A STUDY OF THE EFFECTIVENESS OF THE PRIMARY EDUCATION IMPROVEMENT PROGRAMME (SCIENCE) IN CLASSES ONE AND TWO OF SELECTED SCHOOLS IN NORTHERN NIGERIA

BY

DESMOND PATRICK BROWN

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The undersigned certify that they have read, and recommend to the Faculty Board of Education for acceptance a thesis entitled A STUDY OF THE EFFECTIVENESS OF THE PRIMARY EDUCATION IMPROVEMENT PROGRAMME (SCIENCE) IN CLASSES ONE AND TWO OF SELECTED SCHOOLS IN NORTHERN NIGERIA submitted by DESMOND PATRICK BROWN in partial fulfillment on the requirements for the degree of DOCTOR OF PHILOSOPHY in SCIENCE EDUCATION.

Jack A Reed

Dr. J. Reed
(Supervisor)

Dr. G. Badmus

Dr. P. Lassa

Date

Dr. S. Bajah
External Examiner

ABSTRACT

Under the Primary Education Improvement Project, work on science materials for the primary school began in 1970. Two teachers' guides entitled Primary Science One and Two and workbooks for the children had been produced in published form by 1975. Some formative evaluation had taken place during the writing of these materials but this was not as thorough as it should have been because of staff shortages. No study had been made of the effect the programme was having on the children.

"This study involved evaluating the attainment of the science objectives in terms of the children's ability to practice process skills. It also attempted to measure children's interest, active participation and understanding of the lessons, as well as the availability of materials and ease of preparing and teaching the lessons for the teachers."

Data was collected by means of teacher opinionnaires and a children's test to measure the attainment of process skills. The teachers who completed the opinionnaires rated the programme as successful in terms of all the measured criteria. The study revealed that some teachers were not teaching science because of lack of science competency and a shortage of science materials.

Children in PEIP and non-PEIP schools were tested with

the process test and their performances were compared. The results indicated that there were some significant differences in total test scores in favour of the children in PEIP schools after one year of primary school, but none after two years© Girls in PEIP schools seemed to profit more than the boys in terms of an improved ability to practice process skills.

It was recommended that greater attention be given to the proper training of PEIP teachers and to supplying adequate science materials to the schools, as these two factors seemed to be the main limitations on the programme's success.

DEDICATION

This work is dedicated to my dearly loved wife Remedios, who contributed in so many ways to its successful completion. Her encouragement, advice and constructive ideas as also the high quality of her typing helped to make the work easier and more enjoyable. To her I can only say;

"Kung hindi sa iyo, ako'y hindi magtatagumpay."

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Chapter 1

THE PROBLEM

1.1 Introduction

Theories of instruction, the design of the curricula and views on the nature of Science have undergone a variety of modifications over the past few decades. Resulting primary science programmes in different parts of the world have been carefully developed to adapt to these changes. In the United States, among the programmes developed were the Conceptually Oriented Programme in Elementary Science, the Elementary Science Study, Science - A Process Approach and the Science Curriculum Improvement Study. In the United Kingdom, the development of Nuffield Junior Science was followed by Science 5-13. In Africa, a team of writers from many different countries helped to develop the African Primary Science Programme for use in East and West Africa. In all these programmes it was indicated that learning in young children is likely to be more efficacious if the child is involved in direct, first-hand manipulative experiences (Macbeth, 1974:45-51).

This concern for active pupil participation in the learning experience was advocated in the early years

> by writers such as Maria Montessori and John Dewey and in recent years by the authors of experimental science curriculum projects. Theoretical foundations were also supportive of this notion. Developmental psychologists such as Piaget, Suchman, Bruner and Gagne suggested that active pupil participation and direct manipulation of concrete objects was important in the development of learning in early primary school children.

The Primary Education Improvement Programme (PEIP) in Science begun in June 1970, followed the philosophy indicated by these educationists, and directed itself to the needs of primary school children in Northern Nigeria. The writers found it difficult to decide which approach to the teaching of science would best suit the needs of these children. After initially attempting to write a number of concept oriented syllabi in 1970, it was decided by the panel of writers to abandon this approach, and to follow the lead given by the Nigerian Education Research Council (NERC) by adopting a process approach similar to that of Science-- A Process Approach (SAPA) in the U.S.A. (Young, 1975:24).

By December, 1971, the first book in the form of a teachers' guide had been prepared in trial form. It consisted of detailed instructions to the teacher for the teaching of 26 lessons and was entitled Primary Science One. It concentrated on involving the children and the teacher in activities which provided opportunities to practice process-type skills such as, observation, classification, measuring, etc.

The lessons differed from the units developed by the African

Primary Science Programme (APSP) in that they were highly structured. Detailed guidance was given to the teacher of Primary Science One as it was felt by the writers that most of the teachers would be unfamiliar with the subject and would need some specific help. Apart from some worksheets used in classification exercises, there were no reading materials as such for the children. A kit of simple apparatus was designed for use with the book and was supplied to all the trial schools.

The Primary Education Improvement Programme (PEIP) centred in Ahmadu Bello University, Zaria, Nigeria, was sponsored by UNESCO and UNICEF and materials were being developed in English, Mathematics, Social Studies as well as Science. Under the programme eleven trial centres were chosen in the former Northern Region of Nigeria. In each of these eleven centres, six primary schools were singled out to be project schools. Care was taken not to select only the best primary schools as project schools. The result was a selection of schools which represented a good cross-section of the schools in each centre. Attached to each of the centres were two or more experienced teachers called Mobile Teacher Trainers (MTT). The function of an MTT was to train classroom teachers in the teaching of the trial materials.

The trial edition of Primary Science One was sent to these 66 project schools to be used by the teachers. Very little prior training of the teachers had been carried out and it was left largely

to the MTTs to explain the philosophy behind the science programme and how the lessons should be taught. Primary Science One was presented to the MTT conference in December, 1971 and some in-service training took place at that conference but, no subsequent training was provided. During 1972, Primary Science Two was written. This book followed the general pattern of Primary Science One in that it was geared to teach process type skills through activities in which teachers and pupils participated together. There were more worksheets for the pupils although the programme still emphasised the guide for the teacher.

Evaluation of the materials Primary Science One and Primary Science Two had begun and revised editions of these books were being planned when two key figures in the science curriculum development process left Zaria in 1973. The one remaining writer (Beverly Young) carried on the writing and evaluation process, and later he was joined by a second writer P. Oyebanji.

The pattern of feedback in the evaluation process which took place is shown in Figure 1.1 (Young, 1975:30). Whilst materials were still in trial form, lessons were tested in local primary schools close to the Zaria Institute of Education, Ahmadu Bello University, Nigeria. It was at the Institute that writing took palce. Often lessons were taught in the Zaria schools before being included in the trial editions of the books for use in the project schools.

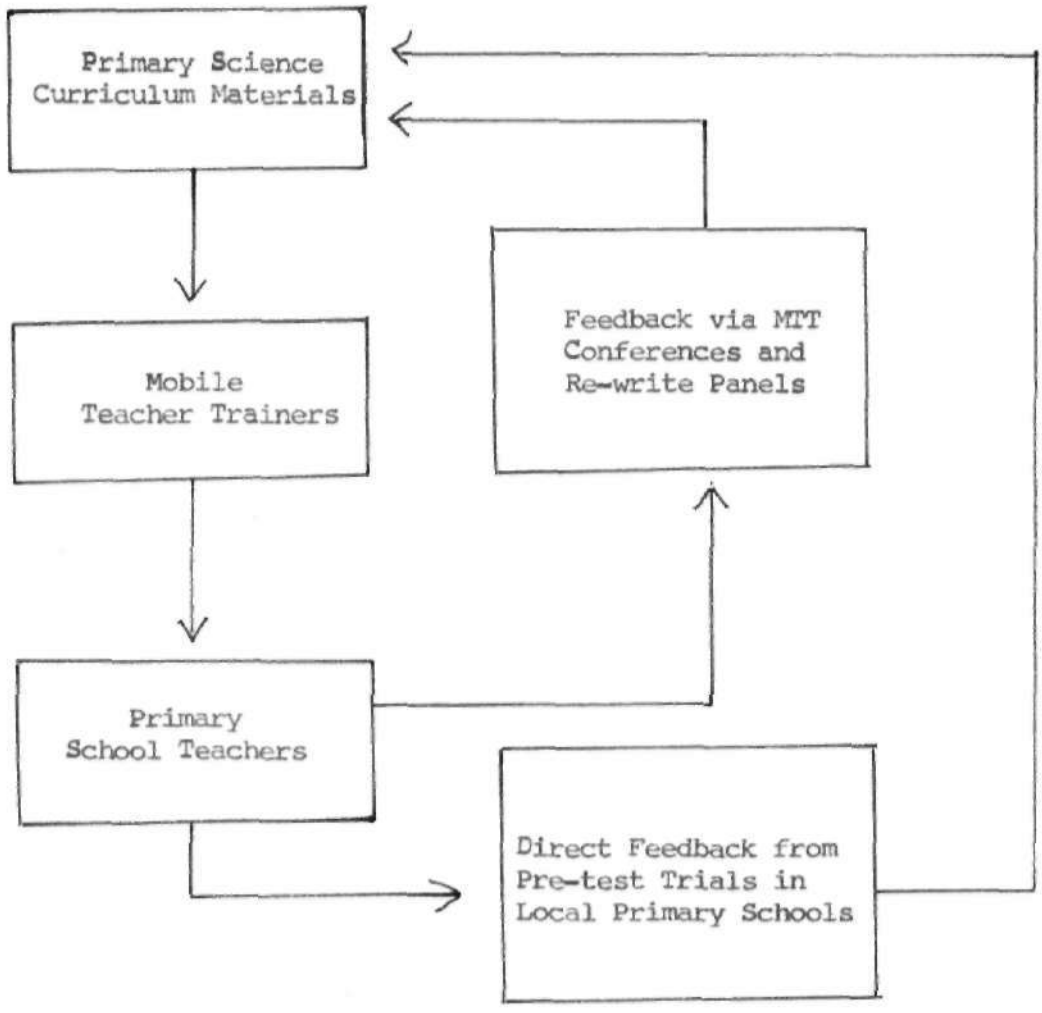


Fig. 1.1 — Pattern of Feedback on Primary Science One and Two

At the conference with Mobile Teacher Trainers during the year, additional feedback information was obtained which helped in the re-writing of certain lessons. As Young (1975:28-30) explained:

> The evaluation was not as thorough nor as vigorous as it should have been, but it was a good, commonsense attempt to improve the quality of the original materials... The other major source of feedback was through the MTTs in the official project schools. It has already been indicated that they were our most direct link with the teachers. But it would be dishonest to pretend that they were able to provide the detailed and comprehensive feedback that was really needed. After all they were responsible for supervising all subject areas in several classrooms. On analysing their feedback forms, we discovered that one or two lessons (in the Science Books) had been seen by no MTTs, and several had been seen by only one MTT.
>
> With greater manpower resources, it would have been possible to undertake a more vigorous evaluation. In particular, it would have been interesting to study the effect of a process oriented science curriculum on children's behaviour. Did it really develop their skills of classification, measuring, experimenting, predicting . . . and so on? Tests could have been devised if we had had more time and manpower but it must be realised that their production is very expensive, both in direct costs and in man/woman hours.

Before writing this paper, Young had suggested that a more thorough evaluation study should be undertaken. He left Nigeria in 1974 after four years of work on P.E.I.P. (Science), and was anxious for someone to undertake an evaluation of the two teachers' guides, for which he had been the principal author. Large sums of money had already been spent on the P.E.I.P. but up to this time, staff shortages in the area of science had made it impossible for any comprehensive evaluation of the materials to be carried out by the curriculum writers themselves. In addition, the two teachers'

guides followed a process-oriented approach to the teaching of science. Such an approach had never before been adopted in Nigeria and the effect it was having on the children was not known. This study was therefore undertaken primarily to find out whether intended changes in the children's behaviour were actually occurring as a result of the approach of the Primary Education Improvement Programme.

1.2 Definition of the Problem

Curriculum evaluation, as discussed in Chapter 2, can take many different forms. This study used one form of curriculum evaluation concerned with the evaluation of the attainment of programme objectives. It was essentially summative in nature. The P.E.I.P. objectives were those indicated by the writers of the teachers' guides.(Young, 1974:1).

> The lessons have as their major objective the practice by the children of the scientific skills of observation, measuring etc. The overall idea of the lessons is that children should be encouraged to raise questions and pose problems about the world around them, and then seek answers to such questions.

In both the teachers' guides, stress was laid on the teaching of process skills. Hence, one of the major objectives of this study was the evaluation of the attainment of these process skills by the children.

A testing instrument was required to evaluate the attainment of process skills by children in the first two years of

primary school. In the Review of Related Literature (Chapter 2) several tests were described that had been successfully used in other countries. However, no such test was reported to have been used in West Africa where the cultural background is different from America or Europe. Hence, a process testing-instrument had to be designed to measure the attainment of process type skills in Nigerian children.

To assess the success of the P.E.I.P. in achieving its objectives, a comparison needed to be made of the children exposed to the P.E.I.P. with those who attended schools where the P.E.I.P. did not operate. If the children in the P.E.I.P. schools performed significantly better in process skills than those in non-project shcools, the programme could be seen to be achieving one of its major objectives. Other major objectives were identified through formal & informal discussions with the writers of the P.E.I.P. materials. To be successful in attaining these objectives there should be sufficiently high level of;

(i) student interest,

(ii) student understanding of lesson materials, and

(iii) student active participation in the lessons.

To obtain information on these factors, the most reliable source was the classroom teacher. The children were too young to be able to supply the sort of information which would be reliable. Hence, an opionnaire for the teachers of Primary Science One and Primary Science Two was considered essential. In addition, the teachers of a programme usually have been considered to be the

best judges of its worth (Victor and Lerner, 1971:467).

A further aspect also needed to be considered when the time and facilities available to the average primary school teacher were taken into consideration. Information as to whether lessons in the programme were "teachable" needed to be obtained in terms of;

(i) availability of materials for the lessons, and

(ii) ease of preparation and implementation of the lessons.

Such information was obtained through teacher opinionnaires for each of the books Primary Science One and Primary Science Two.

1.3 Delimitation of the Study

The study limited itself to the first two years of the primary school. At the time this study was begun, Primary Science One and Primary Science Two for use in Classes I and II of the primary school were in their finalized forms and had been in use for approximately two years. Primary Science Three was undergoing some revisions while Primary Science Four was still being written. For these reasons, it was decided not to include years three and four in the study.

To assess the attainment of project objectives, project school children who had been exposed to P.E.I.P. for one and two years were tested with a process type test. The scores of these children were then compared with those of children at the same

class level in non-project schools, who had not been exposed to the P.E.I.P.

The teachers involved in the study were those teaching primary Classes I and II with the P.E.I.P. Science materials. Their opinions concerning the programme were obtained by the use of opinionnaires.

A study of the training and preparation in Science of the teachers teaching P.E.I.P. Classes I and II was not included in this study, although extensive work had been done in this area as part of a research project by Part III B.Sc.(Ed.) students (1977) in the Department of Education, Ahmadu Bello University, Zaria. The study and the results obtained were referred to in this report.

Another aspect of an evaluation exercise is the on-site evaluation of science lessons while the lessons are being taught in the classrooms. Such evaluation could help to provide direct and immediate information about the degree of success of the basic materials and the teaching strategy. Such observations have been omitted from this study because personnel required to complete the task in the time interval were not available. In addition, such observations in the classroom might have serious drawbacks. Apart from being a disturbing influence for the children, the teacher's behaviour becomes modified as a result of being observed. Sometimes such teachers fear they are being evaluated for other purposes. On-site observation can produce unreal situations as a result of this interference.

This study was limited, therefore, to a measurement of student behaviour and post-hoc teachers opinions for the assessment of the P.E.I.P. science curriculum materials.

1.4 Statement of the Problem

This study attempted to assess the attainment of the major P.E.I.P. Science objectives. Specifically it sought to find answers to the following questions:

(1) How successful do the P.E.I.P. teachers rate the programme in terms of:

(i) children's interest in the lessons

(ii) children's practice of process skills

(iii) children's active participation in the lessons

(iv) children's understanding of the lessons

(v) ease of preparation and implementation of the lessons by the teachers

(vi) availability of materials for teaching the lessons?

(2) Do children in P.E.I.P. project schools perform significantly better than children in non-project schools on a test designed to measure their ability to practice process skills?

In an attempt to answer these questions the following hypotheses were tested:

Ho_1 : The teachers of P.E.I.P. Classes One and Two will not have a positive attitude to the programme.

This will be indicated by an overall mean response not greater than 3 on a scale of 1-5, regarding the following criteria:

(i) children's interest

(ii) children's practice of process skills

(iii) children's active participation in the lessons

(iv) children's understanding of the lessons

(v) ease of preparation and implementation of the lessons

(vi) availability of materials for teaching the lessons.

Ho_2 : After <u>one</u> year's exposure to the programme, project school children will not perform significantly better in terms of total process test scores than will children in non-project schools ($\alpha = .05$).

Ho_3 : After <u>two</u> year's exposure to the programme, project school children will not perform significantly better in terms of total process test scores than will children in non-project schools ($\alpha = .05$).

Ho_4 : Boys in project schools will not attain significantly higher total process test scores than will boys in non-project schools at the same class level ($\alpha = .05$).

Ho_5 : Girls in project schools will not attain significantly higher total process test scores than will girls in non-project schools ($\alpha = .05$).

Ho_6 : Boys will not attain significantly higher total process test scores than will girls at the same class level ($\alpha = .05$),

(i) in project schools, and

(ii) in non-project schools.

1.5 Basic Assumptions

The basic assumptions on which this research was based were:

(1) Children in P.E.I.P. project schools and children in non-project schools in each centre come from the same population.

(2) If other subjects in the school curriculum affect the scores of the children on the process test, the change effected is similar in magnitude for children in project and non-project schools.

(3) It is possible to measure the children's ability to practice process skills using the process test.

(4) The average ability of children to practice process skills at the time of entering primary school will not differ significantly from year to year (over a period of three years);

(a) within a centre, and

(b) across the population of project and non-

project schools.

(5) The opinions of the P.E.I.P. teachers are reliable regarding the attainment of programme objectives.

(6) This programme can be evaluated through a study of teachers' opinions concerning:

(a) children's interest

(b) children's practice of process skills

(c) children's active participation in the lessons

(d) children's understanding of the lessons

(e) ease of preparation and implementation of the lessons

(f) availability of materials for the lessons.

(7) A primary school Science programme is successful if;

(a) it attains its main objectives i.e. in this case the practice of process skills by the children, as measured by a process test.

(b) the teachers rate the programme successful in terms of;

(i) attainment of the objectives

(ii) children's interest in the lessons

(iii) children's active participation in the lessons

(iv) children's understanding of the lessons

(v) ease of preparation and implementation of the lessons

The Primary Education Improvement Programme was one of these new curricula through which Science was given a stronger emphasis in the primary school. The programme began in 1970 and although some formative evaluation took place during the writing process, no evaluation of the outcome of this programme has been undertaken by the P.E.I.P. writers and developers. In order to assess the achievements of the P.E.I.P. in attaining its objectives, this study has been undertaken. It was hoped that through this evaluation the value of the P.E.I.P. in helping Nigeria prepare and train children to be future scientists, engineers and technicians would be easier to assess. This study may also provide a basis for the design of instruments to be used in the evaluation of the P.E.I.P. (Science) in the higher classes of the primary school. In addition, it might be of interest to other educationists in Nigeria who are involved in evaluation studies of other types of primary school science curricula.

1.7 Definition of Terms

The meaning of some abbreviations and terms which may not be familiar to the reader and need defining in the context of this study, have been included in this section.

P.E.I.P. - Primary Education Improvement Programme. A programme

which began in 1970 to design primary school materials for all subject areas taught in Nigerian primary schools.

N.E.R.C. - Nigeria Educational Research Council. A Federal body centred in Lagos which advises the Government on educational matters.

S.A.P.A. - Science— A Process Approach. An elementary school Science programme developed in the U.S.A.

S.C.I.S. - Science Curriculum Improvement Study. An elementary school Science programme developed in the U.S.A.

A.P.S.P. - African Primary Science Programme. A primary school Science programme developed in East and West Africa.

M.P.S.P. - Mid-West (Bendel State) Primary Science Programme. A primary Science programme developed in the Mid-West (Bendel State) of Nigeria.

M.T.T. - refers to a Mobile Teacher Trainer who was responsible for training and supervision of PEIP teachers in all the subjects being developed in the programme.

Project School - A primary school where the PEIP programme was being used under the supervision of a Mobile Teacher Trainer.

Non-Project School - A primary school not using the PEIP books.

Traditional Course - In the context of this study, traditional meant a course or syllabus supplied by the Ministry of Education or any other course which followed a 'content'

or factual approach to the teaching of science in the primary school.

Process Skills - These are the mental 'skills' which the scientist (in this case the child) uses as he is attempting to solve or find an answer to a problem. The process skills which need defining, because reference is made to them in the present study, are;

1. Observation - of the physical world, both natural and man-made. Stress is laid on accuracy and the importance of identifying the phenomenon to be observed.
2. Measurement - refers to a continuous number to the application of congruent (= identical) units to measure physical quantities.
3. Classification - is a very wide but fundamental scientific skill. It includes sorting, grouping, ordering and the application of both quantitative and qualitative criteria to these processes.
4. Inference - often implies cause and effect relationships. It may be based on a little or much data.
5. Prediction - is possible when an event can be foretold with some degree of certainty. If a prediction is valid, consistent result should be obtainable in given circumstances.

6. Manipulation - refers to the need to give children the opportunity to develop their skill in making and handling physical objects. The acquisition of mechanical skills of manipulation provides an opportunity for other processes to be naturally brought out.

7. Experimenting - is concerned with the practical investigation of phenomena, often by trial and error techniques, based on previous experiences.

8. Understanding Space Relationships - refers to the skill of understanding the position of objects in relation to one another (e.g., in front of, behind, to the left, to the right.)

Mean Lesson Response - The mean response to all lessons, made by an individual teacher.

Mean Teacher Response - The mean response of all teachers to one lesson.

Overall Mean Response - The mean of the responses of all the teachers to all the lessons concerning a particular criterion.

TOPS - Test of Process Skills. This refers to the test used in this study to measure the ability of children to practice certain process skills.

Chapter 2

REVIEW OF RELATED LITERATURE

2.1 INTRODUCTION

In this chapter relevant literature concerning curriculum evaluation in general, was reviewed to put the present study in its proper perspective. The purpose of evaluation, the different forms it can take and its possible scope were outlined, and the use of student testing and teachers opinionnaires in evaluation studies were also discussed. The task and role of the evaluator were described and some of the problems associated with evaluating curriculum projects developed by other people were mentioned. A number of recently developed primary school science programmes and the procedures used for their evaluation were chosen for discussion. The background of the PEIP programme and its development were outlined as also were some of the feasibility studies conducted to evaluate its success.

2.2 CURRICULUM EVALUATION IN GENERAL

2.21 Purpose of Evaluation

One of the main reasons for the current emphasis on the evaluation of educational programmes and curricula has been

ascribed to the large sums of money that are being invested in educational innovation. Local, federal and international bodies that are financing these efforts have come increasingly interested in the evidence concerning the return on their investments (Lindvall and Cox, 1970:1). In addition, curriculum evaluation is carried out to determine whether a programme is achieving the objectives for which it was designed. The evaluation of the P.E.I.P. (Science) has been undertaken partly for these reasons. Several years of hard work and large sums of money have been invested in P.E.I.P. up to this point. This report attempted to describe the success of this investment, and the achievement of the P.E.I.P. objectives.

2.22 Forms of Curriculum Evaluation

Curriculum evaluation can take two main forms. One of these is the gathering of data while a programme is being developed for the purpose of guiding the development process. This is termed formative evaluation. When an evaluational procedure is used to make some type of summary assessment of the overall value of an educational programme, the term summative evaluation is used.

The teachers' guides for P.E.I.P. (Science) went through a formative evaluation process as was shown in Figure 1.1 p. 5 of this report. The evaluation dexcribed in this report was largely summative in nature as it was unlikely that any modification would

occur in the materials being evaluated as a result of this evaluation. However, it is possible that the information gathered in this report will help guide the curriculum writers of PEIP (Science) who are still in the process of writing materials for the higher classes of the primary school. The type of evaluation described in this report could be labelled "conventional". In the past few years newer forms of evaluation have been developed and two such forms are briefly described here.

1. Illuminative Evaluation

Illuminative evaluation is not merely a style of evaluation, but fits more comfortably beneath the broader title of educational research. It recommends flexibility in method, and the breadth and variety of data sources, aiming for "description and interpretation" and a "comprehensive understanding" (MacDonald, 1976:121). In asking the question "What is happening?", in relation to an innovative enterprise in the curriculum, rather than "Are we having the effects we wanted to have?", illuminative or holistic evaluators have abandoned the narrow criteria of success which normally operates in conventional evaluation. Advocates of the illuminative approach maintain that the human state cannot be adequately represented by ticks on an observation schedule or scores or quotients derived from standardised tests.

(2) Case-Study Evaluation

Case-study evaluation is an intensive detailed analysis of a curriculum. It makes use of a broad based methodology, which may include testing, classroom observations, content analysis of records and materials, interviews with students and staff and descriptions of physical facilities and resources. The case-study method also allows evaluators to deal with variables that are hard to quantify e.g. staff morale and institutional vitality (Anderson et al., 1974:46).

2.23 Scope of Evaluation

The term "evaluation" covers a wide variety of meanings and has been used to describe many processes (Taba, 1962:310).

> In the first place, one can evaluate anything about the school's curriculum: its objectives, its scope, the quality of personnel in charge of it, the capacities of students, the relative importance of various subjects, the degree to which objectives are implemented, the equipment, materials and so on. Secondly, the term evaluation may refer to . . . rendering of a value judgment based on sheer opinion. Evaluation by judgment can help to describe the various aspects of a programme such as the objectives, the method of curriculum development and the materials used.

The evaluation described in this report was concerned with the attainment of programme objectives, evidenced by matching student performance to intended objectives (Bloom, 1971:262). It was also concerned with value judgments based on the opinions

of teachers.

