice is given in the examination technique. The observation studies should also provide evidence of teacher examination orientation. In cases where cognitive achievement is dominated by recall of factual knowledge it is likely that scores on measures of examination orientation will also be high. If this proves to be so then it points towards the necessity for making overt change in the examination system if the sort of cognitive objectives stressed by the Integrated Science Course are to be achieved by the majority of pupils.

(f) Cultural and Socio Economic Factors: Schools used in the study will be broadly categorised in terms of the socio-economic status of the families of pupils and, if non-selective, of their catchment areas. If it appears necessary attention will also be paid to the cultural composition of schools.

6. The Value of the Research.

It is hoped that the research will have value not only to Malaysia and Sri Lanka but also to other developing counties with similar school structures and patterns of selection within the school system, and similarly motivated attempts to reform science curricula.

A major result of the study of the process of designing reformed curricula will be to bring together in one report an analysis of the experience gained with difference patterns of course development. This, it is hoped, would serve as additional much-needed material on which to base further development strategy decisions in Malaysia and Sri Lanka and elsewhere.

The values underlying the researcher's work are those to which there is a good deal of public assent -- namely that the schools should concentrate on education for the majority who do not proceed to university rather than the minority who do. If gaps between the protestations and the reality are exposed, and people become consciously aware of the sources of the pressures pushing in directions contrary to declared policy, one has at the very least added to pressures in the opposite direction.

Clearly in the implementation study it will be difficult to arrive at precise quantitative measurements of the variables (but this is not to devalue the worth of work in an area which is often not studied in depth for precisely this reason.) It should,however, be possible to produce sufficiently strong prima facie evidence to illuminate any existing connections enhancing particular types of cognitive achievement, and thus point the way for future development. If one of the conclusions is that the effect of examinations is so overwhelmingly strong that curriculum change in isolation from a radical review of the examination system is unlikely to be successful, then the case for such a review is greatly strengthened. Alternatives such as aptitude tests which have less powerful 'backwash' effects on the implementation of a curriculum may need to be seriously considered.

The result of this research will not be in the form of an extensive array of statistically validated associations between factors contributing to school achievement. Nevertheless it should be possible to demonstrate some interconnections with a high degree of plausibility and to advance suggestive conclusions to provide the basis for further, more extensive, research.

The proposed research programme has been discussed with the representatives of the Curriculum Development Centres, the Examination Departments and the Educational Planning and Research Divisions of the Ministries of Education in Malaysia and Sri Lanka, and its basic theme agreed upon. Clearance for the study has been given. Results from the study will be made available to all the above-mentioned institutions for use as additional evaluative material in future policy-making. In addition, findings of the reseach will appear as part of a book, and several papers are planned.

SCHEDULE OF ACTIVITIES

(i) March - May 1975

Preliminary work at the Institute of Development Studies and the Education Area, University of Sussex, to finalize details of fieldwork and coorindate with ongoing work at the Institute on qualification and selection in the education systems of developing countries. During this period data collected during an initial feasibility study will be analyzed and fed into the programme of field work.

(ii) June 1975 - February 1976

Resturn to Kuala Lumpur to conduct fieldwork programme. The researcher will be based at the University of Malaya. Fieldwork will build on a substantial quantity of data collected during early 1975 on the development and implementation of new science courses, and a preliminary study of the feasibility of using public examination results to discriminate between different types of school achievement in the Form 3 Integrated Science Course. It is planned that approximately 8 weeks will be spent finalizing the curriculum development study and the remainder of the time analysing examination results and following up tenative conclusions with investigations at the school level into factors associated with the achievement of higher level cognitive objectives.

(iii) February 1976 - March 1976

Field work in Sri Lanka to complete research study on the process of curriculum development (initiated early 1975).

(iv) March 1976 - November 1976

Data analysis and writing up in the Institute of Development Studies and the Education Area, University of Sussex, and further data collection from UK residents involved in curriculum innovation in Malaysia and Sri Lanka.

Addresses for communication
during this period.