2.24 Student Testing and the Construction of Tests used in the Evaluation of a Programme

Many programmes employ student testing as parts of their evaluational strategy. Not all evaluators are convinced of the value of this form of testing for it can be very time consuming and expensive (Harlen, 1975:81-7). In programmes where student testing has been employed, group or individual tests were constructed and in some cases pre and post-tests scores were compared against a control group. In other cases criterion measures were used which needed no control group.

Whatever testing procedure, the design of student tests required that such tests be both valid and reliable. Student testing was employed in the evaluation of the P.E.I.P. using a test that was validated and shown to be reliable according to methods described in the following paragraphs.

(a) Validity has been described as "the capacity of the evidence to describe what it was designed to describe" (Taba, 1962: 321). In the context of testing, validity means the capacity of a test to measure those things it was designed to measure. This type of validity often referred to as "content validity" can be established by means of judges (Bloom, 1971:76). Judges who have expertise in the particular subject area being tested, are asked to examine the test items. Any modifications suggested by them

are made to the test, until there is a high degree of agreement that the test is measuring what it was designed to measure. The establishment of test validity by this method is often referred to as "validation by experts".

The validation of a test can also be established when children in higher primary grades attain significantly higher mean scores on all sections of the test than do younger primary children. Validity established by this method is referred to as "construct validity" (Dietz and George, 1970:341-52).

The process test instrument used to test children in the evaluation of P.E.I.P. (Science) was shown to possess content validity and construct validity by these methods.

(b) Reliability can be established using statistical tests. Among those commonly used are the Kuder-Richardson formulas 20 and 21 (Kuder and Richardson, 1937:151-160). The Kuder-Richardson formula 20 is applicable to tests in which the items are scored by giving one point if answered correctly and no point if answered incorrectly. If the scores are corrected for guessing or if other forms of weighted scoring are used, more complex variations of the formula must be employed. When test items are of the same level of difficulty, formula 21 can be used. Conversely it cannot be used if the items are not of the same difficulty. In such a situation a Kuder-Richardson formula that is useful in estimating test reliability coefficients of the test items which

are weighted differently and are of different difficulty is

$$r = \frac{k}{k-1}\left[1 - \frac{\Sigma\sigma_i^2}{\sigma_t^2}\right] \quad (1)$$

where k represents the number of separate items, σ_i^2 is the variance of student scores on a particular test item and $\Sigma\sigma_i^2$ is the sum of these variances for all items, and σ_t^2 is the variance of the total item test scores. (Ebel, 1972, 1972:419).

A second method of estimating reliability consists of calculating a product moment correlation between total scores and sub-test scores. Reliability coefficients obtained in this way can be tested for significance (Dietz and George, 1970:341-52).

To establish the reliability of the process test used in the evaluation of the P.E.I.P. neither of the two formulae 20 or 21 were suitable and the alternative formula (1) above was used. This was because items in the process test were weighted differently and were not of equal difficulty. Reliability of the process test was also established by calculating product moment correlations between sub-test and total scores.

2.25 Teachers Opinions used in the Evaluation of a Programme

In the evaluation of a curriculum the use of informal devices as a means of gathering information is a generally accepted practice (Taba, 1962:329). Often these informal devices take the

form of opinionnaires or observation sheets completed by the teachers. The use of such devices is considered important in addition to student testing (S.T.E.P., 1975:124).

> Formal tests (on students), while they constitute a refinement of observations, which can be made in less formal circumstances, will never wholly replace the organised perceptions of teachers sensitive to the reactions of their pupils to their teaching.

In most of the programmes described in this chapter in the following sections, the teachers played an important role in the evaluation strategy. In the evaluation of P.E.I.P. (Science), teachers' opinions were used to help determine the attainment of programme objectives. In addition, they were asked to comment on "interest", "active involvement" and "understanding" of the children. In a programme such as P.E.I.P. where stress was on teaching process skills to children, active involvement of the children was essential. Equally important was the interest shown by the children in the lessons. The teacher's suitability as a judge of children's interest was emphasised in the evaluation of the Elementary Science Study (Victor and Lerner, 1971:463).

> The evaluation of the ESS unit is a process which is implicit in the teaching of that unit. Because the teacher is actively involved in the study, he is continually aware of the degree of his students participation and their learning success . . . The most satisfying form of evaluation reported to us is a subtle one. Teachers tell us of children's excitement at what they are learning and of their enthusiasm for the ways in which they are learning. A student who has hardly participated in class comes alive. A child who has been unsure of himself speaks up,

> 'I know I am right because I tried it'. To us an interested class is a successful one.

In the evaluation of P.E.I.P. (Science) the teachers were asked in addition to comment on the "ease of preparation and implementation of the lessons". To be successful, lessons needed to be fairly easy for the teachers to prepare and to teach. In Nigeria, where primary school teachers, in the majority, were occupied teaching all the subjects in the curriculum, lessons which were difficult were unlikely to be taught.

In most cases, where a programme undergoes a fairly thorough "formative evaluation" stage, lessons difficult for the teachers are modified or re-written before reaching their final form. In the case of P.E.I.P. as was pointed out in Chapter One of this report, the formative evaluation was not as thorough as it might have been. Because of staff shortages, feedback on a number of lessons was sometimes completely lacking (Young, 1975:68). With this in mind it was decided to ask the teachers to comment on the "teacheability" of lessons in this summative evaluation stage.

A kit of simple materials was supplied with the P.E.I.P. teachers' guides. Many of the items in the kits were available in local markets but some could be broken or lost. Since the kit and other materials were essential for some of the lessons, teachers were also asked to report on the "availability of materials". It was believed that to be successful, the level of

material availability should be high.

2.26 Teacher Preparation and Curriculum Evaluation

The preparation of teachers to teach a programme was considered to be of great importance. Some educators have maintained that the success of any programme is very dependent on it (AAAS, 1968:12).

> Evaluation of the teacher education programme has shown that successful teaching of this curriculum (Science-- A Process Approach), as measured by performance of children, depends on the teachers own competence in the science processes.

The curriculum writers of the Mid-Western State Primary Science Programme (MPSP), aware of the importance of training the teachers to teach primary school science, organised a three-month training course for this purpose. Arrangements were made for the in-service training course to be itself evaluated along with other aspects of MPSP (Falayajo, Bajah and Yoloye, 1976:1-72). A summary of this evaluation is contained in Chapter 2, Section 2.7 of this report.

Regarding teacher training and curriculum development Young stated (1975:76);

> Teachers are the key to curriculum development. In the flurry of activity which surrounds the production of materials, or in the curriculum conferences with their resounding recommendations, teachers are easily forgotten. Most curriculum projects discover that changing teachers is the major constraint on the dissemination of ideas. Inevitably, they become involved with in-service training, teachers in trial schools,

> teacher's centres or teachers associations. Less often do they recognise the importance of injecting their ideas or experiences into pre-service training courses for teachers.

The training of teachers of P.E.I.P. was not directly surveyed, but was investigated by students in the Department of Education, Ahmadu Bello University, Zaria under the supervision of the present writer. The results are discussed in Section 2.83 of this report.

2.27 The Task and Role of the Evaluator

The task of the evaluator has been discussed extensively (Lindvall and Cox, 1970:56-57).

> Once a programme has been developed and is fully functioning, the task of the summative evaluator is to describe what the programme does and what it is worth. The evaluator has to consider what kind of information about a programme would be most meaningful. He will have to define and delimit his task. In doing this, he will be using his judgment as an evaluator to decide on the most useful type of information to provide and will consult with other sources and authorities to help him in making his decision.
>
> A major contribution to the general improvement of the task of curriculum evaluation can be made if the evaluators come to recognise the necessity for and the importance of this very conscious and serious delimitation of the task of the evaluator . . . Similarly, a curriculum evaluator cannot afford to be distracted by attempting to answer all possible questions about a given programme or he will soon see his task growing to such magnitude that he will abandon it as being impossible.

The limits and the reasons for the limitations in the evaluation study of P.E.I.P. (Science) were specified in Chapter One. The study has only included information that was considered

to be most useful and relevant to the programme writers who are still engaged in writing materials for the higher classes of the primary school.

The role of the evaluator has been described as a difficult one (Schools Council, 1973:6).

> There are few people who do not resent the attack on their professional competence implied by the criticism their material receives when put on trial, least of all the assertive person who may well be the best curricular apostle. Nevertheless it is important that the evaluator should be able to make such criticisms, inhibited neither by his own involvement in the writing process nor his relationship with other team members.

Independence of the evaluator is seen by some as important (Harlen, 1975:15). In this way, the evaluator is not emotionally involved and can gather evidence impartially and objectively. However, the evaluator must be sufficiently well informed about the purpose, content and context of the work to enable him to gather useful evidence.

It is felt that becuase the evaluator of P.E.I.P. (Science) had not been involved in the process of writing the materials for P.E.I.P., he could be unbiased in his judgment of the programme's effects. Careful review of the P.E.I.P. (Science) objectives, materials and procedures prior to the onset of the study has satisfied Harlen's criteria regarding the evaluator's knowledgeability.

2.3 SCIENCE— A PROCESS APPROACH (SAPA)

2.31 Introduction

Since the mid-fifties revolutionary changes have been taking place in the teaching of science in the United States. Teams of scientists, have attempted to bring about far reaching improvement in the teaching of science, at all levels, including the elementary or primary school level (AAAS, 1968:7).

> Believing that experience with science must begin with the learning of language and continue throughout the educational process, the Commission of Science Education of the American Association for the Advancement of Science, with financial support from the National Science Foundation, embarked upon the preparation of a science programme for the elementary school. Materials were first written during the summer of 1963 and in each of the following summers through 1967. During each school year, beginning in 1963-64, the materials were taught by teachers in ten or more tryout centres across the country.

The feedback information from the teachers in these tryout centres and a systematic evaluation of the children's acquisition of science competencies after each exercise were used as the basis for revising and rewriting the materials during each succeeding summer writing session (Livermore, 1964:271).

2.32 Differences between SAPA and More Traditional Elementary Science Curricula

In some elementary classes, programmes in science have consisted of more or less separate units in which the children

learned about spiders, magnets, ant-lions, birds, plants and many other similar types of things. By the end of such courses, the children had learned a number of facts and concepts about the world of science. These types of programmes assumed that science was mostly a collection of facts and concepts about the natural world. Science-- A Process Approach did not make this assumption, it was concerned rather with what scientists do, when trying to solve a problem. The writers of SAPA maintained (AAAS, 1968:7):

> Science is much more than an encyclopedic collection of facts, and that children even in the primary grades, will derive much more from the study of science if they learn the behaviour of scientists. Although the behaviours of scientists are complex, they have been classified into a number of process skills, some simple and some more complex. These intellectual activities of scientists, the processes, form the core of Science-- A Process Approach.

Science exercises for the primary grades stressed the basic skills of: observing, classifying, using space/time relationships, experimenting, using numbers, communicating, measuring, inferring, predicting and manipulating. Skill in applying these basic processes provided the foundation for the more complex or integrated processes which were the fundamental elements of Science-- A Process Approach in the intermediate grades. The integrated processes were: formulating hypotheses, controlling variables, interpreting data, defining operationally and experimenting.

In Science-- A Process Approach, the ability to read was

not so essential as it was in many traditional curricula. Thus, inquiry into Science could begin as early as kindergarten. Success did not depend on skill in reading, but on the ability to use the processes of science. This essential differences had important implications. It meant that the degree of reading skill was no longer a factor controlling science learning (AAAS, 1968:8).

The first two teachers' guides written for PEIP (Science) adopted the process approach outlined above. The decision to adopt this approach was made after the conference on primary science arranged by the Nigerian Education Research Council. In this conference, the science panel recommended that this approach be adopted for primary schools throughout the country (N.E.R.C., 1971:1).

2.33 Materials for Teaching the Programme (SAPA)

Most of the reading materials prepared were for the teacher only. Rather than reading about science, in this curriculum, children learned science through the use of their senses, mental involvement, and direct manipulation of things in their immediate environment. In addition to reading materials for the teachers, a kit of practical materials was available for the children. Some of the pratical materials were duplications of the sort of things that would be found in any normal school; and the empahasis in the production of kits to accompany each exercise was

simplicity.

Built into the exercises for the lower grades were two measures to assess pupil achievement. These were the Appraisal Measure and the Individual Competency Measure. The Appraisal was planned as a class activity which assisted the teacher in determining how the class as a whole appeared to have achieved the objectives of the exercise. The Competency Measure was administered to individual children by the teacher or professionally prepared assistant. For the higher grades both a Group and an Individual Competency Measure existed to help determine whether or not a child could perform the tasks specified by the objectives, after having had the experiences provided by the exercise.

The Individual Competency Measure was designed to evaluate the achievement of individual children, and the Group Competency Measures were written tests to be administered to the class and were designed also to test individual achievement. It was believed that when a Competency Measure was administered to an individual, the tester was able to observe just what the child was able to do. These tests had the advantage that the child's achievement did not depend on what he was able to read. The Group Competency Measures had the advantage of all group written tests - they could be administered simultaneously to all children in a class. A child's ability in the group tests did depend in part on his ability to read and there was little opportunity in a written group test to

test how the child handled equipment or planned or carried out an investigation.

The Competency Measures were carefully tested during the tryout years. Each test included in a Competency Measure, tested the mastery of an objective of the exercise. The tasks employed were intentionally designed to use content material different from that of the exercise. In this way, the Competency Measures assessed whether the child had indeed acquired the process capabilities described in the objectives of the exercise.

In the overall evaluation strategy of Science-- A Process Approach, the long range achievement of process goals was appraised by the Science Process Measure. This measure was designed to assess pupil capabilities in all the basic science processes identified by the curriculum. With behavioural hierarchies as a guide, seven processes measures were developed (1968) for the eight basic processes, one for each process except Communicating and Predicting, which were combined in a single test. Process measures were provided for Observing, Classifying, Communicating and Predicting, Measuring, Inferring, Using Numbers and Using Space/Time Relationships. The total testing time required for administering these seven tests to an individual child was about two hours. Work was begun in 1967-68 on Process Measures for the five integrated processes but no report of the results has been found in literature. In the tryout experience it was felt that

teaching aides and others not especially trained in such testing could satisfactorily carry out the testing following suitable orientation. This offered the possibility of using the process measure in many schools where guidance counsellors and trained testing personnel were unable to devote much time to the process of testing.

In the materials for the P.E.I.P. (Science) no group appraisal measures were specifically designed for the classes. Workbooks accompanying Primary Science One and Two contained some brief exercises for the children to complete, which could be used in part to assess individual children's progress at regular intervals. They did not rely on the ability of the children to read, and instructions for each of the exercises were given by the class teacher.

The process test described in this report was the only reported instrument that has been developed to measure the achievement of children taught under P.E.I.P. in the first two years of primary school. The test could be administered by teachers in the schools after a short period of training in the testing procedure

2.34 Studies Involving AAAS Science-- A Process Approach

Folow-up studies on Science-- A Process Approach have been conducted by numerous researchers (Gallagher, 1972:19-46).

Some of these studies which were relevant to the present study are discussed here.

McGlathery (1968:1) carried out a study which constrasted the effects of instruction in Science--A Process Approach and a local science programme on the achievement of five and six year olds from different socio-economic backgrounds. The criterion instruments used were the Competency Measures developed by the AAAS. The results of the study showed that children instructed in SAPA scored higher on the Competency Measures than children in the control group. Five and six year old children scored about equally. Middle class children scored higher than lower class children on tasks requiring verbalisation, but no differences were observed on non-verbal tasks. In the evaluation of P.E.I.P., no attention was given to social class because of the difficulty of defining this concept in the African context. If social class had been considered, it would have been interesting to have seen whether results followed the same pattern as those in McGlathery's study.

Raun and Butts (1967:261-8) carried out a study which was concerned with the relationship between strategies of inquiry and pupils' cognitive and affective behavioural change. Pupils from grades four, five and six who had previously had no inquiry-centred instruction were given 5 months of experience in Science-A Process Approach. After instruction these pupils were tested

on achievement, attitudes, recall and divergent thinking. The findings showed that performance in observing, classifying, using numbers and using space/time relations was correlated with behaviour factors associated with intelligence, divergent thinking, science recall, reading and perception of potency of science.

Partin (1967:1) compared achievement and interest in science between fourth grade students who were taught by SAPA and a control group of fourth graders who used a more traditional approach. The criterion measures used were the California Achievement Test, the Sequential Tests of Educational Progress - Science, Competency Measures, and an investigator developed Informal Interest Inventory. The performance on the Competency Measure was unrelated to I.Q. in contrast to the results obtained by Raun and Butts. These two studies show no clear relationship between intelligence and the ability to practice process-type skills. In the evaluation of P.E.I.P. no measures of intelligence were available for the children tested, as there is no known intelligence test for this age group in Nigeria.

Macbeth (1974:45-51) carried out an investigation to test the importance of manipulative experience in the attainment of science process skills for kindergarten and third grade pupils. Prior to the beginning of the instructional sessions, each child was administered the Science Process Instrument (part of the SAPA programme) to assess his general level of skill in using the

processes of science. Students were then paired on their scores on this preassessment test, so that they were opposite someone of the same ability. One group was then taught with lesson material so that each pupil had the opportunity to actively take part in each exercise. The pupils in the other group however, had no opportunity to manipulate objects during the exercises. On a subsequent series of lessons, the partners changed roles. The results of the kindergarten testing showed that the mean score for the manipulator treatment was significantly larger than the mean for the non-manipulator treatment. The results of the third grade testing showed that there was no significant differences between the two groups.

The results of this experiment suggested that the influence of direct first-hand manipulative experiences in the development of process skills may well be more important for the early primary grade child than for older children. This observation was supportive of theoretical literature that has suggested that children in Piaget's "pre-operational stage" must operate on concrete objects. As they mature, children become less dependent on manipulative learning and more on verbal learning. Although, this may not be universally true, it seemed to be confirmed in the learning of process skills.

Dietz and George (1970:341-352) identified specific skills they believed to be part of the problem solving process and then

attempted to measure the children's strengths and weaknesses in the identified skills by means of a picture test. The children tested were in Grade One, Two and Three. To minimise variance due to reading, the directions and the test questions were posed orally and each pupil was supplied with answer sheets containing only pictures. The child indicated his answer by palcing an "X" in a box beneath one of the picture choices given for each question. Similarly, to minimise variance due to reading, in the evaluation of the P.E.I.P. all the student tests were posed orally and the children were required to respond by completing a practical task.

To establish construct validity of their tests, Dietz and George (1970:345-46) offered evidence to show that the Problem-solving Skills Test measured the identified skills and science principles built into it. One type of evidence was that pupils in the upper primary grades attained significantly higher mean scores on all sections of the test than did children in lower grades Two kinds of reliability coefficients were computed while forming this test. The coefficient of internal consistency was estimated to show consistency of performance on different parts of the test. This coefficient was computed by the Kuder-Richardson Formula 20. Coefficients found in this manner proved to be moderately high. The second method used to estimate reliability consisted of calculating a product-moment correlation between total scores and

sub-test scores. The correlations were significantly high. The reliability of the process test used in the P.E.I.P. evaluation was established in these two ways. Evidence of validity of the process test used in this study was also obtained by showing that children in higher grades scored significantly higher on all parts of the test than those in the lower grades.

Walbesser and Carter (1970:1-8) investigated the effect of changing the task and response format from an individual to a group format. The group and individual competency measures were examined for two tryout years 1966-68 in 14 test centres in the United States. The pooled results indicated that there was no difference in the results for behaviours associated with writing, identifying and stating a rule in writing. However, for behaviours associated with naming orally, constructing, demonstrating, describing orally, applying a rule, and distinguishing, the number of subjects able to complete such tasks decreased when the format was changed from individual to group. As the writers pointed out, "the significance of the results for teachers is their effect on judgments of student attainment. By using more convenient group format tasks, the teacher may be underestimating the attainment of students". Individual testing was used in the evaluation of the P.E.I.P. (Science) in order to avoid possibly underestimating the attainment of the children on practical tests.

2.4 THE SCIENCE CURRICULUM IMPROVEMENT STUDY (SCIS)

2.41 Introduction

The Science Curriculum Improvement Study was used as a source for ideas for the writers of the P.E.I.P. Although the emphasis of the SCIS was more conceptually oriented, some of the activities for the children in both programmes were similar. Mr. Sauna, introduced in Primary Science One (P.E.I.P.) and used as a central theme throughout the book was identical to Mr. O used in the units on "Relativity" and "Position and Motion" in the SCIS. Some other lessons which were similar are shown in Table 2.1.

Table 2.1

Comparison of Similar Lessons in SCIS and the PEIP

S C I S	P E I P
An Object Hunt	Another Look at the School Compound
Material Objects (Lesson 2)	Primary Science One (Lesson 9)
Grandma's Button Box	Colour as a Property Size as a Property Colour and Size
Material Objects (Lesson 3)	Primary Science One (Lessons 10,11 and 12)

Table 2.1 (cont'd)

S C I S	P E I P
Seeds and Plants	Observing Change in a Growing Plant (Primary Science One)
Organisms - Part One	Seed Germination (Primary Science Two) Lesson 16
Variation in Green Beans	The Number Tree
Variation and Measurement (Lesson 4)	Primary Science One (Lesson 25)
Models for Electric and Magnetic Interaction	Torch, Batteries and Bulbs
Student's Manual (Activity 2)	Primary Science Two (Lesson 21)

2.42 Rationale of the SCIS

The writers of the SCIS believed that a person's scientific literacy resulted from his basic knowledge, investigative experience and curiosity (Karplus, 1970:8-11).

> In the SCIS programme, these three factors were integrated, balanced, and developed through the children's involvement with major scientific concepts, key-process oriented concepts, and challenging problems for investigation. Educators have frequently distinguished among content, process, and attitude when they described an educational programme or evaluated its outcomes. The SCIS programme combined these factors. Children were introduced to knowledge of scientific content through their experiences with diverse physical and biological

> materials. And, in the course of their investigations, they engaged in observation, measurement, interpretation, prediction, and other processes.

Central to the SCIS programme, was the view that "changes take place because objects interact in reproducible ways when manipulated in similar conditions" (Karplus, 1970:11). By interaction was meant the relation among objects or organisms that do something to one another, thereby bringing about a change. The four major scientific concepts used to elaborate the interaction viewpoint were "matter", "energy", "organism" and "ecosystem". Children's experiences and investigations in the physical science sequence were based on the first two; the last two provided the framework of the life science sequence.

In addition to the four major scientific concepts, there were also four process-oriented concepts which were central to the SCIS conceptual framework. These were referred to as Property, Reference Frame, System and Model. These concepts, together with others that related to specific units were, it was believed, the heart of the processes of observing, describing, comparing, classifying, measuring, interpreting evidence and experimenting. The SCIS programme was based on two sequences of units which were studied alongside each other. These were the Physical Science Sequence and the Life Science Sequence, which are shown in Figure 2.1.

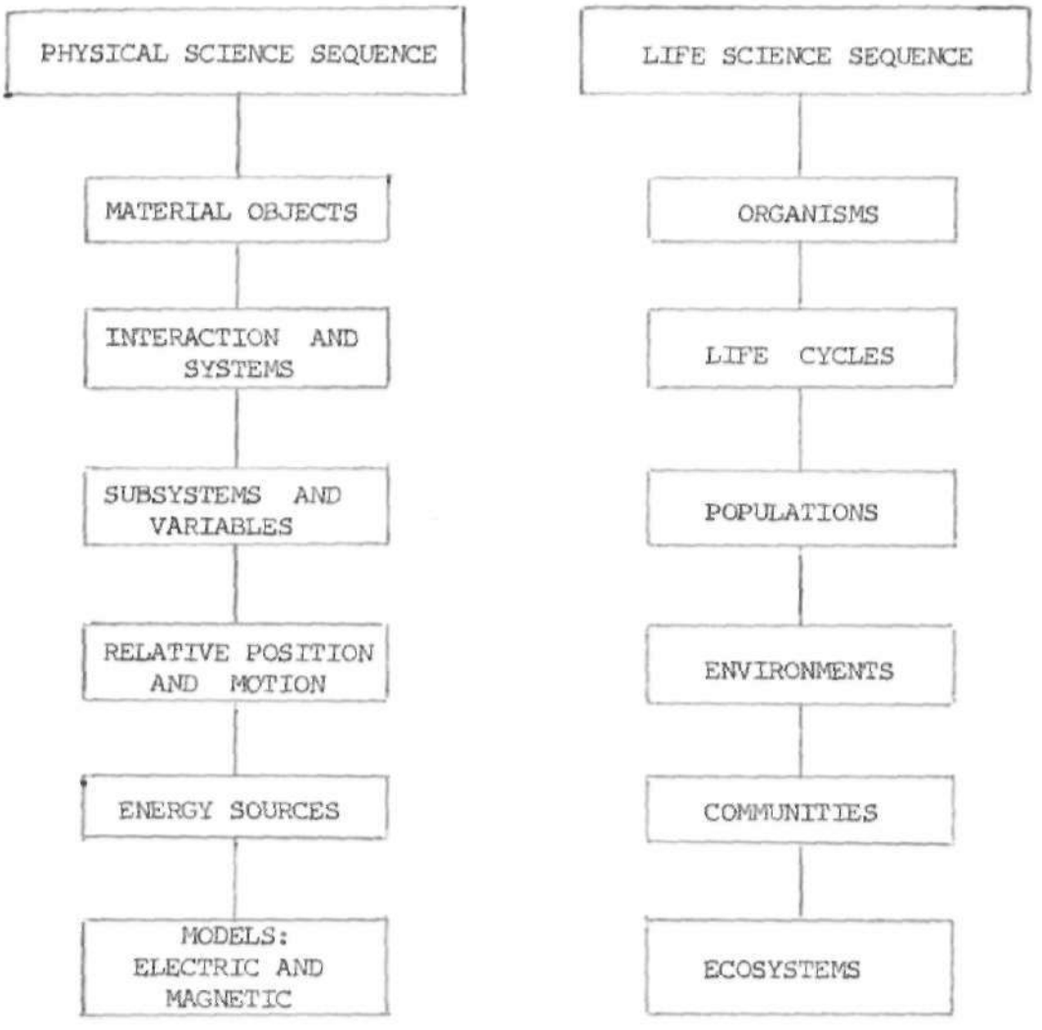


Fig. 2.1 — Sequences in the SCIS Programme

In the first year of primary school the students studied the units Material Objects and Organisms. In year two, they studied Interaction and Systems, Life Cycles and so on up to year six where they studied Models and Ecosystems.

2.43 Evaluation of SCIS

Karplus who was the director of the SCIS for many years, wrote of SCIS when it was still in the developmental stage (1964: 293-303);

> Trial units . . . have been produced and are being tested and revised in the light of classroom experience by SCIS staff members and by regular public school teachers. In the current exploratory phase, work is also in progress to determine ways in which the pupils' learning can be gauged. SCIS faces several special problems in this area. First, communication with young children for evaluation or other purposes is not easy to accomplish in a standardised and reproducible fashion. Second, it is of interest to find out what the pupils have learned not merely whether certain narrowly specified objectives have been attained. Third, the really significant long term objectives are certainly attained only after a lengthy period of learning. But over a period of a year or two, young children mature in response to so many experiences that it is difficult to ascribe specific changes to their activities in the school science programme. Novel approaches are called for and are being studied.

Karplus here highlighted some of the problems faced in any attempted evaluation of a primary school science programme. It is doubtful if it will ever be possible to find out all that the pupils have learned as a result of a programme. As an alternative, establishing that the programme objectives have been attained is very valuable information. Influences outside of the school science programme may be different to some extent for each child. However, with a large sample of children tested in more than one group, from the same population areas, these influences

could be assumed to be the same for each group.

At the time of carrying out this study only one report of an evaluation study of the SCIS units was available in recorded literature. Perry and Merkle (1976:243-247) reported that an evaluation device was designed by the developers of SCIS, that would enable classroom teachers to evaluate student progress in the programme. However, at the time they stated that no data on the effectiveness of this classroom instrument was available. as a result, they set out to investigate the validity and reliability of this SCIS test for the Organisms Unit.

The researchers assessed only the Concept/Process Section of the SCIS instrument in terms of content validity and reliability. It was assumed by the researchers that because of the student-oriented nature of the SCIS programme, teacher differences would not be a threat to the validity of the study.

The sample was taken from first grade students in the Chambersburg Area School District, Pennsylvania, U.S.A., who were receiving instruction in the SCIS elementary science programme. Ten students, five girls and five boys, were selected at random from the first-grade classes of each of the eight elementary schools in the district. The Concept/Process Section of the Organisms assessment instrument was administered as a pre-test and a post-test to all students included in the study. Reliability for the post-test scores on the Concept/Process Section of the

assessment instrument was determined by the split-half method using the Spearman-Brown formula. An r value of .577 was obtained and this was considered to be significant. The Concept/Process Section of the Organism assessment instrument was therefore considered to be reliable test. The reliability coefficient of 0.76 using the Kuder-Richardson formula for the P.E.I.P. test compared favourably with this result.

Content validity was established by comparing the Concept/Process objectives in the Organisms teachers' guide (SCIS, 1970) to the test items of the Concept/Process Section of the assessment instrument. This was done by two first-grade teachers who had taught the Organisms unit, and the researchers. These four individuals compared the specific objectives within the teacher's guide with the items on the evaluation instrument. A consensus of four opinions was used to derive a single statement of content validity by the researchers. A similar method of using judges was used to establish content validity of the P.E.I.P. test.

Perry and Merkle concluded that the Concept/Process Section of the assessment instrument of the SCIS Organisms unit was both valid and reliable.

The evaluation of SCIS in terms of student attainment of the programme objectives has so far received little attention in recorded literature. The evaluation that has taken place and is recorded is of a formative nature and more studies would seem to

be required which are summative in nature.

2.5 ELEMENTARY SCIENCE STUDY (ESS)

2.51 Introduction

The Elementary Science Study was also used as a source of ideas for the Primary Education Improvement Programme in Science. Paul D. Merrick who was the principal author of the ESS unit "Gases and Airs", spent more than a year in Zaria, Nigeria as one of the writers of P.E.I.P. materials. Lesson 15 and 18 of Primary Science One of the P.E.I.P. bear strong resemblances to the ESS unit on "Gases and Airs". Also lesson 23 of Primary Science Two entitled "Usman's Animal", is similar to parts of the ESS unit entitled "Behaviour of Mealworms".

2.52 Development of ESS

ESS was one of many curriculum development programmes in the field of Science, Social Studies and Mathematics, prepared at the Education Development Centre, Massachusetts, U.S.A. Work on these programmes began in 1958 to develop new ideas and methods for improving the content and process of education.

ESS was supported by grants from the National Science Foundation. Development of materials for teaching science from kindergarten through eighth grade started on a small scale in 1960. The work of the project involved more than a hundred

scientists and educators in the conception and design of its units of study. Among these scholars were biologists, physicists, mathematicians, engineers and teachers experienced at working with children of all ages from kindergarten through college.

Equipment, films and printed materials were produced with the help of staff specialists as well as that of the film studio, the photographic laboratory and the production shops of EDC. At every stage of development, ideas and materials were taken into actual classrooms, where children helped to shape the form and content of each unit before it was released to the schools elsewhere. ESS units are now being taught all over the United States and in some other countries (Victor and Lerner, 1971:463-64).

For the development of the P.E.I.P., neither the funds nor the staff for producing a programme like ESS were available. Films and sophisticated equipment would not have been practical in Nigeria where the majority of classes have no electricity supply. As a result much simpler materials had to be developed.

2.53 The ESS Approach

The ESS put physical materials into children's hands from the start, and helped each child investigate through these materials, the nature of the world around him (Victor and Lerner, 1971:64).

> It is apparent that children are scientists in disposition: they ask questions and use their senses as well as their reasoning powers to explore their physical environments; they derive great satisfaction out of finding out what makes things tick; they like solving problems; they are challenged by new materials or by new ways of using familiar materials.

The approach in the P.E.I.P. was similar for "in many of the lessons a simple problem situation is posed, and a hypothesis is constructed on the basis of the evidence which can be gathered" (Young, 1973:4).

2.54 Evaluation of ESS

The programme developers maintained that the evaluation of an ESS unit was a process which was implicit in the teaching of that unit. Because the teacher was actively involved in the study he should have been continually aware of the degree of his students participation and their learning success.

Formal evaluation according to the writers might have been carried out when the teacher or school felt it necessary. Certain units lent themselves well to written examinations but the developers felt this was an incomplete way to evaluate a learning experience. For many of the units, independent projects were suggested in the teachers' guide, and a student's ability to carry out one of these on his own was a measure of what he had learned. The programme developers reported (Victor and Lerner, 1971:467-468):

> The most satisfying form of evaluation reported to us is a subtle one. Teachers tell us of children's excitement at what they are learning and of their enthusiasm for the ways in which they are learning. A student who has hardly participated in class comes alive. A child who has been unsure of himself speaks up. To us, an interested class is a successful one.

In the P.E.I.P., shortages of staff and the inherent difficulties of evaluating students' progress in the early years of primary school meant that little or no direct evaluation was done. The ESS philosophy about evaluation may have also influenced the writers to have relied on the teachers as their main source of feedback on the children's progress.

2.6 AFRICAN PRIMARY SCIENCE PROGRAM (APSP)

2.61 Introduction

A review of the African Primary Science Programme and its evaluation is relevant to the evaluation of the Primary Education Improvement Programme (Science) for several reasons:

1. Both APSP and PEIP were developed in Africa for African children, whose cultural environment is different from that in other parts of the world.

2. The APSP materials were used as source materials for the PEIP.

3. Similar problems of evaluation encountered in the evaluation of the APSP were encountered in the evaluation of the PEIP, because neither programme had clearly stated objectives.

2.62 Development of APSP

The African Primary Science Proagram (APSP) was one of the major projects sponsored in the 1960's by the Educational Services Incorporated (E.S.I.), later to become the Educational Development Center (E.D.C.) newton, Massachusetts, U.S.A.

After an initial conference in Kano, Nigeria, in February, 1965, a six week writing workshop took place at Entebbe, Uganda in the summer of 1965 for the development of materials. Science Educators and Ministry Officials from eleven, English-speaking African countries as well as from Europe and the United States of America took part. These people came from widely different backgrounds and had in some cases conflicting philosophies of science education at the primary school level. There followed two more large-scale workshops in Dar Es Salaam, Tanzania (1966) and in Akosombo, Ghana (1967). Further development of trial materials took place in Sierra Leone, Nigeria, Ghana, Kenya, Uganda, Tanzania and Malawi and eventually 40 units, which were mainly in the form of teachers guides were produced. The APSP approach was open ended and the units were to serve as resource materials for the teacher. The emphasis of the APSP was the child and by implication, a predominantly "open" classroom where the child's participation in what was to be learned was high (Yoloye, 1971:28). No detailed outline or blueprint of objectives for APSP was ever decided upon by the curriculum developers

at this stage and writing was more "by ear" than according to any rigid plan or framework.

2.63 Objectives of APSP

Yoloye who was the coordinator of the evaluation exercise from 1967 pointed out the difficulties encountered in trying to get the writers of the APSP units to verbalise what they were trying to do. "There was little doubt that what the writers were doing was promising and exciting yet nobody had laid down specific goals for the programme" (Yoloye, 1971:21-25). As part of the evaluation exercise Yoloye was able to compile a list of objectives, which the writers agreed, the programme seemed to be aiming at.

> The African Primary Science Programme aimed at the development of the following characteristics in children:
> (1) First-hand familiarity with a variety of biological, physical and man-made phenomena in the world around them;
> (2) Interest in further exploration of the world around them on their own initiative;
> (3) Ability to find out for themselves, to see problems and to be able to set about resolving them for themselves;
> (4) Confidence in their own ability to find out for themselves and do things for themselves;
> (5) Ability to share in a common development of knowledge, through collaborating on problems, talking, listening and discriminating use of second-hand sources. (Yoloye, 1971:22-25).

2.64 Evaluation of APSP

In 1967, E.A. Yoloye was asked to take charge of evaluation activities and a group of seven people with some expertise were specifically invited to work with him. During the years 1968-69, Eleanor Duckworth was appointed as a full time evaluator. She travelled extensively throughout Africa testing evaluation instruments and techniques. She produced the first summative evaluation study of the programme outcomes on children. About the same time Yoloye, working with colleagues in Ibadan, outlined a philosophy and framework for the evaluation of APSP. Three broad categories of events were identified that would have to be evaluated. These were:

(1) Antecedents: relevant conditions prior to the introduction of the programme.

(2) Transactions: the various kinds of interactions and activities that take place during the development and presentation of the programme.

(3) Outcomes: effect of introducing the programme on various categories of people and possibly things.

Since this paper is more concerned with summative evaluation, discussion will concentrate on the summative aspects of the APSP programme; in particular the evaluation of "outcomes" with special reference to the child and to the teacher.

Duckworth (1971:64-66) carried out a two-phased study in

Kenya. Phase compared children who had been exposed to the APSP with those who had not been exposed in terms of the variety of ideas that the children had about what to do with the materials. Phase 2 compared similar groups of children by their performance on specific tests. Fifteen primary school classes which had been exposed to APSP for periods varying from two terms to nearly three years were designated "experimental" classes. Thirteen primary school classes which had not been exposed to the APSP were designated "comparison" classes. On the basis of a subjective rating, the experimental and comparison classes were considered approximately matched in terms of the quality of the teachers and the school environment. For Phase 1, twelve children were randomly selected from each class for the study. For Phase 2, six children were randomly selected from each class.

In Phase 1, a set of materials equally familiar or equally unfamiliar to children in both experimental and comparison groups was collected. Familiar objects included wood, metal, grass, pins, match boxes etc. Unfamiliar objects and materials were mainly imported commercial toys, Bilo, Play Pax, Pattern Blocks, Cuisinaire Rods and Lego.

The materials were set up in an empty room. The twelve selected children were then brought in and asked to do whatever they liked with the materials. Two observers recorded what the children did in terms of (1) different things done and (2) the

complexity of things done. Scores of experimental and comparison classes were then compared.

In Phase 2, six tests were used for comparing children from the experimental and comparison classes. Four tests (nos.1-4) were used in the lower primary classes and two tests (Nos.5 and 6) in the upper primary classes.

The test items consisted of the following (Yoloye, 1971: 64):

> (1) Missing Piece. A set of plastic rectangles of six colours and four sizes was presented to the child. He was then asked to shut his eyes, the rectangles were mixed and one piece removed. The child was then asked to open his eyes and identify the missing piece.
>
> (2) Straight Line. Two grains of maize were placed on a sheet of paper so that the line joining them would slant across the page. The child was then requested to arrange eight more grains between them in a straight line. In other words, the child was requested to build a straight line where there was no edge to follow.
>
> (3) Bilo. The child was given the photograph of a model built from a Bilo set. He was then given the necessary pieces and asked to build it.
>
> (4) Lego Corner. Six lego bricks were built to form three layers of three, two and one bricks respectively and to form a right angled corner. The child was then given six similar bricks to construct a similar corner.
>
> (5) Bilo. The same procedure was used as for test 3 but using a more complicated model.
>
> (6) Ordering Weights. The child was given six objects of different sizes, shapes and weights. He was asked to arrange these (with the aid of a balance) in order of their weights. Next he was given a seventh weight to put in its right place in this arrangement (without using the balance).

The results of the above tests showed that, in Phase 1, the experimental classes did significantly better than the comparison classes in terms of the variety and complexity of what they did. In Phase 2, upper primary experimental classes did significantly better than the comparison classes on "Bilo" but there was no significant difference on "Ordering Weights". In Phase 2, lower primary, the experimental classes did significantly better on all tests.

In the process test used in the evaluation of the P.E.I.P., sub-test five made use of photographs as did items three and five of Duckworth's test. Test item four of Duckworth's test also resembled sub-test four of the P.E.I.P. test which made use of wooden blocks.

The problem of matching experimental and comparison classes in terms of the school environment also arose in the evaluation of the P.E.I.P., where a subjective rating was also used in matching schools from the same town.

Johnson (1970:66-68) carried out a study on the effect of APSP on teacher-pupil interaction in Sierra Leone. In particular he tried to (1) identify any change in teacher behaviour (2) indicate the direction of such change (3) show how change in teacher behaviour influenced pupil behaviour.

In the study, the sample consisted of six classes which had been exposed to APSP and six which had not. These two groups

were designated the experimental and control group respectively. Of the six schools in each group, three were urban and three were rural. Each sub-group of three was made up of Classes 4, 5 and 6 in the primary schools. The experimental classes had one to three years contact with the APSP.

An interaction analysis schedule based on Flanders was used for recording teacher-pupil interaction. It differed from Flanders, however, in that it had twenty categories instead of ten and included non-verbal behaviour which Flanders did not deal with.

Five consecutive lessons were observed each day by the same observer. The five lessons in all twelve classes were, by previous arrangement, approximately of the same kind.

The results of the study showed that:

(1) In experimental classes, the incidence of pupil activity was higher than teacher activity, whereas the reverse was the case in the control group.

(2) Teachers in experimental classes used predominantly indirect influence, whereas those in control classes used predominanatly indirect influence.

(3) Pupils in experimental classes exhibited more independent behaviour, whereas those in the control classes exhibited more dependent behaviour.

(4) Length of contact with the APSP did not seem to be

directly related to the amount of change in teacher behaviour.

No study was made of classroom interaction in the P.E.I.P. evaluation. This was due to restrictions and also due to a shortage of trained personnel to carry out such a study. Cliff and Tidy, in their evaluation of the Primary Pilot Project in Singapore were concerned about the disturbing effect of an observer being in the classroom, to record teacher-pupil interactions (1973:91). "The possibility of initial and perhaps continuing disturbance brought about by the observers presence was also worrying". For this reason also, a study of classroom interaction was not included in this evaluation.

2.45 Concluding Remarks

The bulk of the reported evaluation of APSP, described by Yoloye at some length in his report, was a formative nature. As was pointed out, a lot of revisions and rewrites following discussions and trials of units were carried out before the final version of units were produced. Studies by Foster (1965) into the socio-economic background of secondary school children in Ghana and Yoloye (1971) in the Western State of Nigeria, as well as a survey of teachers' backgrounds to identify factors which may have influenced their responsiveness to APSP all provided useful evaluative information. In addition, a "readability index" was constructed for all the APSP units to ascertain if the

teachers had the requisite level of comprehension to use the teachers' guides. Nineteen APSP units were also analysed in terms of the process type skills they involved.

An interesting outcome of the APSP evaluation has emerged (Yoloye, 1971:8).

> One fact that has become quite clear to evaluators is that the key problem of the program is teacher training. This is so because the APSP is not just a list of scientific content to be taught to children; it is more fundamentally a way of working with children. Therefore, until the problem of teacher training is solved, i.e., the problem of how one gets the primary school teacher to interpret and practice correctly the APSP spirit, evaluation of outcomes on the children, teachers and others will remain seriously handicapped.

Teacher training may well be the most crucial factor determining the success or failure of any new curriculum.

2.7 THE MID-WEST (BENDEL STATE) PRIMARY SCIENCE PROJECT (MPSP)

2.71 Introduction

A study of the Mid-West Primary Science Project was relevant to the present study for several reasons. First of all it was developed in Nigeria about the same time as the PEIP, and was directed to a similar group of primary school children. The approach and scope were different from the PEIP and were, therefore, appropriate for comparison purposes. The MPSP had also been evaluated by a team of experts who used methods of evaluation which could be compared with those used in the PEIP.

evaluation.

2.72 Development of the Project (MPSP)

The Mid-West (Bendel State) Primary Science Project was a statewide curriculum project undertaken by the former Mid-West Government with the assistance of UNDP, UNESCO, and UNICEF. The project began, after some delays in 1969. It was originated to ensure that all primary school pupils would learn science throughout their primary school years. One of the objectives of the project was also, to ensure that each school in the state would have a number of teachers who had been specially trained to teach science in the primary school.

More specific objectives related to the expected effect of science teaching on children were the development of (MPSP, 1972:2):

(a) a habit of keen observation
(b) an attitude of enquiry
(c) the habit of exploring, experimenting and recording data
(d) basic concepts of cause and effect
(e) to have made them see the usefulness of group work.

It was also hoped that the teacher would be able to;

(a) select and organise suitable learning experiences involving simple experiments
(b) devise different techniques and materials for teaching primary school science
(c) review the curriculum critically and suggest desirable changes.

2.73 Features of the Project

The main features of the project were:

(1) the development of science materials for pupils in primary schools, the training of teachers and the development of appropriate teachers' guides

(2) the operation of the trial materials for the first few years in about 100 pilot schools

(3) the usual routine of revisions, re-writing and trial runs (Falayajo, Bajah and Yoloye, 1976:1).

The P.E.I.P. differed from the MPSP in that, P.E.I.P. did not emphasise teacher training as one of its main objectives. In P.E.I.P., mobile teacher trainers were given workshops lasting one or two weeks in all the subjects e.g. English, Social Studies, Mathematics, Science etc. They then returned to their centres to train the teachers in all these subjects. In the MPSP, the teachers were directly trained in science for a three month period in the Science Curriculum and Development Centre at Abraka. Along with the teachers, those who were more experienced were trained to be inspectors and supervisers for the project. By the end of 1974, more than 650 teachers had been through the three months course at Abraka (Sharma, 1974:24-26).

Curriculum materials in the MPSP took the form of teachers' guides as they also did in the P.E.I.P. Instead of process skills emphasised in the P.E.I.P., the MPSP books emphasised

concepts. The MPSP curriculum was concentric in nature and was composed of nine themes which were treated in each of the Classes One to Six. These themes were:

1. Animal Life
2. Plant Life
3. Our Health
4. Safety Measures
5. Our Universe
6. Air, Water and Weather
7. Rocksoil and Minerals
8. Measurement
9. Materials Around Us

The programme began by using 100 pilot schools where the materials were tried out. By 1973, all the schools in the former Mid-West State were using the MPSP materials in Classes One to Three, although the pilot schools were still the main source of feedback on the trial editions being tested for Classes Four, Five and Six.

The MPSP had advantages from being a state-wide project, rather than an almost nation-wide project, such as the P.E.I.P. Pilot schools under the MPSP were close to the Development Centre and so feedback was easier to obtain from the teachers. In addition, the Ministry of Education was in full support of the project because they felt it belonged to them. The P.E.I.P. had its project schools spread over a large area encompassing hundreds of square kilometers. In addition, there were numerous Ministries to be dealt with and they were not all as enthusiastic as they might have been if the project had been for their state

alone.

2.74 Scope of the Evaluation of the MPSP

Apart from the formative evaluation carried out during the writing and revising of the trial editions, a full scale summative evaluation was carried out by staff members from International Centre for Educational Evaluation in Ibadan. Their second and main report on the evaluation of the MPSP was published in April 1976 (Falayajo, Bajah and Yoloye, 1976:1-72).

Four devices were used to collect information for the evaluation. These devices were:

1. Interviews with the Ministry officials, education officers and personnel at the Curriculum Development Centre to determine the extent of the project plan implementation.

2. Questionnaires to determine the project plan implementation, the background and training of teachers, the teacher's views about the units and the in-service training.

3. An Achievement Test to determine the impact of the project on class five children.

4. A Class Interaction Sheet to measure interaction between children and teachers in the classroom.

The devices used to collect information in the P.E.I.P. evaluation also included questionnaires and an achievement test. Some informal interviews were also conducted with the teachers

and the writers of the teachers' guides. A class interaction sheet was not used because of shortage of trained personnel to carry out the observations. The presence of observers in the classroom can also disturb lessons and create an artificial situation.

2.75 Results of the MPSP Evaluation

The background and qualifications questionnaire for teachers was completed by 103 pilot teachers and 91 non-pilot school teachers. The teachers were selected from schools which were "matched", the criterion for matching being that both pilot school and non-pilot school were in the same town or village. The results of the questionnaire showed that about equal number of teachers (80 percent) in pilot and non-pilot schools were qualified up to the Grade II level. Of the teachers, 78.5 percent in pilot schools and 37.5 percent in non-pilot schools, had received in-service training for MPSP. The large percentage of teachers in non-pilot schools who had been through in-service training for the MPSP resulted from teachers being transferred from pilot to non-pilot schools. In the pilot schools, 88 percent were specialist science teachers while in the non-pilot schools only 19 percent were specialists.

In a similar survey carried out on P.E.I.P. teachers and on teachers in schools where P.E.I.P. did not operate (see Section

2.9), only 25 percent of the P.E.I.P. teachers and non-P.E.I.P. teachers were found to have the basic grade II qualification. None of the teachers surveyed were specialist teachers in Science. About 80 percent had received at least one in-service course in the teaching of science in primary school but the courses attended did not normally last more than a week.

In the MPSP evaluation, the science achievement test was administered to 160 pilot and non-pilot school children in Class Five. The results showed that pilot school children had mean scores which were slightly higher than non-pilot school children but the differences were not statistically significant. The standard deviation of scores of pilot school children was lower than that of the non-pilot school children, and this was interpreted to mean that the pilot school children formed a more homogeneous group (Falayajo, Bajah and Yoloye, 1976:19-23).

The testing of children in experimental and control groups was made less meaningful by the transfer of teachers from project to non-project schools. Transfers introduced a compounding variable or at least minimised the effectiveness of the control.

A noticeable difference between the MPSP and the PEIP evaluation existed. In the pilot and non-pilot schools selected for the MPSP evaluation, all the schools were using the MPSP materials. Hence, the comparison between pilot and non-pilot school children was a comparison between two groups using the

same books, but having teachers trained to different levels. In the P.E.I.P. evaluation, project schools were using the P.E.I.P. materials but non-project schools were using the more traditional materials in the form of Ministry Schemes of Work and Syllabi.

2.8 THE PRIMARY EDUCATION IMPROVEMENT PROGRAMME

2.81 Developement of P.E.I.P. Materials in Science

In 1971, the writers of the P.E.I.P. materials in science decided to adopt a "process approach" to the teaching of science in the primary school. This decision followed the recommendations of the Nigerian Education Research Council which specified the guidelines for curriculum development in primary school science in 1971 (NERC, 1971:1). The list of process skills recommended by the NERC differed vry little from that of the American Association for the Advancement of Science (AAAS) in the programme Science-- A Process Approach (SAPA).

The writing of the materials for the P.E.I.P. took place at the Institute of Education, Ahmadu Bello University, Zaria. Process-rich themes were identified for use in the first book which took the form of teacher's guide for Primary Class One. The first book entitled Primary Science One was highly structured and gave detailed instructions for the teaching of science lessons. It also contained suggestions for science games and

activities as well as an extended study on plant growth to be carried out at the discretion of the teacher (Young, 1975:25). Accompanying Primary Science One was a kit of simple equipment which was supplied by UNESCO/UNICEF.

A central figure around which many themes were studied, was plywood puppet named Mr. Sauna, whom the children were to regard as a self-centred observer. The idea of Mr. Sauna was taken from a similar figure, Mr. O, in the Science Curriculum Improvement Study. Mr. Sauna was used for the same reasons as Mr. O, and the children were encouraged to try to see things from his point of view. Children were asked, "what does Mr. Sauna see?" and were hence, encouraged to practice the skill of observation. In other lessons they were asked the position of objects in relation to Mr. Sauna, and hence, practiced the skill of understanding space relationships.

Primary Science One was tested in local primary schools in Zaria before the trial edition was presented to the Mobile Teacher Trainers Conference in December, 1971. At this conference, experienced teacher trainers who were due to train the teachers of Primary Science One in their centres, were given a workshop on the philosophy and methodology on which Primary Science One was founded. These teachers, who were each to take the responsibility of training teachers in six project schools, became known as Mobile Teacher Trainers (MTT). Accompanying the

teachers' guide were seven worksheets for the children, largely concerned with classification exercises. Apart from these worksheets no other means of assessing the children's performance was included. Feedback on the lessons was obtained mainly through the Mobile Teacher Trainers.