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1. Progression of an age cohort through the Malaysian Education System

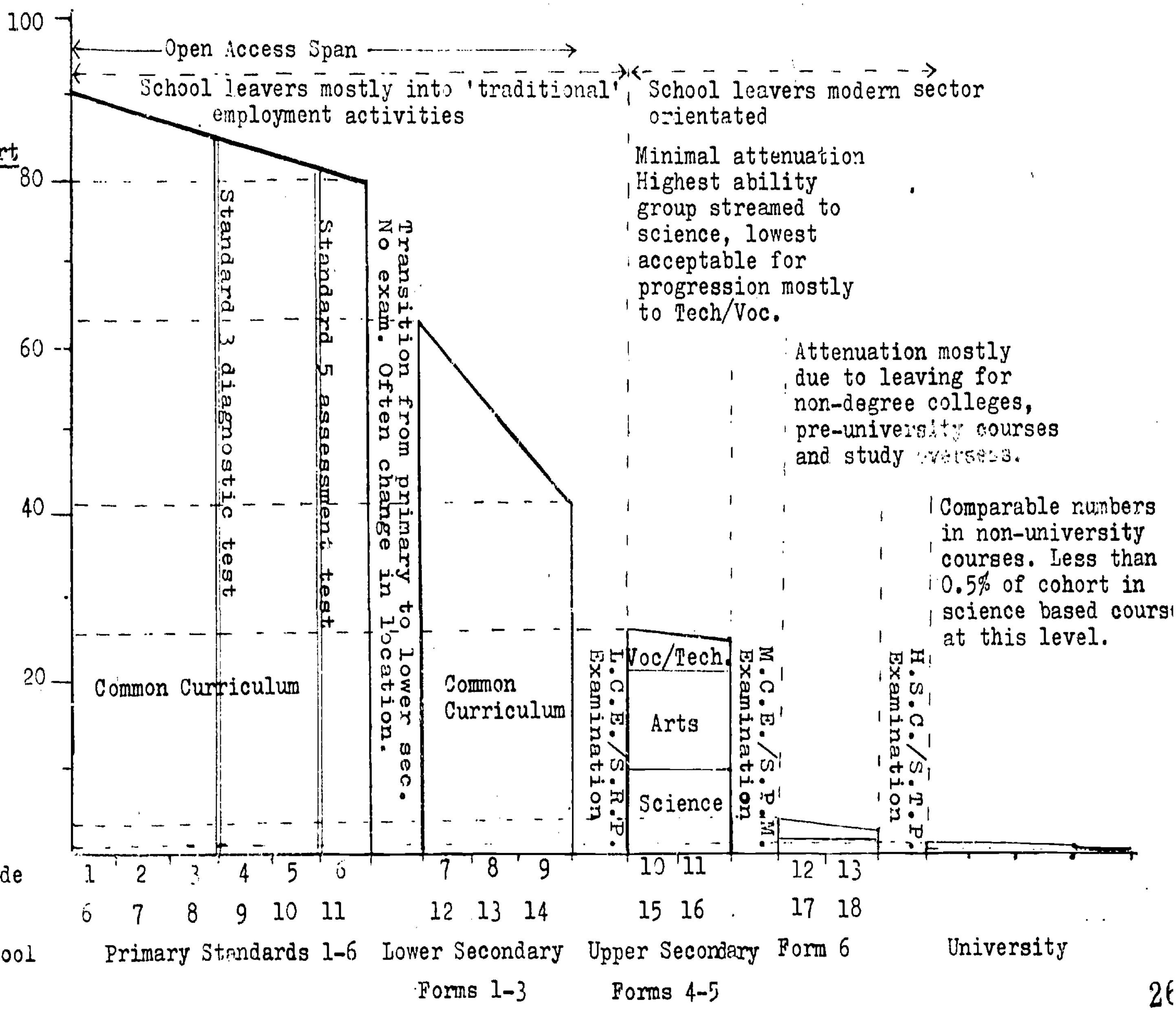
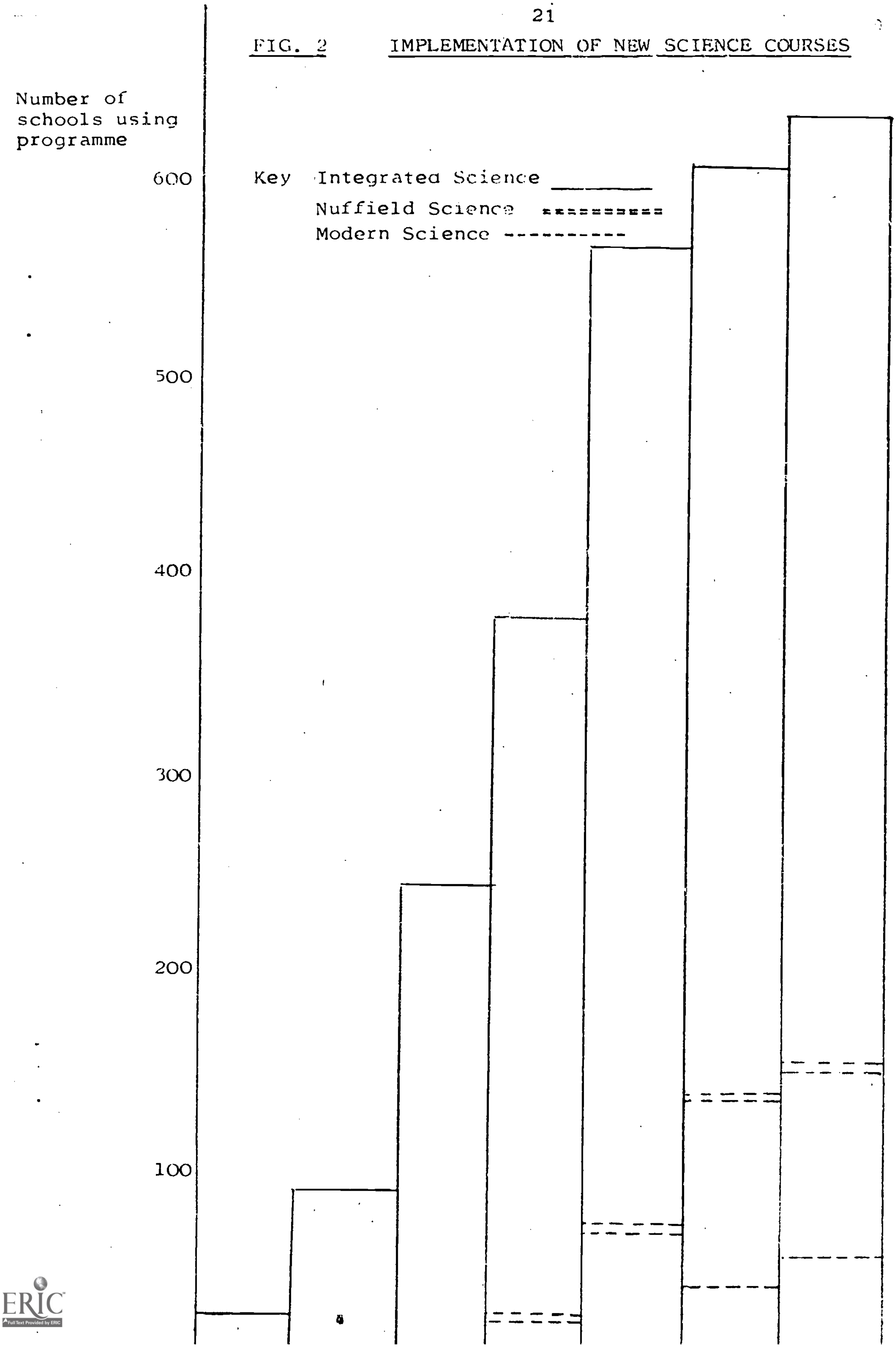
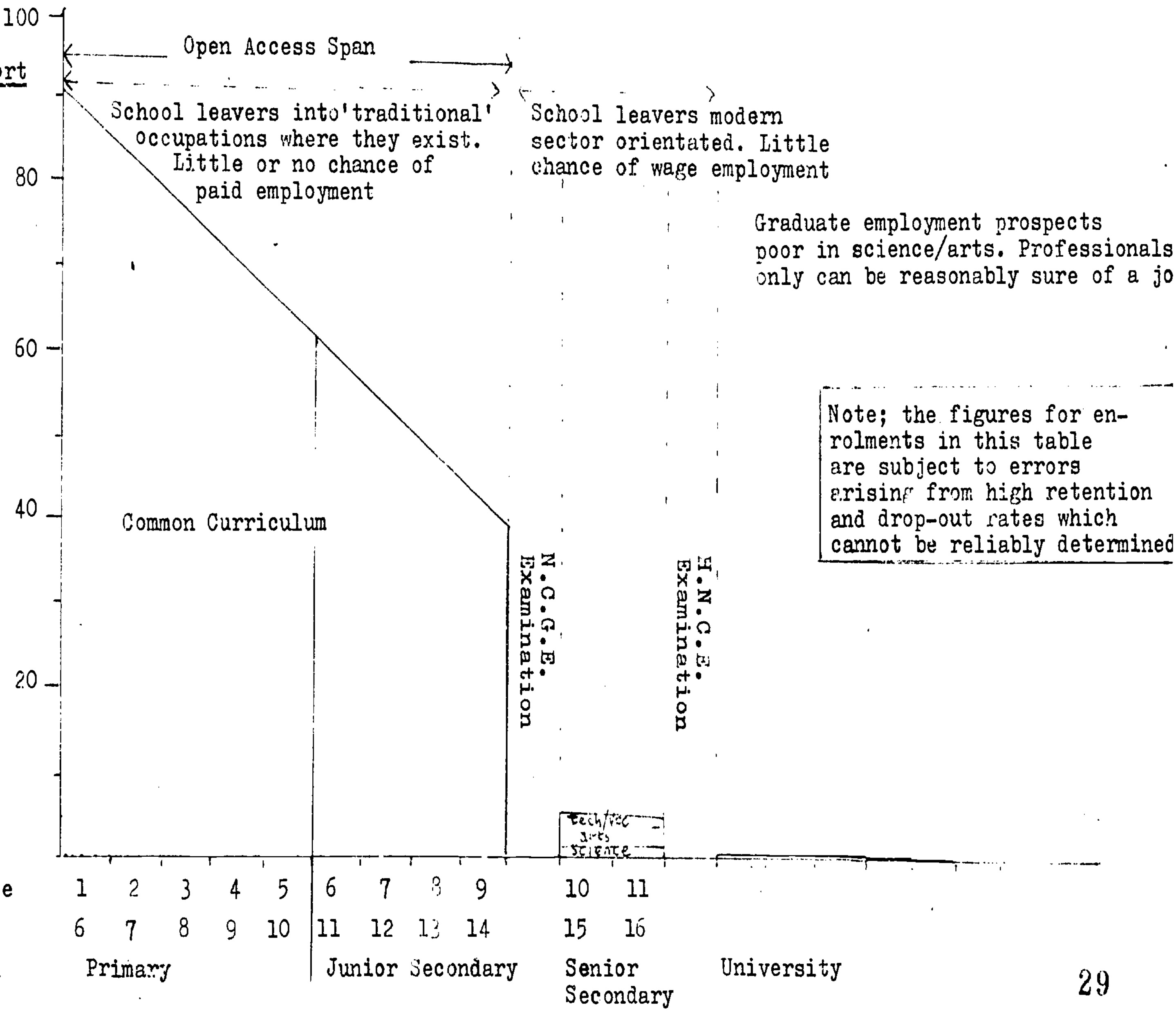


FIG. 2 IMPLEMENTATION OF NEW SCIENCE COURSES



Progression of an age cohort through the Education System in Sri Lanka



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