During 1972 work began on the teachers' guide for Class Two and this was entitled Primary Science Two. This book followed the pattern of Primary Science One in emphasising the practice of process skills by the children. Mr. Sauna had a less important role in Primary Science Two and there were more worksheets included for the children. After another conference in which the Mobile Teacher Trainers were introduced to the trial edition of Primary Science Two, work began on Primary Science Three. During 1973, Primary Science One was rewritten and was published by Longmans, Nigeria Ltd., at the end of 1974. By the same time Primary Science Two had been rewritten after feedback had been obtained through the Mobile Teacher Trainers and it was published in 1975.

The themes and ideas used in Primary Science One and Primary Science Two apart from those which were conceived by the authors themselves, were drawn from materials used in APSP, SAPA, SCIS and ESS studies, as well as some others.

The evaluation of Primary Science One and Primary Science Two began in 1975 at which time Primary Science Three was still

being rewritten. This evaluation report has, hence, limited itself to the first two books.

2.82 Feasibility Studies in the Evaluation of PEIP

Two feasibility studies were carried out in 1975 and 1976 by science education students of the Department of Education, Ahmadu Bello University, Zaria. The procedure and the instruments were designed by the present writer and the work was supervised by him.

The first type of study involved a questionnaire designed by the present writer for the teachers of Primary Classes One and Two on the success of the PEIP in their classes. The questionnaires drawn up required teachers to respond on a five point scale, from strongly disagree to strongly agree, to statements about the PEIP. The questionnaires were administered to an average of six Primary One teachers and six Primary Two teachers in each of the centres Sokoto, Kano, Keffi, Maiduguri, Kagoro and Ilorin in 1975. The results of the study indicated that the teachers had a strong positive attitude towards the programme (Brown, 1976:1-20). However, the questionnaires were not well constructed and there were complaints from the teachers that (1) the language of the questionnaires was too difficult for them to understand properly, (2) the questionnaires were too long and (3) some of the statements in the questionnaires were ambiguous.

The second type of feasibility study was carried out by Lapai (1976) and Yates (1976). It involved using a process test instrument designed by the present writer, and was conducted to determine whether the individually administered process test was a reliable measure of the children's ability to practice process skills. The instrument was validated by three judges who were lecturers in science education, Ahmadu Bello University, Zaria. Evidence of reliability was obtained from the results of this study.

Two centres, Bida and Kagoro, where the PEIP was operating were selected for the study. Three PEIP project and three non-project schools were randomly selected in each centre. In Class Two of each school, 12 children were randomly selected for testing. Each child was given the individually administered process test with instructions in the local language of the area. The test concerned manipulative tasks which required no writing or reading on the part of the child. It took about 30 minutes to administer.

The children in each class were ranked on their performance in the test and the teachers of each class were asked to rank the children using a Spearman Rank Correlation Test. The correlations were significant ($\alpha = .05$) in eleven out of the twelve classes, indicating reliability. Children in PEIP project schools in Kagoro performed significantly better ($\alpha = .01$) than children in non-project schools (Yates, 1976:42). In Bida, there

were no significant differences between the two groups (Lapai, 1976:41).

Certain weaknesses in the process test and in its administration procedure became apparent in this study:

(1) the test took too long to administer and the children became distracted before the end.

(2) some of the items involving graphics were poorly drawn and were also in need of revision.

(3) some of the items were too easy for the children and nearly all gor full marks, while others were too difficult and nearly all the children scored zero.

(4) the mean scores of the children in Bida were considerably higher than those in Kagoro. This occurred because of a slight difference in test administration in the two centres. There was a need to unify the testing procedure in any future study.

These feasibility studies provided useful information about the construction of teacher opinionnaires and a process test instrument. The experience gained from designing and closely supervising these feasibility studies provided valuable insights useful in the redesign of the instruments to be used in the formal evaluation of the PEIP.

2.83 Survey of Qualifications, Background and Training of PEIP and Non-PEIP Teachers

This survey was carried out in 1976/77 session by the students of the Department of Education, Ahmadu Bello University, Zaria, also under the supervision of the present writer. The study was carried out in Bida, Kano, Maidugiri, Ayangba, Ilorin, Keffi and Sokoto (Agaie, Shiru and Gana, 1977:77-89). In all, 50 PEIP teachers and 40 non-PEIP teachers agreed to fill in the confidential data sheets. The results showed that the percentage of teachers who passed Grade II or Grade III was the same (30 percent) for both groups. Among the PEIP teachers 90.9 percent had studied some science, while 87.7 percent of the non-PEIP teachers had also studied science. The PEIP teachers had more in-service training, in the form of one week courses, than their counterparts and had also more years of teaching experience.

2.84 Reports of Conferences on the PEIP

From 1975-1977 a number of important conferences and workshops were arranged by the Institute of Education, ABU, Zaria to assess the progress of the PEIP project in the different subject areas. From 1974 onwards, because of growing interest by Ministries, Teachers and Parents, the PEIP had begun to expand into new schools and new centres. The expansion itself created problems and several conferences took place to identify the problems

being faced by the Mobile Teacher Trainers and Co-ordiantors.

At the workshop arranged for the Mobile Teacher Trainers in 1975 several suggestions were made for improving the project (Institute of Education, 1975:55). One of the problems faced by the MTTs was transportation. UNICEF had supplied some vehicles to help the MTTs supervise their schools, but these were too few and some were in need of repair. In addition, the MTTs requested for further special training courses for themselves. The one or two week courses, which were all the training they had up to that time, were felt to be insufficient. Another problem identified was the late and sometime inadequate supply of the materials to the schools which was making the teachers frustrated. Another source of disatisfaction was the absence of any financial incentives for the project school teachers and the MTTs.

In 1976, at another Mobile Teacher Trainers Conference, the number of schools operating under the PEIP were given as follows (Institute of Education, 1976:3-39):

	Benue Plateau State	100 project schools
	Kano State	70 project schools
	Kwara State	102 project schools
	Kaduna State	70 project schools
	North Eastern State	70 project schools
	North Western State	102 project schools
Total:	Six States	514 project schools

The rapid expansion of the project had not helped to solve the problems already encountered up to this time. Transportation, shortages of staff, shortages of materials as well as the transfer of trained PEIP teachers to non-PEIP schools were all preventing the project from being as successful as it might have been.

The creation of the new states served to aggravate these problems. In a short space of time, PEIP found itself spread over ten states instead of six, with four additional ministries to deal with. Further problems arose with the introduction of the UPE programme. With the large increase in the number of schools, many PEIP teachers were offered positions as headmasters and thus, they left the project. Also the recruitment by the Ministries of large numbers of Primary Seven holders to teach in the primary schools meant that many teachers in PEIP schools did not know anything about the PEIP.

However, inspite of the problems, the number of PEIP schools kept increasing. The latest figures available (Institute of Education, 1977:11-43) showed the number of PEIP schools and classes in the different states as follows:-

Bauchi State	61 project schools	220 classes
Bornu State	26 project schools	345 classes
Gongola State	36 project schools	123 classes
Kano State	105 project schools	455 classes
Kwara State	75 project schools	425 classes

Benue State	61 project schools	770 classes
Niger State	50 project schools	not available
Sokoto State	298 project schools	not available
Plateau State	56 project schools	407 classes
Kaduna State	142 project schools	not available
Total = Ten States	910 project schools	

Up to date statistics on the number of non-project schools in each state were not available at the time of writing this report.

With the expansion of the project, more and more financial responsibility had to be adopted by the states themselves. In some states the project had been generously helped by the Ministries, but in others the sum of money allocated was too small or non-existent. There also were some signs that the project as a whole was achieving some success. In Kano and Ayangba, the common entrance examination results showed that children from the PEIP schools did better than children from non-PEIP schools. Parents and teachers in some areas also began to request for PEIP for their children. Rivers State recently decided to adopt the PEIP for all the schools in the state.

Chapter 3

DESIGN AND PROCEDURE

3.1 INTRODUCTION

Three instruments were designed for the collection of data in this study:

1. An opinionnaire for the project school teachers of Class One
2. An opinionnaire for the project school teachers of Class Two.
3. A process test instrument for children in Classes One, Two and Three of selected project and non-projec project schools.

This chapter describes the design of each of these instruments, the sampling and the administration procedures used and the techniques used for analysing the responses.

3.2 THE TEACHER OPINIONNAIRES

3.21 Design of the Teacher Opinionnaires

The teachers' opinionnaires in this study had been first used in trial form in feasibility studies carried out in

1975 (see Chapter 2, p.71). The opinionnaires used in those studies were found to be in need of several modifications. In redesigning the opinionnaires for use in this study, careful attention was given to the objectives of the PEIP. These objectives had been clearly but briefly stated by Young (1974:1).

> The lessons have as their major objectives the practice by the children of the scientific skills of observation, classification, experimenting, measuring, etc. The overall idea of the lessons is that children should be encouraged to raise questions and pose answers to such questions.

The practice of process skills, the raising of questions and the seeking of answers to these questions implied on the part of the children; active involvement in the lessons, interest in what was going on, and new understanding and learning. In addition, a programme like PEIP could not succeed if there were not adequate materials for manipulation and experimentation by the children. Nor could the programme succeed if the teacher found the lessons too difficult to prepare and conduct.

The teachers' opinionnaires, hence, sought information concerning the following six criteria:

(i) children's practice of process skills

(ii) children's interest

(iii) children's understanding and learning

(iv) children's active participaticipation in the lessons

(v) availability of materials for the lessons

(vi) ease of preparation and implementation of the lessons by the teachers.

To obtain information on all six criteria for each of the lessons in Primary Science One and Primary Science Two would have meant constructing very lengthy opinionnaires which would have taken the teachers too long to complete. In order to produce opinionnaires that were of a reasonable length, ten lessons from each of the two teachers' guides were randomly selected. One statement on each of the above criteria was constructed for each of the ten lessons. The resulting opinionnaires each contained 60 statements. The teachers were asked to respond on the five point scale devised by Likert (Bloom, 1971:623).

Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
5	4	3	2	1

Not all the statements were positive in nature. Some were of the reversed or negative type. An example of a positive statement was:

> At the end of the lesson the children understood the meaning of "longer than" and "shorter than".

An example of a negative statement was:

> At the end of the lesson the children did not understand the meaning of "behind Mr. Sauna" and "in front of Mr. Sauna".

This procedure was adopted to encourage care and sincerity in respondents. If all the statements had all been of a positive nature, teachers who had wished to save time might have marked the same response for all the statements without reading them carefully. By including negative statements, it was hoped that the teacher would read all the statements carefully, in order to respond consistently.

Drafts of the original opinionnaires were submitted to four science educationists in Ahmadu Bello University to help establish its validity. Their suggestions and criticisms were used in redrafting the opinionnaires. According to Bloom (1974:87) this is a generally accepted method of establishing the content validity of an instrument.

3.22 Sampling and Administration (The Teachers' Opinionnaires)

The administration of the teacher opinionnaires was carried out in seven PEIP centre. The centres were Keffi, Kano, Ayangba, Bida, Ilorin, Sokoto and Maiduguri. In each of the centres, six schools operated PEIP in one stream of classes. A maximum of 42 Class One and 42 Class Two teachers should have been able to complete the opinionnaires (Table 3.01). The opinionnaires were taken to each of these centres by the research assistants and distributed to the teachers in September 1976. Whilst more than 50 percent of the teachers returned completed

or partially completed opinionnaires on Primary Science One or Primary Science Two a large number of teachers failed to respond.

Table 3.01

Sampling of Teachers for Completion of Opinionnaires

Class One Teachers	Class Two Teachers
42	42

There were three main reasons why teachers did not attempt to complete the opinionnaires.

(1) Many of the teachers had been recently transferred to PEIP schools and were not yet familiar with the PEIP materials.

(2) Some of the classes had students from Grade II Colleges who were completing their teaching practice and the regular class teachers were difficult to locate.

(3) Some of the teachers openly admitted that they did not teach science often because (a) they did not feel competent to do so and (b) because the kits of apparatus were not available. As a result they were reluctant to complete any opinionnaire on

either of the two teachers' guides.

3.23 Procedure for Analysis Responses to the Teacher Opinionnaires

For each of the ten lessons randomly selected in each book, teachers responses were obtained for each of the six criteria:

(i) children's practice of process skills

(ii) children's interest

(iii) children's understanding and learning

(iv) children's active participation in the lessons

(v) availability of materials for the lessons

(vi) ease of preparation and implementation of the lessons.

For positive statements, responses to a particular lesson of weighted value 4 and 5, meant that the teacher considered the criterion, e.g. student interest, to be present for the lesson at a high level. For the negative statements, weighted values of 1 and 2 also meant that the criterion, e.g. student interest, was present to a high level. In order to be able to calculate a mean numerical response for each lesson, the teachers' numerical values to negative statements were reversed in the analysis. Responses of five were changed to one, resp-

onses of four were changed to two, and vice versa. In this way a mean response greater than three meant that the lessons were attaining one of the above criteria, and a mean response less than three meant that they were not attaining the criterion (Table 3.02).

Table 3.02

Format of Tabulated Teachers' Responses
e.g. Student Interest

Teacher Number	Lesson 5	Lesson 10	Lesson 15	Lesson 20	Mean Lesson Response
1	5	3	2	5	3.75
2	4	4	3	3	3.50
3	5	3	2	5	3.75
4	4	4	3	3	3.50
5	5	3	2	5	3.75
Mean Teacher Response	4.60	3.40	2.40	4.20	

The Mean Teacher Response gave the average of the ratings of all the teachers on a lesson in terms of student interest. In the example given (Table 3.02), lessons 5, 10 and 20 have means greater than three indicating high student interest. Lesson 15 has a mean less than three indicating

low student interest. The Mean Lesson Response gave the average of the ratings of one teacher to all the lessons. In the example they are all numerically above three indicating that each teacher rated student interest high on the average, for all the lessons.

The results of each lesson were also represented on a bar graph to show the distribution of the responses one to five. The Overall Mean Response was calculated from the responses of all the teachers to all the lessons. To ascertain whether the teachers ratings were significantly greater than 3.0, the t-test (one-tailed) was applied to the values of the Overall Mean Responses.

3.3 DESIGN OF THE PROCESS TEST INSTRUMENT USED IN THE EVALUATION OF THE PEIP

3.31 Developement of the Test

The feasibility studies carried out by Lapai (1976) and Yates (1976), students of the Department of Education, Ahmadu Bello University, Zaria, provided valuable information which helped in the re-design of the Test of Process Skills (TOPS) used in this study. The feasibility studies were discussed in Chapter 2 (Section 2.82) and the weaknesses in the instrument used in them were pointed out. The modified TOPS used in this

study possessed the following characteristics.

(i) It did not require any reading or writing on the part of the child doing the test. The test consisted of items which were practical tasks to be completed by the child, assembling pictures, measuring, arranging blocks of wood to predetermined pattern etc., which were independent of the ability to read or write.

(ii) The TOPS was administered individually in the local language. The design of the test was such that it required individual children to be tested. Instructions were given in the local language by the tester to the child who was then required to complete certain tasks.

(iii) A time limit was set for the successful completion of each item of the test. The attention span of a child of this age was found not to be very long in the feasibility study and for this reason the test was made fairly short (25 minutes).

(iv) The TOPS was designed to measure only those process skills taught in the books Primary Science One and Primary Science Two, which were identified as; observation, classification, measurement, inference, prediction, understanding space relationships, experimentation and manipulation.

Two other process skills taught in the books were "Using Numbers" and "Raising Questions". Using Numbers as a process

skill was not tested for, as it was felt that such a skill was too dependent on mathematics. The skill of "Raising Questions" was not believed to be easily measurable using this type of test instrument.

Several sources provided ideas for the test items used in the TOPS. The main source was the Wechsler Intelligence Scale for Children (1956 Edition). The test items contained in this instrument had been used over a long period of time and in many countries in the world. Their reliability was well established. Some of the items with slight modifications were suitable for measuring practice of process skills in children. Diagrams and pictures in the Wechsler Test which were culturally unsuitable were redrawn so that the children would find them more familiar. A second source, which provided the basis of the classification test, was a pamphlet from the Wisconsin Research and Development Centre, entitled "A Cross-Sectional Investigation of Children's Classificatory Abilities" (1974). Duckworth's test used in the evaluation of the APSP made use of photographs. The children carefully looked at a photograph of a model built by Bilo and they re-built that model using the Bilo set provided (Yoloye, 1971:65). A test similar to this was designed to test the children's ability to interpret space relationships. Other items were designed using ideas which had been used in other elementary science programmes.

Test items were chosen so they would not be a direct repetition of what the children had already seen in the PEIP books, the skills being measured were those which were emphasised in the books.

3.32 Description of the Test of Process Skills (TOPS)

The TOPS consisted of test items which were grouped into seven sub-tests. Each sub-test consisted of items which were similar.

1. Sub-test One - Picture Assembly. The three items of this test required the child to assemble cut up pictures of; (i) a dog (3 pieces), (ii) a village scene (4 pieces) and (iii) a train (4 pieces). Another item required the child to put together pieces of card which when assembled properly would form a picture of a man. The last item involved pieces of wood which when assembled correctly formed a model of a lorry. This sub-test involved the skills of observation and manipulation.

2. Sub-test Two - Picture Arrangement. There were two items which required the child to put four pictures in order in the correct sequence. The pictures told a story and followed a logical order. These items were entitled (i) Fetching Water, and (ii) House Building. This sub-test involved skills of inference, prediction and observation.

3. Sub-test Three - Measurement. This one item concerned the skill of measurement. Five cut-outs of men made of paper card were presented to the child to be arranged in order of decreasing size, beginning with the longest down to the shortest.

4. Sub-test Four - Block Arrangement. There were two items which concerned copying designs with wooden blocks which were first shown to the child by the tester. The blocks were painted with different arrangements of colours on each side. Once he was shown a design made of four blocks, the child was required to arrange four other blocks to obtain the same design. This test measured skills of observation, experimenting and understanding of space relationships.

5 Sub-test Five - Assembling Objects Shown in Photographs. Three items consisted of photographs showing different arrangements of objects. The child was given a photograph showing an arrangement of objects. He was then given the objects shown in the photograph and asked to place the objects in the same arrangement. The objects were; a packet of Omo, a bar of Lux toilet soap, a bottle and a packet of peppermints. This test involved skills of understanding space relationships and observation.

6. Sub-test Six - Classification. This test was adapted from a pamphlet entitled "A Cross-Sectional Investiga-

tion of Children's Classificatory Abilities" (Wisconsin Development Centre, 1974). Squares and circles of two different sizes and colours were shown to the child. He was required to arrange these in different ways according to shape, colour and size. The skill of classification was involved in this test.

7. Sub-test Seven - Mazes. There were six items of this type which gradually increased in difficulty. After a demonstration and explanation by the tester, the child was required to find the route out of each maze. The mazes were drawn similarly to those in the Wechsler Intelligence Scale for Children (1956 Edition). Skills of prediction, experimentation and observation were involved in this test.

The scoring and the time limits set for each item were indicated in the Instruction for Administering the TOPS (Appendix E).

3.33 Procedure for Establishing the Validity and Reliability of the Test of Process Skills (TOPS)

The items of the TOPS used in this study were based on similar items from other tests. Sub-tests One, Four and Seven of the process test were adapted from items in the WISC (1956). The Wechsler Scale has been used for many years in many countries. Sub-test Six was based on a test to measure children's classificatory abilities developed by the Wisconsin Research and Develop-

ment Centre (1974:120). Sub-test Five was adapted from a test used by Duckworth with children in Kenya as part of the evaluation of the APSP (Yoloye, 1971:65). Sub-test Two was based on a test developed by the Educational Testing Service, described by Stone, Geis and Kustan (1971:33).

The trial version of the TOPS was used in two feasibility studies carried out in Nigeria by Lapai (1976) and Yates (1976) under the supervision of the present writer. Evidence of validity and reliability of the test in measuring process skills in children were reported by Lapai (1976:42) and Yates (1976:48). Evidence of content validity of the modified process test used in the present study was obtained by the use of judges. The TOPS was examined by four science educationists in Ahmadu Bello University. Modifications and suggestions from these judges were incorporated in the final version of the test. Other evidence of validity and reliability was obtained using the results of the final testing.

Evidence of construct validity was obtained using analysis of variance to compare scores at different class levels. Children in higher classes obtained significantly higher mean scores than those in the lower classes. Evidence of reliability (See Chapter 2, pp. 40-41) was obtained by:

1. testing for internal consistency using a Kuder-Richardson formula suitable for this type of test.

2. measuring the product-moment correlation between the children's sub-test and total scores.

3. comparing mean scores with age level.

The results of these tests of validity and reliability are obtained in Chapter 4 of this report.

3.34 Sampling and Administration (TOPS)

The design of this part of the study was based on Campbell and Stanley's "Posttest-Only Control Group Design" (1966: 25). The design could be represented diagrammatically as;

G_1	R	X_1	O_1
G_2	R	X_2	O_2

Project school children (G_1) randomly selected (R) were given treatment X_1, resulting in behaviour O_1. Non-project school children (G_2) randomly selected (R) were given treatment X_2, resulting in behaviour O_2.

Four of the original centres where the PEIP operated for several years were chosen for the administration of the TOPS. This selection of the centres was governed by the availability of research assistants proficient in the local language. Also the use of four centres provided a large enough sample for the study. Twelve research assistants, all of whom were experienced teachers were employed, three for each centre. Each assistant

took part in a two-day workshop to become familiar with the testing procedure. Children from a local school were brought in as part of the workshop and the research assistants practiced testing with these children.

In each of the four centres, Kano, Ilorin, Sokoto and Maiduguri, two project schools and two non-project schools were selected (Table 3.03). The selection of the project schools was at random. The names of all the schools were written on pieces of paper, and put into a box. The first two names taken out were used. The non-project schools were selected so that they were reasonably equivalent to the project schools in terms of buildings and facilities.

Table 3.03

Number of Children Tested by Centres, Types of Schools and Class Levels

Centre Number	Class One		Class Two		Class Three		Total
	P	NP	P	NP	P	NP	
1	24	24	24	24	24	24	144
2	24	24	24	24	24	24	144
3	24	24	24	24	24	24	144
4	24	24	24	24	24	24	144
Total	96	96	96	96	96	96	576

In each of the selected schools, 36 students were tested. Twelve children for testing were randomly selected from each of the Classes One, Two and Three. The children in each class were given numbers. Pieces of paper with numbers written on them, corresponding to the numbers of the children in the class were put into a box. Then twelve numbers were taken out of the box and the children with those numbers were tested. The time of testing was deliberately chosen to coincide with the first week of the new school year (September 1976).

In the four centres, testing was carried out in eight project and eight non-project schools. The number of children tested was five hundred and seventy six. In each of the Classes One, Two and Three, ninety six children were tested in both project and non-project schools.

Children in Class One of both groups in each centre were in their first week of formal schooling, and neither group had been taught science in school. It was reasoned that there would not be any significant differences between the project and non-project children in each centre when tested with the TOPS because, (1) the children come from the same population area and (2) there was no formal selection for admission to the schools.

Children of Classes Two and Three in the project schools had been exposed to the PEIP (Science) for one and two complete years respectively. On the other hand, children in non-project

schools in Classes Two and Three had no exposure to the PEIP but had been taught by more traditional methods. Differences between these two groups were expected. The selected children in a class were put in one room and then called individually to be tested in another room. Once tested, a child was not allowed to have contact with the other children yet to be tested. The selected children in a class were all tested on the same day to prevent them from passing on information to one another overnight.

3.35 Procedure for Analysis the Results of TOPS

The results of the TOPS were analysed with the aid of a computer. The data on each child who was tested was put onto a punched card. The number of data cards punched was 576 corresponding to the number of children tested. The following information was punched on each data card.

(a) An identification number for the child's centre

(b) An identification number for the child's school

(c) An identification number indicating whether the child's school was a project or non-project school

(d) The child's number within his class

(e) A number corresponding to the child's sex

(f) The age of the child

(g) The scores of the child on each of the sub-tests one to seven

(h) The total score of the child on the test

The computer programmes used were from the Statistical Package for Social Sciences (1975 Edition). The sub-programme "Breakdown" (SPSS, 1975:250) was used to calculate the standard deviations and mean scores of;

(1) children at each age level

(2) children in project and non-project schools at each class level (one to three)

(3) boys in project and non-project schools at each level

(4) girls in project and non-project schools at each class level.

A one-way analysis of variance was performed on the mean sub-test and the total test scores using the sub-programme "Oneway" (SPSS, 1975:422). The following groups of children were compared;

(1) project school children with non-project school children in Classes One, Two and Three for each centre

(2) project school children with non-project school children in Classes One, Two and Three across the whole sample

(3) project school boys with non-project school boys

at each class level (across the whole sample of boys)

(4) project school girls with non-project school girls at each class level (across the whole sample of girls)

(5) project school boys with project school girls at each class level

(6) non-project school boys with non-project school girls at each class level

3.36 Methodological Assumptions and Limitations of the Study

Apart from the basic assumptions mentioned in Chapter One of this report, certain other assumptions were made regarding the methodology of the study. It was recognised that these assumptions were in fact limitations of the study.

For the purpose of this study it was assumed that:

(1) The qualifications, teaching ability and teaching experience of the teachers in project and non-project schools were the same on average.

(2) The members of a class in a project or non-project school had remained constant since the beginning of Class One.

(3) The project school children and teachers did not perform differently because they were part of an

experiment (Hawthorne Effect)

(4) There was no difference in the way the TOPS was administered or in the testers personality which affected the results.

(5) There are certain assumptions that are made in using a simple one-way fixed effects model Anova. These have been expressed by Glass Stanley (1970: 369-372) as follows:

1. $X_{ij} = \mu + \alpha_j + e_{ij}$
2. $e_{ij} \sim NID(0, e^2)$, i.e. within each of the J groups the observations are normally and independently distributed about their mean μ_j, with variance σ^2.

The first assumption is that an observation can thought of as a Simple Sum of three components: one reflecting the overall elevation of the measurements (μ); a second reflecting the increment or decrement on the dependent variable resulting from all observations taken in group j being exposed to treatment j; and a component e_{ij}, that comprises things usually referred to in the behavioural sciences as "individual differences" and "measurement error", among others. Various ways exist in which assumption 1 can fail to be met. One is that the effect of treatment j is not the same, α_j, for all persons exposed to the treatment. For example some students may benefit more from a particular treatment than others.

It is not known whether children exposed to the PEIP (Science) all benefited to the same extent. As a consequence there is no guarantee that this assumption was satisfactorily met in this study.

There are three types of possible violations involving the second assumption; (1) non-normality (2) different variances from group to group and (3) non-independence. According to Glass and Stanley (1970:372),"many years of study have shown clearly that the effects of non-normality on the nominal level of significance of the F - test are extremely slight". Regarding the case when the variances differ from group to group they conclude;

> (i) When the sample sizes are equal, the effect of heterogeneous variances on the level of significance of the F-test is negligible.
>
> (ii) When the sample sizes and variances are unequal and fewer persons are sampled from a population with larger variances, the probability of Type I error is greater than α. In other words, the effect of heterogeneous variances in this case is to shift the distribution of F-ratios to the right.
>
> (iii) When the sample sizes and variances are unequal and greater numbers of persons are sampled from the population with larger variances, the probability of a Type I error is less than α. The effect of heterogeneous variances in this case is to shift the distribution of F-ratios to the left.

In the results described in Chapter 4, the majority of the significant cases fell under (i) or (iii) above. In only one case did significant results correspond to category (ii). In this case the level of probability obtained was $p = .004$. Since the level of significance set for the study was $\alpha = .05$, the effect of heterogeneous variances it was believed, would not affect the interpretation.

In the study described in this report the children had been exposed to only one form of treatment either in a PEIP or in a non-PEIP school. Non-independence of results usually arises when the same children have been exposed to more than one form of treatment. Hence, it was believed that the independence assumption was successfully met.

Chapter 4

RESULTS AND ANALYSIS

4.1 INTRODUCTION

This chapter contains; i) the results of the teachers' opinionnaires on Primary Science One and Primary Science Two, and ii) the results of the children on the process test. To make the results and their analysis easier to follow and understand, each section contains its own introductory statement on the treatment and analysis of the results in that section. At the end of each section the results of that section are summarised, interpreted and discussed.

4.2 RESULTS OF THE TEACHERS' OPINIONNAIRE ON PRIMARY SCIENCE ONE

4.21 Introductory Statement on the Treatment of Results

This section deals with the results of the teachers' opinionnaire on Primary Science One. The results have been tabulated according to the six categories of statements to which the teachers responded concerning:-

(1) Children's Interest in the Lessons

(2) Children's Practice of Process Skills

(3) Active Participation by Children in the Lessons

(4) Children's Understanding of the Lessons

(5) Ease of Preparation and Implementation of the Lessons for the Teacher

(6) Availability of Materials for the Lessons

Each teacher who completed the opinionnaire was given a number 1-22. The mean response of each teacher to all lessons was calculated and called the Mean Lesson Response. This mean was reflective of the individual teacher's response to all the lessons in Primary Science One for each of the above categories of statements. Also calculated was the Mean Teacher Response. This reflected the response of all the teachers to one lesson under each category of statements. The Overall Mean Response included in the analysis of results, gave the mean of the responses of all the teachers to all the lessons to each category of statements 1-6 above.

The numbers of the teachers' responses corresponded to the following:-

1 = Strongly Disagree
2 = Disagree
3 = Undecided
4 = Agree
5 = Strongly Agree

X = No response, or respondents marked two numbers, or mark was not clear.

A Mean Lesson Response of less than or equal to three indicated that the individual teacher gave a low rating to all the lessons in Primary Science One on the category e.g. Children's interest. A mean response greater than three indicated a high rating.

A Mean Teacher Response of less than or equal to three indicated that on average, all the teachers gave a low rating to the lesson in terms of the category of statements being considered. Conversely, a mean response greater than three indicated a high rating by the teachers.

The Overall Mean Response gave the mean rating of all the teachers to all the lessons. Overall mean responses were calculated for each of the six categories of statements.

The standard deviation of the responses was also calculated to indicate the spread of the response distribution. Frequency distribution tables and bar charts have been included in the analysis of the results, to establish the relative success of the lessons on each of the six categories of responses.

In the discussion of the results, tables were included which helped to identify the most successful and least successful of the ten lessons studied. Also discussed were the ratings of the lessons by individual teachers who consistently rated high or low, and some reasons for these ratings were suggested.

4.22 Teachers' Responses Concerning Children's Interest In the Lessons (Primary Science One)

The results shown in Table 4.01 indicated that the teachers of Primary Science One believed that the level of the children's interest was high for all the lessons selected. The range of the Mean Teacher Responses was from 3.61 to 4.47. The most interesting lessons for the children were; Lesson 21 - "Mr. Sauna and Mirrors" and Lesson 14 - "Mr. Sauna Observes a Burning Candle". The least interesting lessons were Lesson 23 - "Longer than and Shorter than" and Lesson 16 - "Mr. Sauna Observes Liquid Volume".

The Mean Lesson Responses in the same table range from 3.16 to 4.75 although not all the teachers completed the responses to all lessons. One teacher did not answer any of the questions on children's interest in the lessons.

The Overall Mean Response for all the lessons by all the teachers was 4.06, indicating that in their opinions the lessons were of a high level of interest for the children. The standard deviation of the responses was 0.94.

The frequency distribution of the teachers' responses is shown in Table 4.02 and in Figure 4.01. The percentage of teachers' responses that showed agreement on children's interest in the lessons was 67.27, and 8.63 percent showed disagreement.

The overall pattern of the results in this section showed

Table 4.01

Frequency Distribution of Teachers' Responses Concerning Children's Interest in the Lessons (Primary Science One)

Responses	Frequency	Percentage	
Strongly Disagree (1)	3	1.36	8.63
Disagree (2)	16	7.27	
Undecided (3)	9	4.09	
Agree (4)	89	40.45	68.17
Strongly Agree (5)	61	27.72	
No Response (X)	42	19.09	

Overall Mean Response = 4.06

Standard Deviation = 0.94

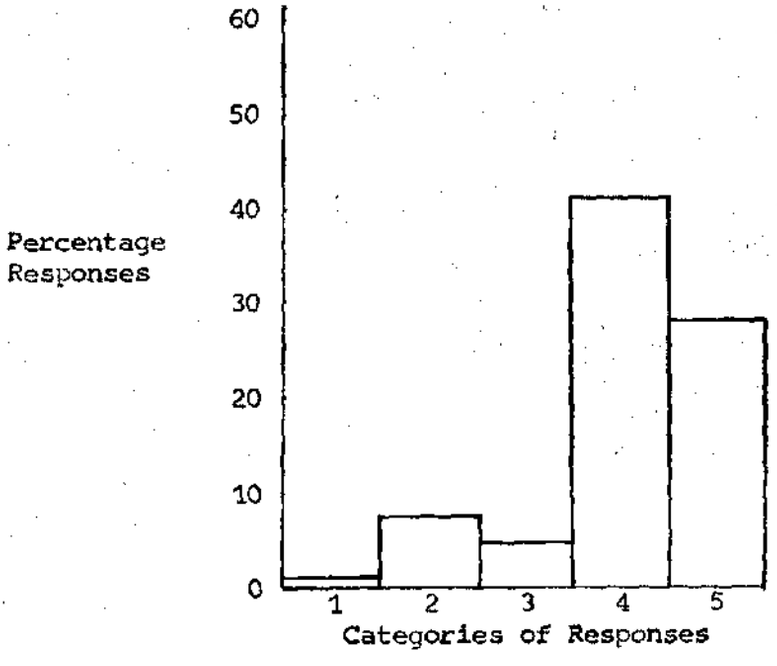


Fig. 4.01— Teachers' Responses Concerning Children's Interest (Primary Science One).

that the lessons selected from Primary Science One produced a high level of interest in the children, in the opinions of the teachers.

4.23 Teachers' Responses Concerning Children's Practice of Process Skills (Primary Science One)

The results in Table 2, Appendix A, show that in the opinions of the teachers, children's practice of process skills in the lessons of the Primary Science One was at a high level.

The Mean Teacher Responses were all above 3.0; the range being 3.66 to 4.33. The Mean Lesson Responses were all above 3.0 except for two teachers who gave mean ratings to the lessons of 2.8 and 2.5 respectively. One of these teachers only completed responses on two of the ten lessons and hence his rating may not be considered very reliable. The lessons which received the highest ratings in terms of the children's practice of process skills were lessons 21, 15 and 19. Lesson 21 was entitled "Mr. Sauna and Mirrors", and Lesson 15 - "Mr. Sauna Observes Change" and Lesson 19 - "Impressions in Clay". Those which received the lowest ratings were Lessons 16 and 23, although the ratings were still well above 3.0. Lesson 16 was entitled "Mr. Sauna Observes Liquid Volume" and Lesson 23 was called "Longer than and Shorter Than".

The frequency distribution of the teachers' responses

are shown in Table 4.02 and Figure 4.02. The percentage of the teachers who agreed that the children practiced process skills during the lessons was 72.73 percent while 8.18 percent disagreed. The Overall Mean Response for all the lessons by all the teachers with regard to the children's practice of process skills was 4.08. The standard deviation was 1.08.

4.24 Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science One)

The responses of the teachers to this category of questions are shown in Table 3, Appendix A. The Mean Teacher Responses for all the lessons was above 3.0. This indicated that for all the lessons surveyed, the children actively participated in the lessons in the judgment of the teachers. The lessons that received the highest ratings in terms of active participation by the children were lessons 19 and 13. Lesson 19 was entitled "Impressions in Clay" and Lesson 13 - "The Grab Bag". The lessons receiving the lowest ratings were lessons 12 and 14. These lessons were respectively entitled "Colour and Size" and "Mr. Sauna Observes a Burning Candle".

The Mean Lesson Responses were generally above 3.0, except for two teachers who rated the lessons below 3.0. They represented 9.1 percent of the teacher population and gave mean response of 2.8 and 2.71 respectively, indicating a low level

Table 4.02

Frequency Distribution of Teachers' Responses to Children's Practice of Process Skills (Primary Science One)

Responses	Frequency	Percentage	
Strongly Disagree (1)	1	0.45	8.18
Disagree (2)	17	7.73	
Undecided (3)	4	1.82	
Agree (4)	106	48.18	72.73
Strongly Agree (5)	54	24.55	
No Response (X)	38	17.27	

Overall Mean Response = 4.07

Standard Deviation = 1.08

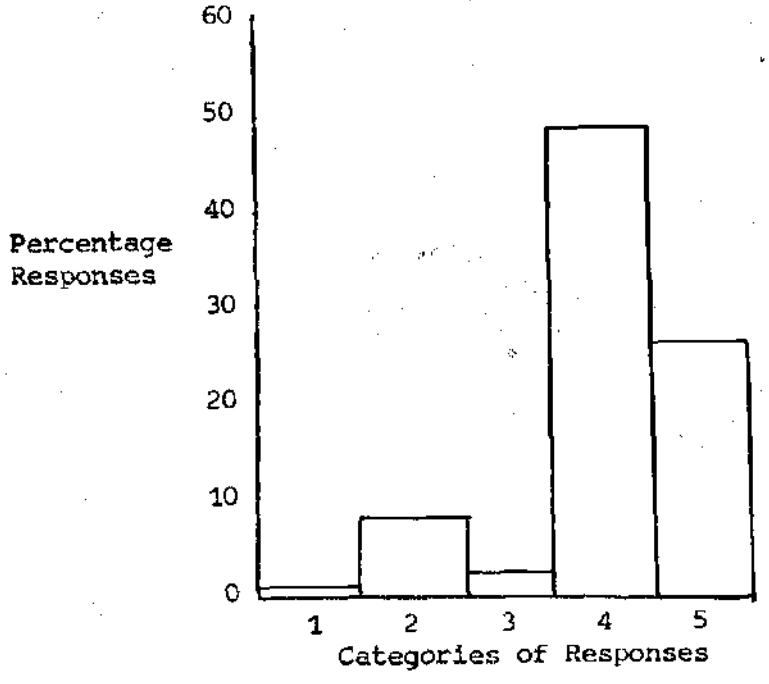


Fig. 4.02— Teachers' Responses Concerning Children's Practice of Process Skills (Primary Science One).

of active participation by the children in the lessons in their classes.

Table 4.03 shows the frequency distribution of the teachers' responses concerning active participation of children in the lessons. The same is illustrated in Figure 4.03. It can be seen that 68.18 percent of the teachers agreed that children actively participated in the lessons, while 8.18 percent disagreed. The Overall Mean Response of all the teachers to all the lessons was 3.90 and the standard deviation of their responses was 0.86.

4.25 Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science One)

The responses of the teachers concerning children's understanding of the lessons in Primary Science One are shown in Table 4, Appendix A. Lessons selected were all rated high by the teachers as was indicated by the Mean Teacher Responses being all above 3.0. Lesson 19 - "Mr. Sauna Observes Sinking and Floating" was rated highest with a mean of 4.2. Lessons 21 and 16 were rated lowest with means of 3.67 and 3.60. These lessons were entitled respectively, "Mr. Sauna and Mirrors" and "Mr. Sauna Observes Liquid Volume".

The Mean Lesson Responses ranged from 2.86 to 5.0. Three teachers rated the lessons less than or equal to 3.0 indicating a low level of understanding of the lessons by the children. These teachers represented 13.6 percent of the population of

Table 4.03

Frequency Distribution of Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science One)

Responses	Frequency	Percentage	
Strongly Disagree (1)	4	1.82	8.18
Disagree (2)	14	6.36	
Undecided (3)	10	4.55	
Agree (4)	117	53.18	68.18
Strongly Agree (5)	33	15.00	
No Response (X)	42	19.09	

Overall Mean Response = 3.90

Standard Deviation = 0.86

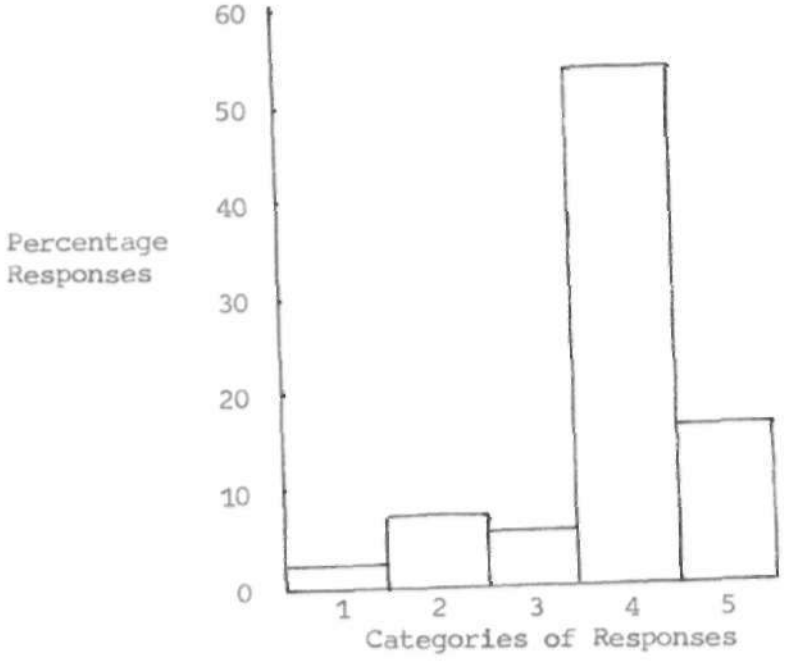


Fig. 4.03— Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science One).

teachers.

Table 4.04 and Figure 4.04 show the distribution of teachers' responses concerning children's understanding of the lessons. It was indicated by 68.18 percent of the teachers' responses that the children understood the lessons while 10.45 percent of the teachers' responses indicated that the children did not understand the lessons. The Overall Mean Response to all the lessons was 3.85 and the standard deviation of responses was 0.92.

4.26 Teachers Responses Concerning Ease of Preparation and Implementation of the Lessons (Primary Science One)

The responses of the teachers concerning the ease of preparation and implementation of the lessons are shown in Table 5, Appendix A. Eight of the ten lessons had Mean Teacher Responses greater than 3.0 and two lessons, 13 and 15 had responses not greater than 3.0. Lesson 13 was entitled "The Grab Bag" and Lesson 15, "Mr. Sauna Observes Change". The responses of the teachers indicated that they had some difficulty preparing for and teaching these lessons. All the teachers except four, gave Mean Lesson Responses greater than 3.0. The four teachers whose mean responses were not greater than 3.0 represented 18.2 percent of the population of teachers. Their response indicated than on average they had difficulty preparing for and teaching the lessons. One teacher did not respond to any statements in this category.

Table 4.04

Frequency Distribution of Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science One)

Responses	Frequency	Percentage	
Strongly Disagree (1)	5	2.27	10.91
Disagree (2)	19	8.64	
Undecided (3)	8	3.64	
Agree (4)	116	52.73	67.73
Strongly Agree (5)	33	15.00	
No Response (X)	39	17.73	

Overall Mean Response = 3.85

Standard Deviation = .93

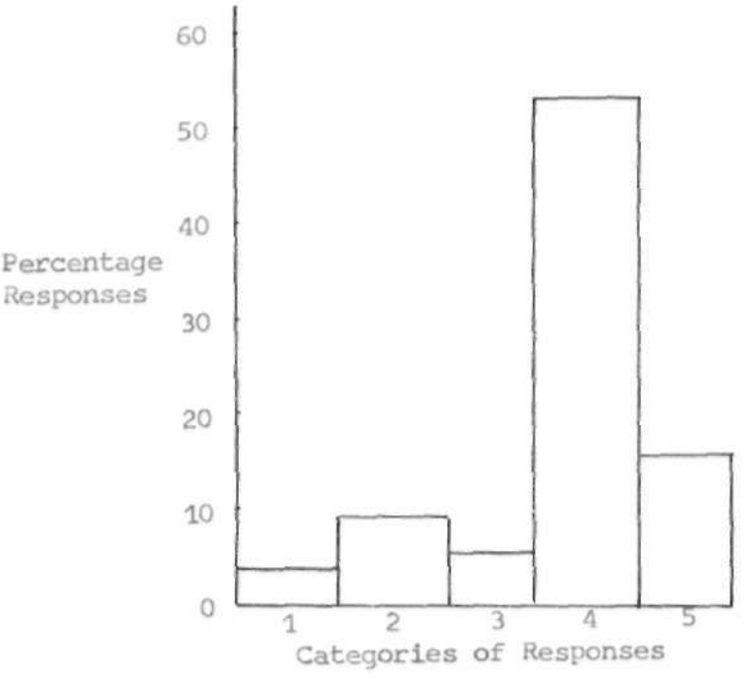


Fig. 4.04— Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science One).

The frequency distribution of the responses is shown in Table 4.05 and Figure 4.05. Of the teachers' responses, 55.45 percent agreed and 17.28 percent disagreed that the lessons were easy to prepare and implement. The Overall Mean Response was 3.60 for all the teachers on all the lessons. The standard deviation of responses was 1.00.

4.27 Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science One)

The responses of teachers concerning availability of materials for Primary Science One are shown in Table 6, Appendix A. Of the ten lessons, nine had Mean Teacher Responses greater than 3.0, and one lesson (Lesson 21) had a mean response of less than 3.0. Lesson 21 was entitled "Mr. Sauna and Mirrors" and the responses indicated that the teachers had some difficulty acquiring materials for teaching this lesson. The Mean Lesson Responses ranged from 2.86 to 4.75. Of the twenty two teachers, four teachers (18.2 percent) gave mean responses of not greater than 3.0 indicating that on the average they had difficulty acquiring materials for the lessons.

Table 4.06 and Figure 4.06 show the frequency distribution of teachers' responses concerning availability of materials. Among the teachers 62.27 percent of the responses agreed that materials were available for the lessons and 14.55 percent

Table 4.05

Frequency Distribution of Teachers' Responses Concerning Ease of Preparation and Implementation of the Lessons (Primary Science One)

Responses	Frequency	Percentage	
Strongly Disagree (1)	10	4.55	17.28
Disagree (2)	28	12.73	
Undecided (3)	16	7.27	
Agree (4)	91	41.36	55.45
Strongly Agree (5)	31	14.09	
No Response (X)	44	20.00	

Overall Mean Response = 3.60

Standard Deviation = 1.08

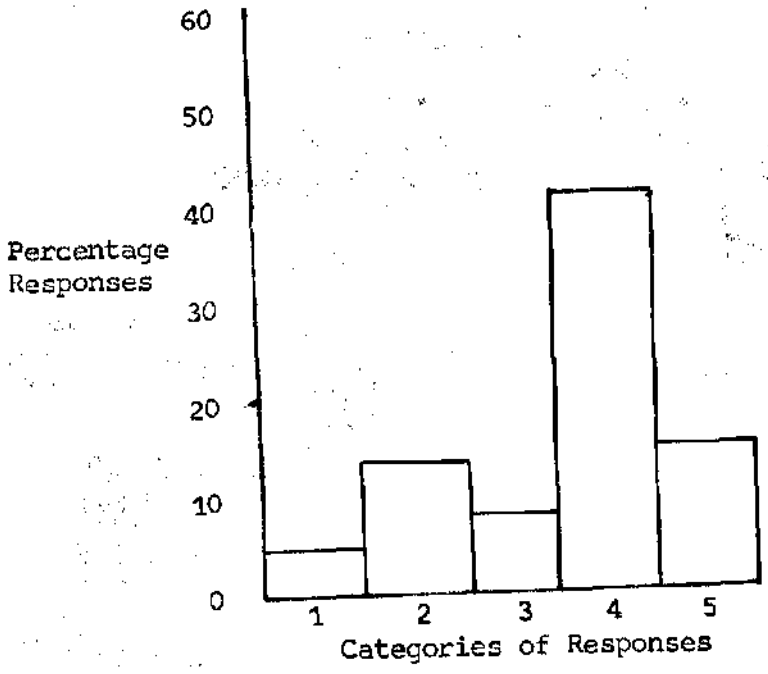


Fig. 4.05— Teachers' Responses Concerning Ease of Preparation and Implementation (Primary Science One).

Table 4.06

Frequency Dsitribution of Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science One)

Responses	Frequency	Percentage	
Strongly Disagree (1)	4	1.82	14.55
Disagree (2)	28	12.73	
Undecided (3)	9	4.09	
Agree (4)	90	40.91	62.27
Strongly Agree (5)	47	21.36	
No Response (X)	42	19.09	

Overall Mean Response = 3.83

Standard Deviation = 1.06

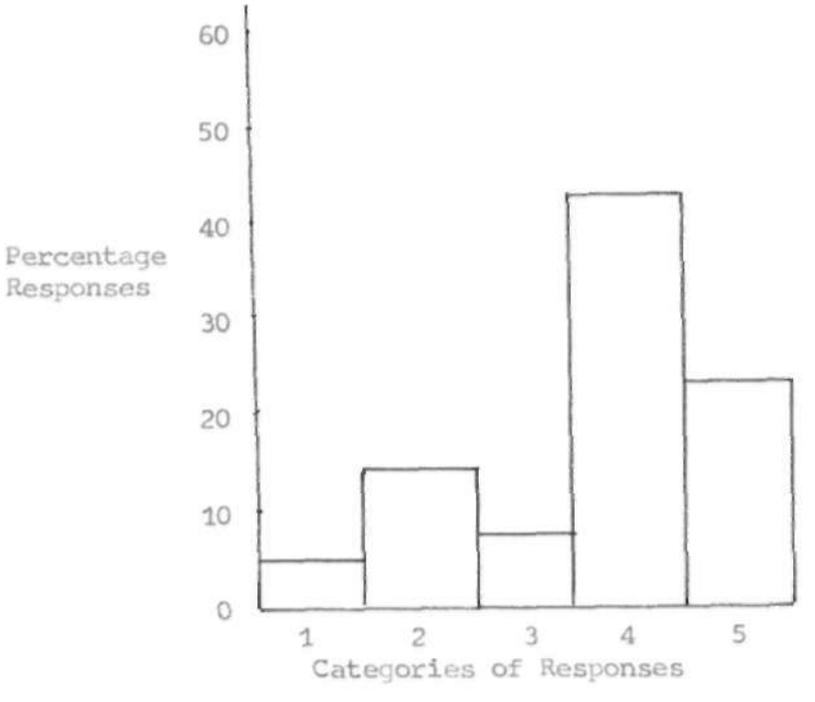


Fig. 4.06— Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science One).

disagreed. The Overall Mean Response to all the lessons by all the teachers was 3.83 and the standard deviation was 1.04.

4.28 Summary, Discussion and Interpretation of the Results from the Teachers' Opinionnaires on Primary Science One

The summary of the teachers' responses to the opinionnaires on Primary Science One is shown in Table 4.07 below.

Table 4.07

Summary of Teachers' Responses to the Opinionnaire on Primary Science One

	Category of Response	Overall Mean Response	Standard Deviation	Computed t-value
1.	Children's Interest in the Lessons	4.06	0.94	5.30*
2.	Children's Practice of Process Skills	4.07	1.08	4.65*
3.	Active Participation of Children	3.90	0.86	5.00*
4.	Children's Understanding and Learning	3.85	0.93	4.29*
5.	Ease of Preparation and Implementation of Lessons	3.60	1.08	2.61*
6.	Availability of Materials for the Lessons	3.83	1.06	3.67*

* indicates significance at $\alpha = .05$

The results in Table 4.07 show that the teachers who completed the opinionnaires gave a high rating for each of the categories in the lesson of Primary Science One. The computed t-value for each category of responses showed that the Overall Mean Responses were all significantly higher than 3.0 ($\alpha = .05$). However it should be remembered that a considerable number of teachers did not complete the opinionnaires. Of these, 12 (28.57 percent) had not been willing to complete the opinionnaires because they did not teach science. They gave as reasons (a) they did not feel competent to do so, and (b) the materials for teaching science were not available. A further 8 regular class teachers (19.05 percent) could not be located. Their positions in the classrooms were being temporarily occupied by students on Grade Two teaching practice.

The 22 teachers (52.38) who completed the opinionnaires gave the two highest ratings to children's practice of Process Skills (4.07) and Children's Interest (4.06). Lowest in the ratings (but still above 3.0) were Ease of Preparation and Implementation of the Lessons (3.60) and Availability of Materials (3.83). These lower ratings gave an indication that if the teachers had any difficulties, it was in these two areas.

The Mean Teacher Responses for each of the ten lessons randomly selected for the study are shown in Table 4.08. It also indicates the average of the mean lesson responses. Based

Table 4.08

Mean Teacher Responses for the Lessons (Primary Science One)

Category of Response	Lesson Number									
	9	12	13	14	15	16	19	21	23	25
Children's Interest in the Lessons	3.90	4.06	3.95	4.39	4.17	3.79	4.21	4.47	3.78	4.00
Children's Practice of Process Skills	4.00	4.25	4.11	3.94	4.26	3.89	4.26	4.33	3.66	4.00
Active Participation of Children in the Lessons	3.83	3.42	4.22	3.60	4.00	3.83	4.33	4.13	3.78	4.00
Children's Understanding of the Lessons	3.85	4.00	3.78	3.79	4.00	3.60	4.20	3.67	3.72	3.80
Ease of Preparation and Implementation	4.05	3.78	2.89	3.89	3.00	3.58	4.05	3.71	3.61	3.36
Availability of Materials	4.10	3.78	4.32	4.26	3.83	3.47	3.68	2.93	3.76	4.00
Average Mean Response	3.96	3.88	3.88	3.98	3.88	3.69	4.12	3.87	3.72	3.86

on the values of the average mean responses, the lesson rated highest i.e. most successful was lesson 19 entitled "Impressions in Clay". That which was least successful was lesson 16 entitled "Mr. Sauna Observes Liquid Volume". When the lessons were ranked, based on the mean lesson responses, so that the highest rating was ranked first (1) and the lowest rating was ranked tenth (10) the results obtained are those shown in Table 4.09.

As in Table 4.08, Table 4.09 shows that out of the ten lessons studied, the most successful lesson was Lesson 19 and the least successful was Lesson 16. Other interesting features of the lessons emerged on studying the tables. Lesson 21 entitled "Mr. Sauna and Mirrors" was ranked first in terms of Children's Interest, and first in Children's Practice of Process Skills and third in terms of Active Participation in the lessons by the Children. Concerning Availability of Materials, it was ranked tenth, and on Children's Understanding, it was ranked ninth. This lesson is a potentially successful lesson dependent on materials for it being available. The teachers, however, did not rate the children's understanding of the lesson very high (3.67) even though the children were interested and actively involved.

The least successful lesson (16) was ranked ninth for Children's Interest, ninth for Practice of Process Skills, tenth for Children's Understanding and ninth for Availability of

Table 4.09

Ranking of Lessons Based on Responses of the Teachers

Category of Responses	Lesson Number									
	9	12	13	14	15	16	19	21	23	25
Children's Interest in the Lessons	8	5	7	2	4	9	3	1	10	6
Children's Practice of Process Skills	6	4	5	8	2	9	2	1	10	6
Active Participation of Children in the Lessons	6	10	2	9	4	7	1	3	8	4
Childrens Understanding of the Lessons	4	2	7	6	2	10	1	9	8	5
Ease of Preparation and Implementation	1	4	10	3	9	7	1	5	6	8
Availability of Materials	3	6	1	2	5	9	8	10	7	4
Mean Rank	4.67	5.17	5.33	5.00	4.33	8.50	2.67	4.83	8.18	5.50

Materials. Similarly, Lesson 23 was ranked tenth, tenth and seventh on the same three criteria. Although the ratings for both these lessons are not low (3.69 and 3.72) the lessons might be in need of some re-examination. It is possible that the concepts involved might have been difficult for the children to grasp at the class one level. Further research along these lines could usefully be conducted on all the lessons of Primary Science One, and the findings of that research would help identify lessons needing improvement.

Table 4.10 shows the Mean Teacher Responses for each of the six categories of statements. This table was drawn in order to highlight the individual teacher's general attitude to the programme. The average of the mean teachers responses was an indication of this general attitude.

The teachers who gave the highest overall ratings were those numbering 22, 12 and 21. Their responses were highly positive to all aspects of the programme. The teachers who gave the lowest overall ratings were teachers 3 and 18 although, their average of mean responses was still greater than 3.0. These teachers both gave low ratings to Active Participation and Understanding as well as to Availability of Materials for the Lessons. If the PEIP programme is failing at all, it seems to be in these two areas. This was confirmed by the fact that some teachers (25.87 percent) did not complete the opinionnaires

because they did not feel competent to teach science and did not have the materials to do so. The results of the conference of the MTTs held annually, continually mentioned the need for more training of teachers and the inadequate supply of materials for all subjects, including Science (Institute of Education, 1977: 11-14).

In this section the responses of the teachers to ten randomly selected lessons, concerning six criteria, have been discussed, analysed and interpreted. Additional analysis concerning individual lessons revealed that some might be needing further consideration. Individual teacher's responses were examined and it became apparent that the least successful areas were preparation and teaching of the lessons and acquiring lesson materials. The Overall Mean Responses were, however, all significantly greater than 3.0 ($\alpha = .05$) which implied the rejection of hypothesis Ho_1 for the PEIP Class One teachers who completed the questionnaires. Ho_1 states: The teachers of PEIP Classes One and Two will not have a positive attitude to the programme. This will be indicated by an overall mean response of less than 3.0 on a scale of 1-5 (towards the six mentioned criteria).

Table 4.10

Mean Lesson Responses for the Six Categories of Statements on Primary Science One

Teacher Number	Children's Interest	Practice of Process Skills	Active Part.	Children's Under-standing	Ease of Prep. & Impl.	Avail. of Materials	Average of Mean Response
1	4.00	4.40	4.10	3.70	3.20	3.90	3.88
2	4.00	4.14	4.00	4.43	4.00	4.43	4.17
3	3.50	2.80	2.80	2.90	3.40	2.90	3.05
4	4.80	4.20	3.70	3.90	4.20	4.30	4.18
5	3.60	3.70	3.70	3.80	3.89	3.60	3.72
6	X	4.00	4.00	4.00	X	X	4.00
7	3.80	3.80	3.80	3.80	3.00	3.00	3.50
8	4.00	4.30	4.22	3.90	3.25	4.33	4.00
9	3.20	4.30	3.90	3.40	2.60	4.40	3.63
10	3.70	3.90	4.00	3.40	2.50	3.60	3.52
11	4.10	4.20	4.00	3.90	3.40	3.60	3.87

Table 4.10 (cont'd)

Teacher Number	Children's Interest	Practice of Process Skills	Active Part.	Children's Under-standing	Ease of Prep. & Impl.	Avail. of Materials	Average of Mean Response
12	4.20	4.90	4.90	5.00	4.30	4.80	4.68
13	3.90	3.90	3.80	3.78	3.90	3.60	3.81
14	3.50	2.50	4.50	4.00	4.00	4.00	3.75
15	4.40	4.00	3.80	3.90	3.80	3.60	3.92
16	4.67	4.33	4.25	4.38	3.78	4.11	4.25
17	4.30	4.10	4.00	4.10	4.10	4.10	4.12
18	4.00	3.43	2.71	2.86	3.43	2.86	3.22
19	3.88	3.86	3.88	3.00	2.88	2.86	3.39
20	4.60	4.70	4.20	4.10	4.30	4.20	4.35
21	5.00	4.33	4.33	4.67	4.67	4.00	4.50
22	4.75	5.00	4.25	5.00	4.75	4.75	4.75

4.3 RESULTS OF THE TEACHERS' OPINIONNAIRE ON PRIMARY SCIENCE TWO

4.31 Introductory Statement on the Treatment of Results

A maximum of 42 teachers should have been available to complete the opinionnaire on Primary Science Two. Of these, 16 teachers did not respond to the opinionnaire. The reasons given by ten of the teachers (23.81 percent), were that they were not trained to teach science and the materials for teaching science were not available. The remaining 6 teachers (14.29 percent) were not located in the time available, and hence, no opinionnaires were completed by them.

The responses of the twenty six (61.9 percent) who completed the opinionnaire on Primary Science Two have been tabulated and analysed using the same procedure as for the responses of Primary Science One. The teachers also responded to the same six categories of statements as for Primary Science One. These were:-

(1) Children's Interest in the Lessons

(2) Children's Practice of Process Skills

(3) Active Participation by Children in the Lessons

(4) Children's Understanding of the Lessons

(5) Ease of Preparation and Implementation by

the Teacher

(6) Availability of Materials for the Lessons.

Each teacher who responded to the opinionnaire was given a number 23-48 for identification. The Mean Lesson Response, Mean Teacher Response and Overall Mean Response were calculated and had the same definitions as for Primary Science One (see Section 4.1, p.). Tables and bar graphs to show the frequency distribution of the responses have been included for each of the six categories of statements. The standard deviations have been calculated for each category to indicate the spread of the responses.

In the discussion of the results, tables have been included which helped to establish the most successful and least successful of the ten lessons studied. Also discussed were the ratings of individual teachers who consistently rated lessons high or low.

4.32 Teachers' Responses Concerning Children's Interest in the Lessons (Primary Science Two)

The results shown in Table 7, Appendix A, indicated that the level of children's interest in the lessons was high in the opinions of the teachers. The range of the Mean Teacher Responses was from 3.22 to 4.17. The two lessons with the highest ratings were, Lesson 12, "Building Matchbox Figures" and Lesson 3,

"Comparing and Ordering Objects by Weight". The two lessons with the lowest ratings were Lesson 24, "Air in the Bag" and Lesson 18, "Measuring Time by Counting".

The Mean Lesson Responses were generally above 3.0 except for one teacher who gave a low rating of 1.6. Two teachers gave exceptionally high ratings 4.67 and 4.57.

The frequency distribution of the responses concerning children's interest in the lessons, is shown in Table 4.11 and Figure 4.07. The percentage of teachers' responses which agreed that the lessons were interesting for the children was 69.23 percent while those which disagreed formed 10.39 percent. The Overall Mean Response of the teachers to the lessons was 3.87 and the standard deviation of the responses was 0.96.

From Table 4.11 and Figure 4.07 it appears that the lessons in Primary Science Two had a high level of interest for the children.

4.33 Teachers' Responses Concerning the Children's Practice of Process Skills (Primary Science Two)

The responses of the teachers concerning the children's practice of process skills are shown in Table 8, Appendix A. The Mean Teacher Responses range from 3.26 to 4.15 indicating a generally high level of practice of process skills by the children. The lessons with the highest ratings were lesson 7,

Table 4.11

Frequency Distribution of Teachers' Responses Concerning Children's Interest in the Lessons (Primary Science Two)

Responses	Frequency	Percentage	
Strongly Disagree (1)	6	2.31	10.39
Disagree (2)	21	8.08	
Undecided (3)	23	8.85	
Agree (4)	115	44.23	69.23
Strongly Agree (5)	55	25.00	
No Response (X)	40	15.38	

Overall Mean Response = 3.87

Standard Deviation = 0.96

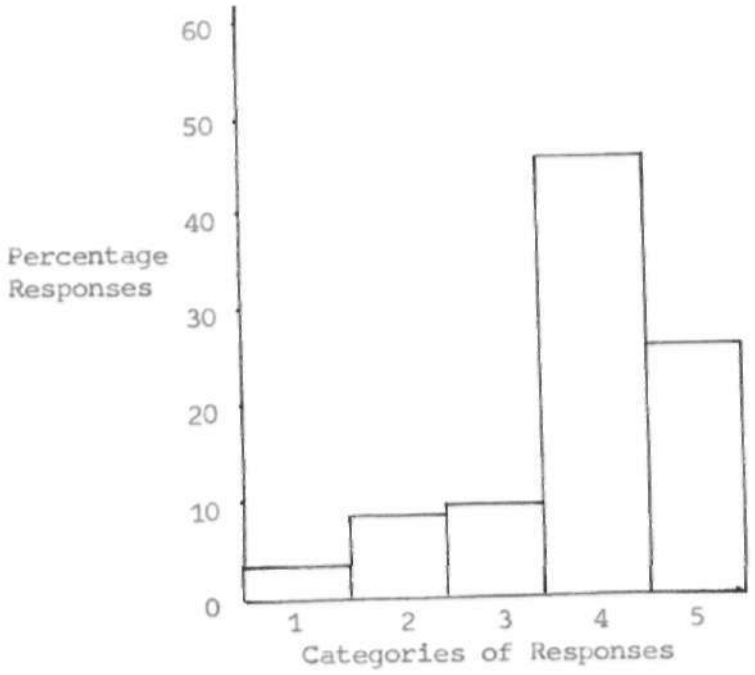


Fig. 4.07— Teachers' Responses Concerning Children's Interest in the Lessons (Primary Science Two).

"Round and Round the Circle" and Lesson 11 "Length and Distance". The lowest rated lessons were Lesson 18, "Measuring Time by Counting" and Lesson 24, "Air in the Bag". Lesson 24 was consistently ranked low by the teachers in each category of responses.

The Mean Lesson Responses were above 3.0 except for one teacher who gave a mean response of 2.50. It is not clear why this teacher gave such a low rating to the practice of process skills by the children in the lessons when the ratings of the other teachers were moderately high.

The frequency distribution of the teachers' responses is shown in Table 4.12 and Figure 4.08. Table 4.12 shows that 65.0 percent of the teachers agreed that the children practiced process skills during the lessons while 12.69 percent disagreed. The Overall Mean Response of the lessons was 3.74 and the standard deviation was 1.02.

4.34 Teachers' Responses Concerning the Active Participation of Children in the Lessons (Primary Science Two)

The responses of the teachers to this category of statements are shown in Table 9, Appendix A. The Mean Teacher Responses were all above 3.0 the range being 3.11 to 4.10. The lessons receiving the highest ratings from the teachers were Lesson 9, "The Ant-Lion and his Pit" and Lesson 20, "More Fun

Table 4.12

Frequency Distribution of Teachers' Responses to Children's Practice of Process Skills (Primary Science Two)

Responses	Frequency	Percentage	
Strongly Disagree (1)	9	3.46	12.69
Disagree (2)	24	9.23	
Undecided (3)	21	8.08	
Agree (4)	132	50.77	65.00
Strongly Agree (5)	37	14.23	
No Response (X)	37	14.23	

Overall Mean Response = 3.74

Standard Deviation = 1.02

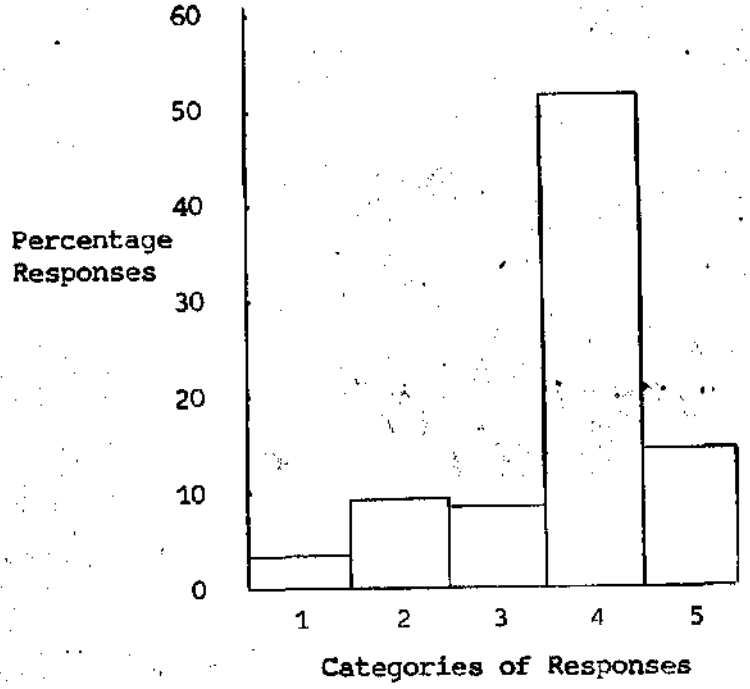


Fig. 4.08— Teachers' Responses Concerning Children's Practice of Process Skills (Primary Science Two).

with Mirrors". The lessons receiving the lowest were Lesson 24 and Lesson 18, "Measuring Time by Counting".

The Mean Lesson Responses were above 3.0 except in the case of two teachers who gave ratings of 2.67 and 2.40. These two teachers represented 7.7 percent of the teacher population.

The frequency distribution of the results is shown in Table 4.13 and Figure 4.09. The table shows that 63.84 percent of the teachers' responses agreed while 13.85 percent disagreed that the children actively participated in the lessons. The percentage of teachers' responses in agreement is sufficiently large to indicate a high level of active participation by the children in the lessons. The Overall Mean Response of the teachers to the lessons was 3.75 and the standard deviation of the responses was 1.0.

4.35 Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science Two)

The responses of the teachers concerning children's understanding of the lessons are shown in Table 10, Appendix A. The Mean Teacher Responses of the teachers were all above 3.0 the range being 3.16 to 4.00. The highest ratings were given to Lesson 11, "Length and Distance" and Lesson 12, "Building Matchbox Figures". The lowest ratings were given to Lesson 24 and Lesson 18. Lesson 18, "Measuring Time by Counting" as well as

Table 4.13

Frequency Distribution of Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science Two)

Responses	Frequency	Percentage	
Strongly Disagree (1)	6	2.31	13.85
Disagree (2)	30	11.54	
Undecided (3)	20	7.69	
Agree (4)	124	47.69	63.84
Strongly Agree (5)	42	16.15	
No Response (X)	38	14.62	

Overall Mean Response = 3.75

Standard Deviation = 1.0

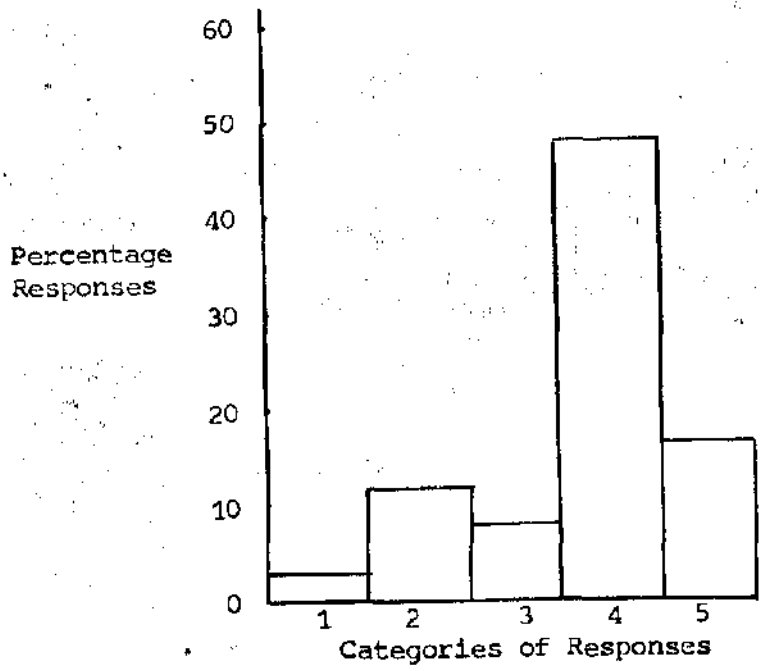


Fig. 4.09— Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science Two).

Lesson 24 were both rated lowest by the teachers in nearly all the categories of statements. Further discussion of these lessons is contained in Section 4.38.

The Mean Lesson Responses were above 3.0 except for two teachers who gave ratings of 2.9 and 2.0 to all the lessons. One of these teachers consistently rated the lessons low in three consecutive categories. Further discussion of the possible reasons for this is contained in Section 4.38.

The frequency distribution of the responses is shown in Table 4.14 and illustrated in Figure 4.10. Table 4.14 shows that 63.08 percent of the teachers agreed and 10.77 percent disagreed that the children understood the lessons. The Overall Mean Response was 3.71 and the standard deviation was 0.92.

4.36 Teachers' Responses Concerning Ease of Preparation and Implementation of the Lessons (Primary Science Two)

The responses of the teachers are shown in Table 11, Appendix A. Due to unclear printing on the opinionnaire, responses for lesson 18 were not complete. Of the remaining nine lessons, seven lessons had Mean Teacher Responses above 3.0 and two lessons had mean responses below 3.0. The lessons with the highest ratings were Lesson 16, "Seed Germination" and Lesson 7, "Round and Round the Circle". The lowest ratings were for Lesson 9, "The Ant-Lion and his Pit" and again Lesson 24.

Table 4.14

Frequency Distribution of Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science Two)

Responses	Frequency	Percentage	
Strongly Disagree (1)	8	3.08	10.77
Disagree (2)	20	7.69	
Undecided (3)	29	11.15	
Agree (4)	134	51.54	63.08
Strongly Agree (5)	30	11.54	
No Response (X)	39	15.00	

Overall Mean Response = 3.71

Standard Deviation = .92

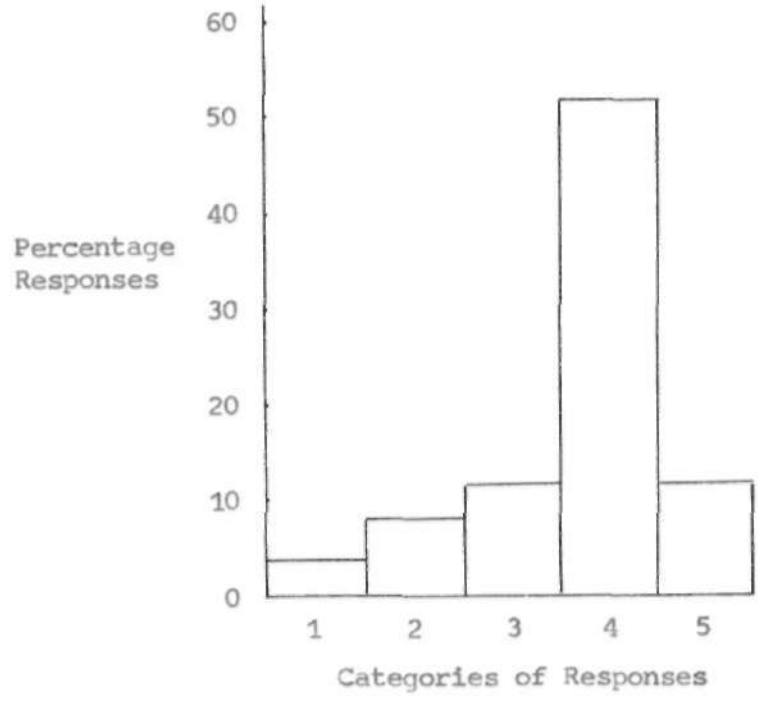


Fig. 4.10-- Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science Two).

Of the twenty six teachers, twenty two (84.61 percent) gave Mean Lesson Responses of greater than 3.0 and four teachers (15.39 percent) gave mean responses of less than 3.0.

The frequency distribution of responses is shown in Table 4.15 and Figure 4.11. The teachers' responses in agreement that the lessons were easy to prepare and implement formed 53.07 percent of the responses, while 20.00 percent were in disagreement. The percentage of teachers in disagreement was larger in this category than in all the former categories. There is an indication that preparing for and teaching the lessons presented some difficulties for the teachers. This could have been due to the materials being too difficult for the children or unsatisfactory in some respects. Lack of teacher preparation and training could also account for these difficulties.

The Overall Mean Response of all the teachers to all the lessons was 3.53 and the standard deviation 1.10.

4.37 Teachers' Responses Concerning Availability of Materials for Teaching the Lessons (Primary Science Two)

The responses of the teachers concerning the availability of materials for teaching the lessons are shown in Table 12, Appendix A. The Mean Teacher Responses were above 3.0 except for one lesson which had a mean response of 2.92. The lessons with the highest ratings were lesson 20, "More Fun with Mirrors"

Table 4.15

Frequency Distribution of Teachers' Responses Concerning Ease of Preparation and Implementation of the Lessons (Primary Science Two)

Responses	Frequency	Percentage	
Strongly Disagree (1)	9	3.47	20.00
Disagree (2)	43	16.54	
Undecided (3)	17	6.54	
Agree (4)	109	41.92	53.07
Strongly Agree (5)	29	11.15	
No Response (X)	53	20.38	

Overall Mean Response = 3.53

Standard Deviation = 1.10

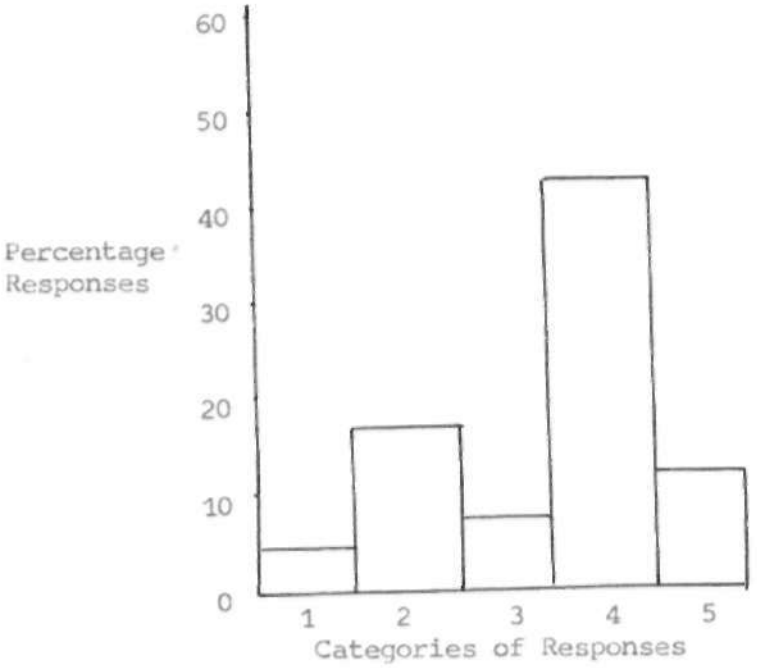


Fig. 4.11— Teachers' Responses Concerning Ease of Preparation and Implementation (Primary Science Two).

and Lesson 16, "Seed Germination". The lowest rated lessons were Lesson 12, "Building Matchbox Figures" and Lessn 24.

The Mean Lesson Responses toward availability of materials were the least positive of all the six categories of responses. Twenty one teachers (80.76 percent) gave positive ratings above 3.0 and five teachers (19.24 percent) gave negative ratings below 3.0. The Overall Mean Responses was the lowest of all six categories at 3.45. The standard deviation of the responses was 1.09.

The frequency distribution of responses is shown in Table 4.16 and Figure 4.12. The percentage of agree responses towards the availability of materials for the lessons was 52.69 percent.

The teachers indicated that there was some shortage of materials for the lessons of Primary Science Two. The percentage of teachers responses which indicated this shortage, 21.93 percent, was sufficiently large that it could not be easily overlooked. Further discussion of this point is contained in Section 4.38 of this chapter and also in Chapter 5, p. of this report.

4.38 Summary, Discussion and Interpretation of the Results from the Teachers' Opinionnaire on Primary Science Two

The Overall Mean Responses of the teachers to each of the six categories of statements are shown in Table 4.17. The table shows that the teachers Overall Mean Responses were all signifi-

Table 4.16

Frequency Distribution of Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science Two)

Responses	Frequency	Percentage	
Strongly Disagree (1)	12	4.62	21.93
Disagree (2)	45	17.31	
Undecided (3)	22	8.46	
Agree (4)	108	41.54	56.69
Strongly Agree (5)	29	11.15	
No Response (X)	44	16.92	

Overall Mean Response = 3.45

Standard Deviation = 1.09

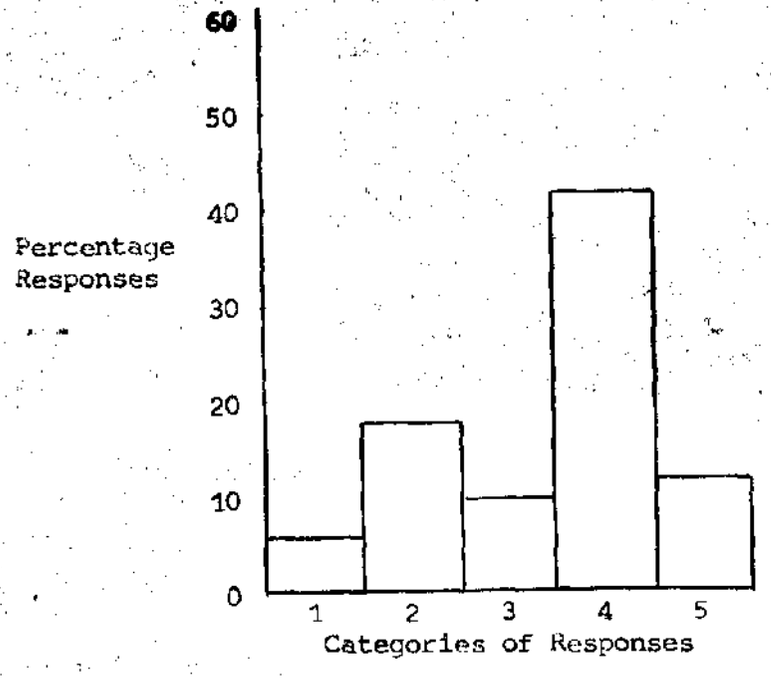


Fig. 4.12— Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science Two).

cantly greater than 3 using a one-tailed t-test (α = .05).

Table 4.17

Summary of Teachers' Responses to the Opinionnaire on Primary Science Two

	Category of Response	Overall Mean Response	Standard Deviation	Computed t-value
1.	Children's Interest in the Lessons	3.87	0.96	4.63*
2.	Children's Practice of Process Skills	3.74	1.02	3.70*
3.	Active Participation of Children	3.75	1.00	3.83*
4.	Children's Understanding and Learning	3.71	0.92	3.94*
5.	Ease of Preparation and Implementation of Lessons	3.53	1.10	2.45*
6.	Availability of Materials for the Lessons	3.45	1.09	2.10*

* indicates significance at α = .05

The highest mean responses were for Children's Interest (3.87) and Active Particpation (3.75), while the lowest were Ease of Preparation of the Lessons (3.53 and Availability of Materials (3.45). These results differed from the responses on Primary Science One where the Children's Practice of Process Skills had the highest rating (see p.116). The values for the

overall mean responses for the opinionnaire on Primary Science Two were lower than those for Primary Science One. The two lowest rated areas for both books were the same, namely, Ease of Preparation and Availability of Materials. These two areas presented the greatest difficulties for the teachers of both books.

In order to ascertain the relative success of each of the lessons, two additional tables were constructed. Table 4.18 shows the mean teacher responses for each of the ten lessons randomly selected from Primary Science Two for this study. The table also shows the average of the mean teacher responses. Based on the values of this average the lesson rated most successful was Lesson 16, "Seed Germination" and that rated least successful was Lesson 24 "Air in the Bag". In the table, Lesson 9,"The Ant-Lion and his Pit" and 24 were rated below 3.0 on Ease of Preparation and Implementation with values of 2.91 and 2.95 respectively. Lesson 12, "Building Matchbox Figures" was rated low on Availability of Materials with a value of 2.91. This was not surprising since the teachers had "to have ready 120 matchboxes, wrapped packages of matchboxes containing 10, 7, 6 and 4 boxes . . ." (Primary Science Two, 1975:43).

When the lessons were each ranked, based on the mean lesson responses, so that the highest rating was ranked first (1)

Table 4.18

Mean Teacher Responses for the Lessons (Primary Science Two)

Category of Responses	Lesson Number									
	3	7	9	11	12	14	16	18	20	24
Children's Interest in the Lessons	4.04	3.90	3.95	3.90	4.17	3.88	3.98	3.58	3.90	3.26
Children's Practice of Process Skills	3.83	4.15	3.71	3.96	3.67	3.72	3.96	3.26	3.68	3.32
Active Participation of Children in the Lessons	3.44	3.80	4.10	3.92	4.04	3.72	3.83	3.37	4.05	3.11
Children's Understanding of the Lessons	3.96	3.50	3.95	4.00	4.00	3.54	3.64	3.32	3.90	3.16
Ease of Preparation and Implementation	3.44	3.85	2.91	3.60	3.83	3.60	4.00	-	3.45	2.95
Availability of Materials	3.54	3.48	3.65	3.54	2.92	3.16	3.71	3.46	3.95	3.11
Average Mean Response	3.71	3.78	3.71	3.82	3.77	3.60	3.85	3.40	3.82	3.15

and the lowest rating was ranked tenth (10), the results obtained were those shown in Table 4.19. The most successful lesson was again Lesson 16 and the least successful was Lesson 24, as shown in Table 4.18. Lesson 18, "Measuring Time by Counting" was ranked low by the teachers in five of the six categories. Responses to Ease of Preparation of this lesson were not given by the teachers because of poor printing on the instrument. However, this lesson along with lesson 24, appears to be in need of some re-examination. Both for Primary Science One and Primary Science Two, further study needs to be carried out on all the lessons before specific recommendations can be made for lesson improvement.

Table 4.20 shows the Mean Lesson Responses of the teachers of Primary Science Two for each of the six categories of statements. The average of the mean responses has been calculated and was interpreted as an indication of the individual teacher's general attitude to all six criteria.

Of the twenty six teachers who responded to the opinionnaire on Primary Science Two, 24 (92 percent) teachers had an average of mean teacher response above 3.0 and two teachers (8 percent) had averages below 3.0. The teacher numbered 34 gave very high ratings to all six criteria and had an average of 4.45. Two teachers numbered 30 and 35, each gave low ratings on three categories of statements and had averages of 2.98 and 2.86 respect-

Table 4.19

Ranking of Lessons Based on Responses of the Teachers

Category of Responses	Lesson Number									
	3	7	9	11	12	14	16	18	20	24
Children's Interest in the Lessons	2	5	4	5	1	8	3	9	5	10
Children's Practice of Process Skills	4	1	6	2	8	5	2	10	7	9
Active Participation of Children in the Lessons	8	6	1	4	3	7	5	9	2	10
Children's Understanding of the Lessons	3	8	4	1	1	7	6	9	5	10
Ease of Preparation and Implementation	7	2	9	4	3	4	1	-	6	8
Availability of Materials	4	6	3	4	10	8	2	7	1	9
Mean Rank	4.67	4.67	4.50	3.33	4.33	6.50	3.17	8.80	4.33	9.33

Table 4.20

Mean Lesson Responses for the Six Categories of Statements on Primary Science Two

Teacher Number	Children's Interest	Practice of Process Skills	Active Part.	Children's Under-standing	Ease of Prep. & Impl.	Avail. of Materials	Average of Mean Response
23	3.70	3.90	4.00	3.20	4.11	4.44	3.89
24	4.40	4.00	3.90	4.10	3.67	3.50	3.93
25	4.67	4.50	4.25	4.50	3.75	3.25	4.15
26	4.33	4.22	3.90	4.33	2.78	3.70	3.80
27	3.50	3.60	3.50	3.70	3.30	3.60	3.53
28	3.40	3.60	3.20	3.60	3.10	3.20	3.35
29	3.80	3.80	3.80	3.44	3.78	2.90	3.50
30	3.22	3.20	3.22	2.90	2.67	2.67	2.98
31	4.00	4.00	4.40	3.60	3.67	4.10	3.96
32	4.40	4.00	3.50	4.00	3.67	2.33	3.65
33	4.30	4.33	4.17	4.00	3.33	4.00	4.02
34	4.57	4.43	4.71	4.43	4.00	4.57	4.45

Table 4.20 (cont'd)

Teacher Number	Children's Interest	Practice of Process Skills	Active Part.	Children's Under-standing	Ease of Prep. & Impl.	Avail. of Materials	Average of Mean Response
35	3.20	2.50	2.67	2.00	3.38	3.40	2.86
36	3.75	3.14	3.88	3.75	2.63	3.13	3.38
37	4.43	3.43	4.17	4.00	3.29	3.14	3.74
38	4.40	4.10	4.00	3.90	3.89	4.10	4.07
39	3.50	3.88	3.88	3.67	3.43	3.75	3.69
40	3.33	3.40	2.40	3.40	4.00	3.25	3.30
41	1.60	3.67	3.71	3.40	3.67	2.83	3.15
42	4.20	3.70	4.10	4.10	4.11	3.70	3.99
43	4.44	4.00	4.40	3.33	3.78	3.38	3.89
44	3.80	4.00	4.00	3.70	3.78	3.60	3.81
45	3.80	3.10	3.11	3.90	3.56	3.11	3.43
46	3.60	3.20	3.30	3.60	3.56	2.63	3.32
47	4.20	4.00	4.10	4.10	4.00	3.56	3.00

Table 4.20 (cont'd)

Teacher Number	Children's Interest	Practice of Process Skills	Active Part.	Children's Under-standing	Ease of Prep. & Impl.	Avail. of Materials	Average of Mean Response
48	4.13	4.15	3.63	4.13	4.13	2.80	3.68

ively. The remainder of the teachers had averages ranging from 3.15 to 4.15, indicating a generally positive attitude to all six criteria. This result confirms what was obtained when the Overall Mean Responses were all calculated to be significantly above 3.0 (α = .05) on a one-tailed t-test. This result implies that for the teachers of PEIP Class Two the null hypothesis Ho_1 is rejected. Ho_1 states: The teachers of PEIP Classes One and Two will not have a positive attitude to the programme. This will be indicated by an overall mean response of less than or equal to 3.0 on a scale of 1-5 (towards the six mentioned criteria).

The teachers' responses, whilst they were predominantly positive to all six criteria, were least positive in the areas of Availability of Materials and Ease of Preparation and Implementation. As for Primary Science One, Primary Science Two seems to present some difficulties to teachers in these two areas. Table 4.20 shows that on availability of materials, 5 teachers (19 percent) gave ratings below 3.0. In addition, ten teachers had not completed the opinionnaires because they were not teaching science for lack of competency to do so, as well as insufficient materials being available for teaching the subject. Some improvement is clearly needed in preparing the teachers for the PEIP (Science) and making it easier for them to acquire the needed materials.

4.4 CHILDREN'S PROCESS TEST RESULTS IN PROJECT AND NON-PROJECT SCHOOLS

4.41 Introduction

In each of the four centres; Maiduguri, Ilorin, Sokoto and Kano, 144 children were tested with the TOPS. The number of project and non-project school children tested, and the class levels at which they were tested were shown in Table 3. (Chapter 3, p.94). In Section 4.42, the children's scores on the TOPS were first used to establish evidence of test validity and reliability. Children's scores were compared at different age and class levels and a reliability coefficient was calculated using a Kuder-Richardson formula suitable for this type of test.

The testing of the children was carried out in early September, 1976, in the different centres to coincide with the first week of the school year. Children in Class One were in their first week of formal schooling and it was presupposed that project school children would not score significantly higher than non-project school children within each centre and across the whole Class One population. Section 4.43 described the procedure adopted to ascertain whether this assumption was correct.

Children at the Class Two level had been through one complete year of formal schooling. The results of Class Two

children across the whole sample were compared in Section 4.44 to test hypothesis Ho_2 which states: After <u>one</u> year's exposure to the programme, project school children will not perform significantly better in terms of total process test scores than will children in non-project schools (α = .05).

Children at the Class Three level had been through <u>two</u> complete years of schooling. The results of Class Three project and non-project school children were compared in Section 4.45, to test hypothesis Ho_3 which states: After <u>two</u> year's exposure to the programme, project school children will not perform significantly better in terms of total process test scores than will children in non-project schools (α = .05).

In Section 4.46 the scores of boys in project and non-project schools were compared at each class level to test hypothesis Ho_4 which states: Boys in project schools will not attain significantly higher total process test scores than will boys in non-project schools at the same class level (α = .05). In Section 4.47, a similar comparison was made of the scores of project school girls with non-project school girls, to test hypothesis Ho_5 which states: Girls in project schools will not attain significantly higher total process scores than girls in non-project schools at the same class level (α = .05).

In Section 4.48 comparisons of scores were made between boys and girls in project schools, and boys and girls in non-

project schools, to test hypothesis Ho_6 which states: Boys will not attain significantly higher total process test scores than girls at the same class level ($\alpha = .05$);

(i) in project schools, and

(ii) in non-project schools.

4.42 Validity and Reliability of the Test of Process Skills (TOPS)

In order to establish content validity, the TOPS was submitted to a panel of four judges. Each judge was a lecturer in Science Education at Ahmadu Bello University, Zaria. Modifications to the test were made on their advice and the suggestions which the panel made were incorporated in the test. To help establish construct validity, the mean total scores of the children at class levels one, two and three across the whole sample were calculated and are shown in Table 4.21.

Table 4.21

Mean Scores of Children by Class Level

Class	Mean Score	Standard Dev.	N
1	14.89	9.87	192
2	23.58	8.45	192
3	28.86	7.82	192

When the scores were compared using analysis of variance, significant differences (α = .001) were found to exist (see Table 4.22). When children in higher classes score significantly higher than in lower classes on a test that test is interpreted as having construct validity (Dietz and George, 1970:341-352).

Table 4.22

Comparison of Children's Scores
Using Analysis of Variance

Source	D.F.	Sum of Squares	Mean Squares	F-Ratio	F-Prob.
Between Groups	2	18795.04	9397.52	122.67	.000
Within Groups	573	43891.80	76.6		
Total	575	62686.84			

Test reliability was established in two ways. Evidence of internal consistency was obtained using a Kuder-Richardson formula applicable to this type of test (Chapter 2, p. 41) Using this formula on the results of the sample a reliability coefficient of r= 0.760 was obtained. When this formula was applied using the values of varaince associated with each class level, the following values of r were obtained:

(Class One) r = 0.744

(Class Two) r = 0.656

(Class Three) r = 0.605

The second method of establishing test reliability was to compute Pearson Product-Moment Correlations of sub-test and the total scores with age and class level. The correlation table is shown in Table 4.23.

Table 4.23

Correlation of Sub-Test and Total TOPS Scores with Age and Class Level

Item	Class N=576	Age N=576
Subtest 1	.47*	.53*
Subtest 2	.37*	.40*
Subtest 3	.36*	.34*
Subtest 4	.36*	.40*
Subtest 5	.33*	.29*
Subtest 6	.33*	.37*
Subtest 7	.44*	.51*
Total	.54*	.60*

* Indicates significance at α = .001

N was the number of children

The table above shows that the correlations between

subtests and total score with class level and age were highly significant (α = .001), indicating reliability of the test instrument.

The mean scores at each level were also computed and the results are shown in Table 4.24.

Table 4.24

Age and Mean Scores of Children on Process Skills

Number of Children	Stated Age (Years)	Mean Score	Standard Deviation
51	5	10.53	7.71
100	6	14.19	8.29
116	7	21.55	8.62
138	8	15.99	7.93
89	9	28.66	8.53
52	10	28.15	8.23
15	11	30.87	7.14
8	12	34.38	5.04
3	13	37.67	2.08

As can be seen from the table, the children's stated ages ranged from 5 to 13 years. The majority of the children were aged 6 to 9 years. In this age range there was a steady increase in the children's scores on the process test (see fig.

4.13, p.155). In the age range 9 to 10 there was a plateau before the children's scores increased once more, up to the age of 13 years. This might represent a transition from one type of lower order learning to one of higher order learning (Hilgard et al., 1971:211). Further research on this phenomenon might prove to be interesting with regard to learning theory.

The above evidence on the test when considered in conjunction with the other evidence indicative of validity and reliability (see Chapter 3, p.) provided a strong argument for the validity and reliability of the TOPS.

4.43 Comparison of Children's Scores in Project and Non-Project Schools in Class One

One of the assumptions in the design of this study was that, on entering primary school, project school children would not score significantly higher than non-project school children in each centre. This supposition was based on certain criteria which were:-

(1) There was no formal selection system for children entering primary schools in the centres.

(2) The project and non-project schools used were in close proximity to each other in each centre and were serving the same population area. Children within the same area should not on average come from very different backgrounds, and hence,

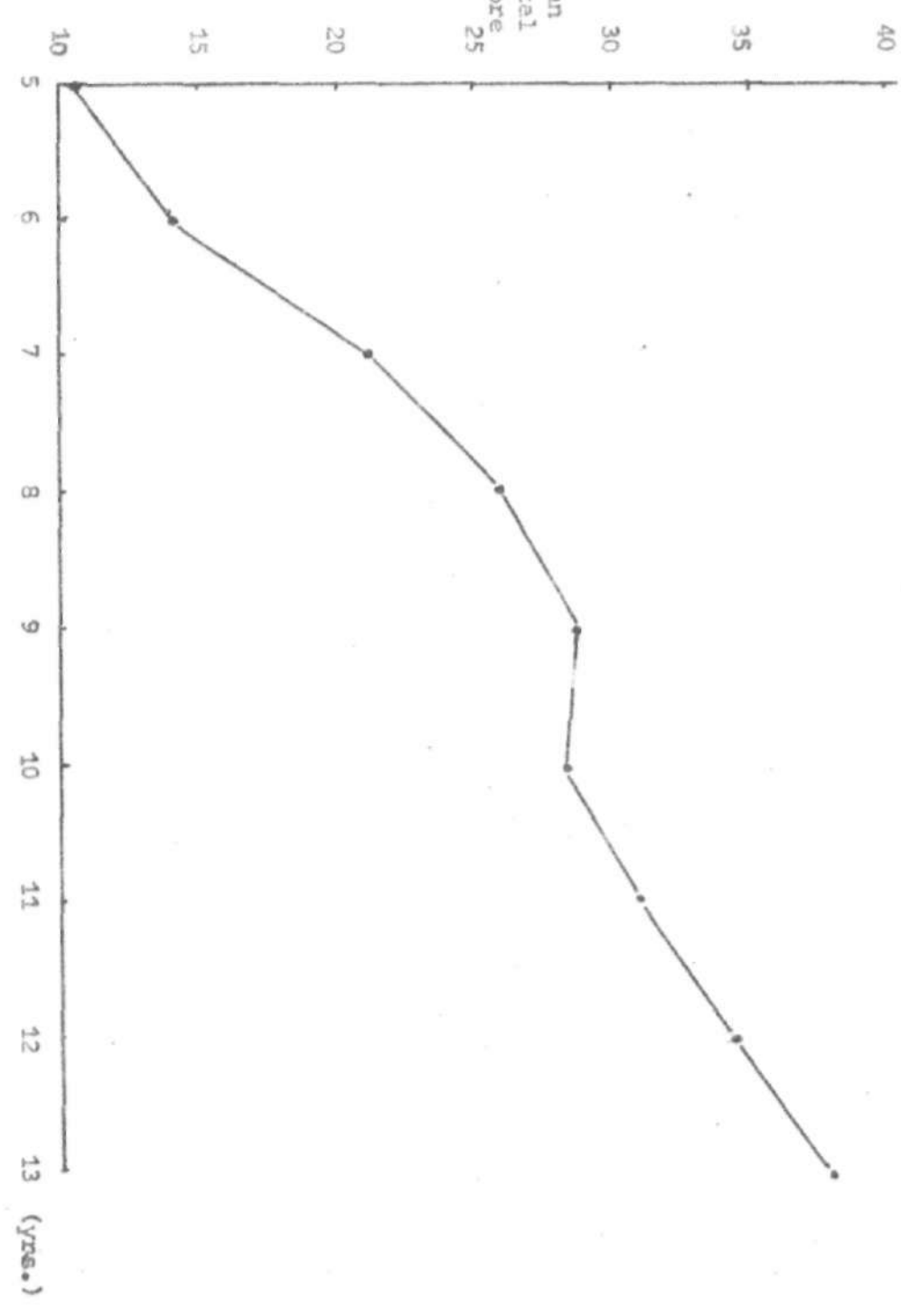


Fig. 4.13 — Mean total score vs. age

each class would have similar scores on the test.

The mean total scores of the children in Class One in each centre are shown in Table 4.25.

Table 4.25

Comparison of TOPS Mean Total Scores of Class One Project and Non-Project Children in Each Centre

Centre Number	PEIP		Non-PEIP		F Ratio	F Prob.
	Mean Total	Standard Deviation	Mean Total	Standard Deviation		
1	13.71	7.80	12.87	7.40	0.21	0.65
2	16.79	11.54	17.58	10.54	0.05	0.83
3	17.88	12.13	15.74	10.05	0.63	0.43
4	13.71	11.10	10.88	9.57	1.00	0.32

When the mean scores of the project and non-project children in each centre were compared using a one-way analysis of variance, it was established that project school children did not score significantly higher than non-project school children in any of the centres.

The sub-test and total scores of children in project and non-project schools across the whole Class One sample are shown in Table 4.26. There were 96 children in each of the two groups.

Table 4.26

Mean Scores of Class One Project and Non-Project Children

Class One	Number of Children	Mean	Standard Deviation
Project Schools	96	15.51	10.76
Non-Project Schools	96	14.19	8.96

When the results were compared using the one-way analysis of variance, project school children did not score significantly higher than non-project school children in their total scores, across the whole Class One sample (Table 4.27).

Table 4.27

One-way Analysis of Variance of Children's Scores in Class One (Project vs. Non-Project)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	94.16	94.16	.96	.33
Within Groups	190	18651.92	98.17		
Total	191	18746.08			

4.44 Children's TOPS Scores after One Year of Schooling in Project and Non-Project Schools (Test of Hypothesis Ho_2)

Children were tested in Class Two at the beginning of the school year. Those in project schools had been exposed to the PEIP programme for one complete year while those in non-project schools had been taught by more traditional methods.

Hypothesis Ho_2 states: After one year's exposure to the programme, project school children will not perform significantly better in terms of total process test scores than will children in non-project schools ($\alpha = .05$).

The mean total scores of project and non-project school children are shown in Table 4.28.

Table 4.28

Mean Scores of Class Two Project and Non-Project Children

Class Two	Number of Children	Mean	Standard Deviation
Project Schools	96	25.21	8.67
Non-Project Schools	96	22.05	7.93

When the scores of the children were compared using one-way analysis of variance, the results obtained were those shown in Table 4.29.

Table 4.29

One-Way Analysis of Variance of Children's Scores in Class Two (Project vs. Non-Project)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	478.17	478.17	6.428	.009
Within Groups	190	13114.57	69.02		
Total	191	13592.74			

The results in Table 4.29 indicate that project children scored significantly higher in their total scores than non-project school children ($\alpha = .05$). As a consequence hypothesis Ho_2 **was rejected.**

The mean scores of the children in each of the subtests are shown in Table 4.30. In sub-test three there was no difference between the groups. This test involved paper figures which were arranged in order of height. In sub-test two, which consisted of arranging pictures in the correct order, the children's scores were also very close. In the other sub-tests, project school children scored consistently higher than non-project school children.

Table 4.30

Mean TOPS Sub-Test Scores of Class Two Children in Project and Non-Project Schools

Sub-Test Number	Mean Scores (Project)	Mean Scores (Non-Project)
1	6.99	6.41
2	2.30	2.13
3	1.72	1.72
4	1.18	0.77
5	4.22	3.51
6	1.26	0.93
7	7.53	6.59
Total	25.18	22.02

4.45 Children's TOPS Scores after Two Years of Schooling in Project and Non-Project Schools (Test of Hypothesis Ho_3)

The children in Class Three were tested at the same time as those in Class One and Two, which was in the first week of the school year. The Class Three children had at that time been through two complete years of schooling.

Hypothesis Ho_3 states: After two year's exposure to the programme, project school children will not perform significantly better in terms of total scores than will children in non-

project schools (α = .05).

The mean total TOPS scores of the two groups of Class Three children are shown in Table 4.31.

Table 4.31

Mean Scores of Class Three Project and Non-Project Children

Class Three	Number of Children	Mean	Standard Deviation
Project Schools	96	29.83	7.78
Non-Project Schools	96	27.82	7.73

In order to test if project school children's total scores were significantly better than the scores of non-project school children, one-way analysis of variance was used. The results are shown in Table 4.32. This table indicates that project school children did not score significantly higher (α = .05) than non-project school children after two years of schooling. As a consequence hypothesis Ho_3 was accepted.

The breakdown of the total scores of the children into sub-test scores is shown in Table 4.33. In sub-test one and three the non-project children scored slightly higher than the project school children. However, in sub-test seven, which

involved mazes, the project school children scored noticeably higher than the non-project children.

Table 4.32

One-Way Analysis of Variance of Children's Scores in Class Three (Project vs. Non-Project)

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	194.01	194.01	3.219	.074
Within Groups	190	11452.61	60.28		
Total	191	11646.62			

The relationship between the mean total scores and class level for project and non-project children is shown in Figure 4.14. The figure indicated an almost linear increase in score with class level for the non-project children over the two years. The project school children had a more rapid increase in score during the first year but during the second year the rate became less. It was not clear why the rate of increase of the scores of these children changed. This point is further discussed at the end of Section 4.47 with reference to Figure 4.16 (p. 184) showing the relative rates of increase in scores of boys and girls.

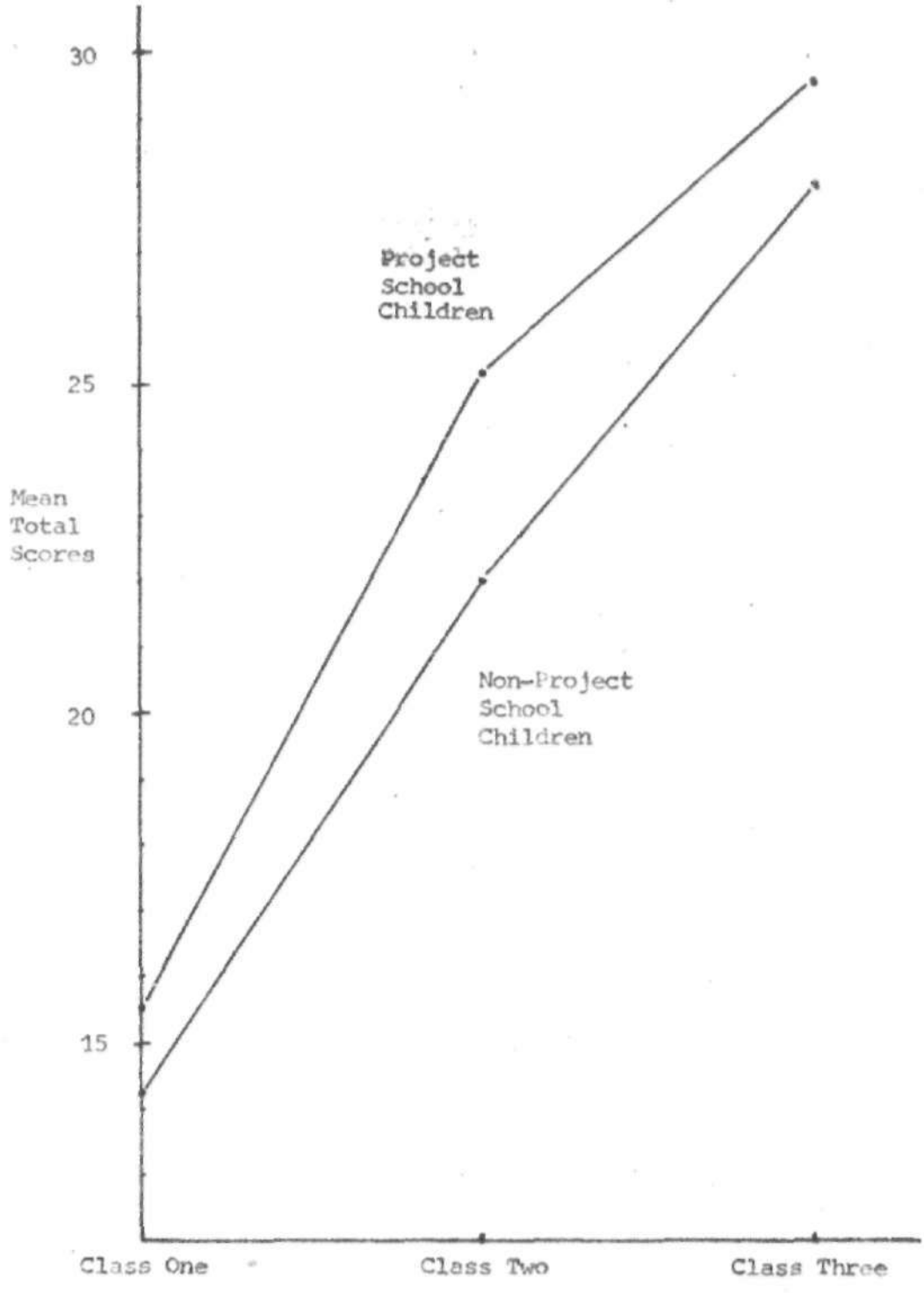


Fig. 4.14 — Mean total scores vs. class

Table 4.33

Mean TOPS Sub-Test Scores of Class Three Children in Project and Non-Project Schools

Sub-Test Number	Mean Scores (Project)	Mean Scores (Non-Project)
1	7.80	7.89
2	2.92	2.76
3	1.91	1.94
4	1.83	1.61
5	4.46	4.18
6	1.52	1.26
7	9.39	8.18
Total	29.83	27.82

4.46 Mean TOPS Scores of Boys in Project and Non-Project Schools (Test of Hypothesis Ho_4)

In the former sections no allowance was made for sex differences between the children in the different classes. In this section the scores of boys in project and non-project schools were compared at each class level to test hypothesis Ho_4. Hypothesis Ho_4 states: Boys in project schools will not attain significantly higher total process test scores than will boys in non-project schools at the same class level ($\alpha = .05$)

The mean total scores of boys at each of the class levels are shown in Table 4.34.

Table 4.34

Mean TOPS Scores of Boys in Project and Non-Project Schools

Class One		Class Two		Class Three	
Mean Score (P) N= 60	Mean Score (NP) N= 52	Mean Score (P) N= 65	Mean Score (NP) N= 54	Mean Score (P) N= 63	Mean Score (NP) N= 59
17.98	16.56	26.10	24.06	30.79	29.27

It is interesting to note that the number of boys in the project school classes is larger than in non-project schools. Project school boys at the Class One level were not expected to score significantly higher than boys in non-project schools, since both groups had begun primary school only a week before they were tested. The results of comparing the scores of Class One boys using analysis of variance are shown in Table 4.35. This table indicates that project school boys at the Class One level did not score significantly higher TOPS scores than boys in non-project schools; hypothesis Ho_4 was hence accepted at the Class One level.

Table 4.35

One-Way Analysis of Variance of Boys' Scores in Class One

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	56.62	56.62	.533	.467
Within Groups	110	11693.81	106.31		
Total	111	11750.43			

Project school boys at the Class Two level had been exposed to the PEIP for one year, while non-project boys had followed more traditional science curricula. The results of comparing the scores of the two groups of boys using one-way analysis of variance are shown in Table 4.36. It is clear that project school boys at the Class Two level did not attain significantly higher total TOPS scores than non-project boys. Consequently, hypothesis Ho_4 was accepted at the Class Two level.

The results of comparing the scores of Class Three project and non-project school boys, using one-way analysis of variance are shown in Table 4.37. As for Class One and Two, Class Three project school boys did not score significantly

higher total TOPS scores than Class Three boys in non-project schools. Hypothesis Ho_4 was thus accepted at the Class Three level.

Table 4.36

One-Way Analysis of Variance of Boys' Scores in Class Two

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	135.64	135.64	1.957	0.164
Within Groups	117	8109.23	69.31		
Total	118	8244.87			

Table 4.37

One-Way Analysis of Variance of Boys' Scores in Class Three

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	70.62	70.62	1.151	0.286
Within Groups	120	7363.98	61.37		
Total	121	7434.60			

4.47 Mean TOPS Scores of Girls in Project and Non-Project Schools (Test of Hypothesis Ho_5)

In this section the scores of project school girls were compared with the scores of girls in non-project schools at each class level, using one-way analysis of variance, to test hypothesis Ho_5.

Hypothesis Ho_5 states: Girls in project schools will not attain significantly higher total process test scores than girls in non-project schools at the same class level ($\alpha = .05$).

The mean total scores of the girls at the three class levels are shown in Table 4.38. It should be noted that the number of girls in non-project classes was larger than that of girls in project schools.

Table 4.38

Mean TOPS Scores of Girls in Project and Non-Project Schools

Class One		Class Two		Class Three	
Mean Score (P) N= 36	Mean Score (NP) N= 43	Mean Score (P) N= 31	Mean Score (NP) N= 42	Mean Score (P) N= 33	Mean Score (NP) N= 37
11.61	11.33	23.13	19.48	27.97	25.49

The results of comparing the scores of Class One project and non-project school girls are shown in Table 4.39.

Table 4.39

One-Way Analysis of Variance of Girls' Scores in Class One

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	1.60	1.60	0.023	0.879
Within Groups	77	5302.00	68.86		
Total	78	5303.60			

In Table 4.39 above, it can be seen that project school girls in Class One did not score significantly higher than girls in non-project schools. Hypothesis Ho_5 was hence accepted at the Class One level.

The results of comparing the scores of Class Two project and non-project school girls are shown in Table 4.40. As can be seen from this table, project school girls did not score significantly higher than Class Two girls in non-project schools. Hypothesis Ho_5 was consequently accepted at the Class Two level.

Table 4.40

One-Way Analysis of Variance of Girls' Scores in Class Two

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	237.99	237.99	3.919	.052
Within Groups	71	4311.96	60.73		
Total	72	4549.95			

The scores of Class Three girls in project and non-project schools were compared and the results are shown in Table 4.41.

Table 4.41

One-Way Analysis of Variance of Girls' Scores in Class Three

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	107.56	107.56	2.037	0.158
Within Groups	68	3590.21	52.80		
Total	69	3697.77			

At the Class Three level project school girls did not score significantly higher TOPS scores than did girls in non-project schools. As a result hypothesis Ho_5 was accepted at the Class Three level.

4.48 Comparison of Mean TOPS Scores of Boys and Girls in Project and Non-Project Schools (Test of Hypothesis Ho_6)

In this section the scores of project school boys were compared with those of project school girls. Also the scores of non-project school boys were compared with scores of non-project school girls. Comparison were made at each class level from Class One to Three to test hypothesis Ho_6. A breakdown of the sub-test scores was included at the end of the section on each class level to show how the total scores were arrived at by the children.

Hypothesis Ho_6 states: Boys will not attain significantly higher total process test scores than girls at the same class level ($\alpha = .05$);

(i) in project schools, and

(ii) in non-project schools

(a) At the Class One Level.

Table 4.42 shows the results of comparing the total

scores of Class One boys and girls in project schools. Boys scored significantly higher mean total TOPS scores than girls (α = .05) in the project schools.

Table 4.42

One-Way Analysis of Variance of Scores of Class One Project School Boys and Girls

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	913.62	913.62	8.520	.004
Within Groups	94	10079.54	107.23		
Total	95	10993.16			

The results of comparing the total scores of Class One boys and girls in non-project schools are shown in Table 4.43. The table indicates that boys in Class One of the non-project schools also scored significantly higher mean TOPS scores than the girls in the same schools.

Results shown in Tables 4.42 and 4.43 indicated a rejection of hypothesis Ho_6 at the Class One level in both project and non-project schools.

Table 4.43

One-Way Analysis of Variance of Scores of Class One Non-Project School Boys and Girls

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	644.32	644.32	8.664	.004
Within Groups	93	6916.27	74.37		
Total	94	7560.59			

The breakdown of total TOPS scores into sub-test scores is shown in Table 4.44. The largest numerical score differences between the boys and the girls occurred in sub-tests one and seven. Sub-test one involved five picture completion items shown in Appendix E. Skills of observation, manipulation and experimentation were associated with this sub-test. Sub-test seven consisted of six mazes of increasing difficulty. Skills of observation, prediction and experimentation were involved in this sub-test.

Table 4.44

Mean Sub-Test and Total Scores of Class One Boys and Girls

Sub-Test Number	Project School		Non-Project School	
	Mean Score Boys N= 60	Mean Score Girls N= 36	Mean Score Boys N= 53	Mean Score Girls N= 43
1	5.28	3.53	4.98	3.47
2	1.62	1.19	1.44	1.21
3	1.23	1.03	1.25	1.09
4	0.73	0.58	0.52	0.42
5	2.80	2.19	3.00	2.65
6	0.78	0.67	0.73	0.67
7	5.54	2.42	4.64	1.81
Total	17.98	11.61	16.56	11.33

(b) At the Class Two Level.

The results of comparing the total scores of Class Two boys and girls are shown in Table 4.45. It can be observed that the boys did not score significantly higher than the girls in their total scores (α = .05).

Table 4.45

One-Way Analysis of Variance of Scores of Class Two Project School Boys and Girls

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	197.95	197.95	2.680	.105
Within Groups	94	6943.88	73.87		
Total	95	7141.83			

The results of comparing the total scores of Class Two boys and girls in non-project schools are shown in Table 4.46.

Table 4.46

One-Way Analysis of Variance of Scores of Class Two Non-Project School Boys and Girls

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	495.43	495.43	8.502	.004
Within Groups	94	5477.31	58.27		
Total	95	5972.74			

Table 4.46 shows clearly that boys in Class Two of the

non-project schools scored significantly higher than the girls in the same schools (α = .05). For Class Two boys and girls hypothesis Ho_6 was accepted for project schools and rejected for non-project schools.

The breakdown of the total scores into sub-test scores for Class Two boys and girls is shown in Table 4.47.

Table 4.47

Mean Sub-Test and Total Scores of Class Two Boys and Girls

Sub-Test Numbers	Project School		Non-Project School	
	Mean Score Boys N= 65	Mean Score Girls N= 31	Mean Score Boys N= 54	Mean Score Girls N= 42
1	7.28	6.39	6.72	6.00
2	2.51	1.87	2.11	2.14
3	1.66	1.84	1.78	1.64
4	1.08	1.39	0.91	0.60
5	4.23	4.23	3.93	2.98
6	1.31	1.16	0.87	1.00
7	8.13	6.25	7.74	5.12
Total	26.20	23.13	24.06	19.48

Table 4.47 reveals that project school girls scored higher than project school boys in sub-tests three and four, and scored equally on sub-test five. Sub-test three involved measurement and ordering by length, while sub-test four involved arranging blocks to a pre-determined design. The skills involved in arranging the blocks were observation, manipulation and experimentation. In the non-project schools, girls scored on average slightly higher on sub-test two, which involved arranging pictures in the correct sequence. Skills involved in sub-test two were observation, prediction and inference.

(c) At the Class Three Level.

The results of comparing the total scores of Class Three project school boys and girls are shown in Table 4.48.

Table 4.48

One-Way Analysis of Variance of Scores of Class Three Project School Boys and Girls

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	172.70	172.70	2.904	.092
Within Groups	94	5589.29	59.46		
Total	95	5761.99			

As for Class Two of the project schools, the results of Table 4.48 show that Class Three project school boys did not score significantly higher than the girls in the same schools (α = .05).

The results of comparing the total scores of Class Three non-project school boys and girls are shown in Table 4.49.

Table 4.49

One-Way Analysis of Variance of Scores of Class Three Non-Project School Boys and Girls

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	1	325.72	325.72	5.707	0.019
Within Groups	94	5364.90	57.07		
Total	95	5690.63			

Class Three non-project school boys scored significantly higher total scores than Class Three non-project school girls. On the basis of the results shown in Tables 4.48 and 4.49, hypothesis Ho_6 at the Class Three level was accepted for project schools but rejected for non-project schools.

The breakdown of total scores into sub-test scores for Class Three boys and girls is shown in Table 4.50.

Table 4.50

Mean Sub-Test and Total Scores of Class Three Boys and Girls

Sub-Test Number	Project School		Non-Project School	
	Mean Score Boys N= 63	Mean Score Girls N= 33	Mean Score Boys N= 59	Mean Score Girls N= 37
1	7.97	7.73	8.14	7.27
2	3.18	2.64	2.90	2.47
3	1.90	1.91	1.88	1.83
4	1.86	1.79	1.68	1.50
5	4.50	4.58	4.12	4.27
6	1.54	1.48	1.24	1.30
7	9.84	7.84	9.31	6.84
Total	30.79	27.97	29.27	25.48

From Table 4.50 it can be observed that project school girls scored higher than project school boys in sub-tests three and five. Sub-test three involved measurement while sub-test five involved understanding space relationships. In all the other sub-tests, boys in project schools scored higher than the girls. In the non-project schools girls scored higher than the boys on sub-test five and six. Sub-test six in-

volved classification. In all the other sub-tests, boys scored higher than the girls.

4.49 Discussion and Interpretation of the Children's TOPS Results

(1) Results at the Class One Level.

The scores of children beginning Class One in project and non-project schools were compared using one-way analysis of variance. The results indicated that project school children did not score significantly higher ($\alpha = .05$) total TOPS scores than non-project school children (a) when the whole Class One sample was considered, and (b) when each of the four centres was considered individually.

When allowances was made for sex differences between the children and the total scores of boys in project and non-project schools were compared using one-way analysis of variance, project school boys did not score significantly higher ($\alpha = .05$) than boys in non-project schools. Project school girls did not score significantly higher total scores than girls in non-project schools ($\alpha = .05$). Hypotheses Ho_4 and Ho_5 were hence accepted at the Class One level.

The evidence of the above comparisons lent support to the basic assumption that children of the same sex entering

Class One would on average begin at the same level. It seemed reasonable to extend this assumption to include project and non-project school Classes Two and Three and to conclude that when they entered primary school they began at the same level. The same assumption was extended to include Class Two and Three project and non-project school girls.

Comparison of the scores of Class One project school boys with girls using one-way analysis of variance showed that boys scored significantly higher total scores than the girls ($\alpha = .05$). The same result was obtained when the total scores of Class One non-project school boys were compared with the scores of girls in non-project schools. On the basis of the above results hypothesis Ho_6 was rejected at the Class One level in project and non-project schools.

When the total scores were broken down into sub-test scores, it appeared that the greatest numerical differences in sub-test scores between the boys and girls occurred in sub-tests one and seven. Skills involved in these sub-tests were observation, manipulation, prediction and experimentation. The boys generally performed better on all the test items and it could be concluded that at the beginning of their years of formal schooling, boys were more competent in tasks involving process skills than the girls.

(2) Results at the Class Two Level.

The total TOPS scores of children beginning Class Two in project and non-project schools were compared using one-way analysis of variance. The results showed that project school children obtained significantly higher total scores than non-project school children (α = .05). On the basis of this result hypothesis Ho_2 was rejected. When the total scores were broken down into sub-test scores project school children were shown to have scored higher on six of the seven sub-tests. From this result above it appeared that after one year of exposure to PEIP Science project school children were better in the practice of process skills than children exposed to a traditional course in non-project schools.

When the total scores of Class Two project school boys were compared with the scores of Class Two non-project school boys, project school boys did not score significantly higher (α = .05). Class Two project school girls also did not score significantly higher total scores than Class Two non-project school girls (α = .05). Hypotheses Ho_4 and Ho_5 were hence accepted at the Class Two level.

When the total scores of Class Two project school boys and girls were compared, boys did not score significantly higher than the girls (α = .05). However, when the same

comparisons were made for Class Two boys and girls in non-project schools, the boys did score significantly higher than the girls ($\alpha = .05$). These results lead to the acceptance of hypothesis Ho_6 for project schools, and its rejection for non-project schools at the Class Two level.

The total scores of boys and girls in Classes One, Two and Three are shown on a graph (Fig. 4.16). With reference to Figure 4.16 it is apparent that project school girls and boys achieved the greatest increase in TOPS scores between beginning Class One and beginning Class Two. The increase in scores for the non-project school boys and girls was fairly constant from Class One to Three, while the rate of increase of scores of project school boys and girls began to drop off after Class Two began.

The breakdown of total scores into sub-test scores showed that project school girls scored highest of the groups of boys and girls in sub-tests three and four. They also attained the same score as project school boys on sub-test five. The skills which were involved in these sub-tests were measurement, observation, manipulation and experimentation. It is possible that project school girls made most improvement in these skills and this accounted for the more rapid increase in their scores. More study is clearly needed to investigate

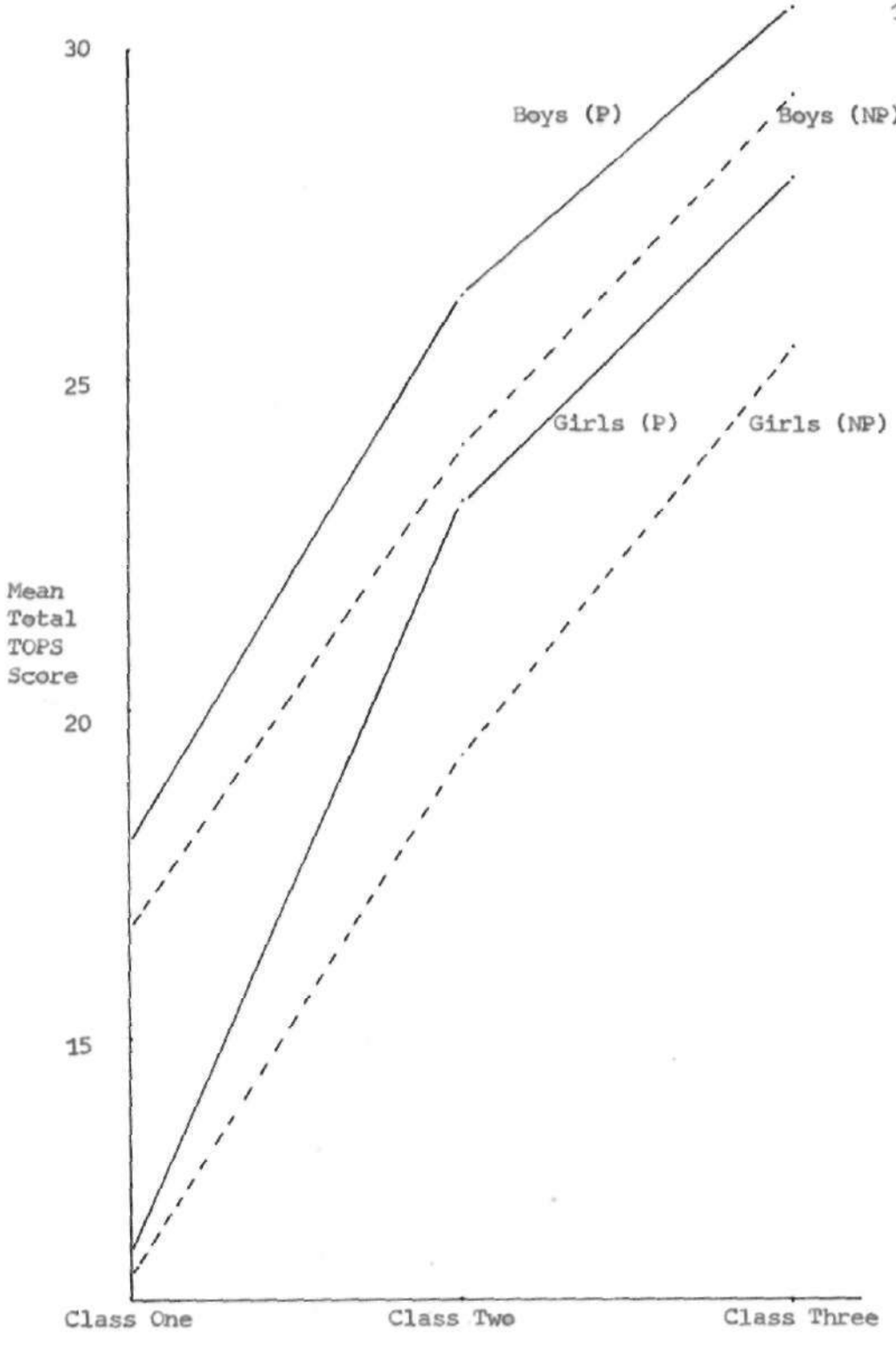


Fig. 4.16 — Mean TOPS Scores of Project (P) and Non-Project (NP) School Boys and Girls.

precisely which skills the children became better in.

(3) Results at the Class Three Level.

When the scores of Class Three project school children were compared with those of Class Three non-project school children, the results indicated that project school children did not score significantly higher total scores (α = .05). As a consequence hypothesis Ho_3 was accepted. Class Three project school boys did not score significantly higher total scores than Class Three non-project school boys. Also, when the scores of the two groups of girls were compared, Class Three project school girls did not score significantly higher total scores than Class Three non-project school girls (α = .05). Hypotheses Ho_4 and Ho_5 were hence accepted. Class Three project school boys did not attain significantly higher total scores than Class Three project school girls (α = .05). However, in the non-project schools Class Three boys did score significantly higher than Class Three girls (α = .05). As a consequence hypothesis Ho_6 was accepted for the project schools but rejected for the non-project schools at the Class Three level.

From the breakdown of total scores into sub-test scores no clear pattern emerged. However, project school boys scored highest of all the groups in four of the seven sub-tests, while

non-project school boys scored highest in only one sub-test. Project school girls scored highest in two of the sub-tests and non-project school girls did not score highest in any of the sub-tests. It appears that project school girls who made the most rapid progress up to the beginning of Class Two maintained their position up to the beginning of Class Three. More than any other group, project school girls seem to have improved the most during the two year period.

Chapter 5

SUMMARY, GENERALIZATIONS AND RECOMMENDATIONS

5.1 Introduction

The Primary Education Improvement Programme (Science) started in 1970 under the sponsorship of UNESCO and UNICEF. A small panel of writers based at the Institute of Education, A.B.U., Zaria, Nigeria began to produce materials in the form of teachers' guides, for the teaching of science in the primary school. The approach adopted was known as "a process approach" in which the emphasis was placed on teaching children the process skills used by the scientist when he attepmts to solve a problem e.g. observation, classification, inference, prediction etc. This approach had been recommended by the N.E.R.C. in 1971.

Trial materials were tested in local Zaria schools and in project schools distributed over a large area in the former Northern Region of Nigeria. After some rewriting, the final editions of the teachers' guide for the first two classes of the primary schools were published in 1975. Some formative evaluation of the materials had taken place during the writing

process but it was not as complete as was desirable, mainly because of staff shortages (Young, 1975:28-30).

In that no evaluation of the effect the programme was having on Nigerian children in the many schools which are now operating the PEIP, it was important to undertake this evaluation.

5.2 Summary of the Problem

This study took the form of a summative evaluation of specific aspects of the PEIP (Science). It was limited to evaluating the attainment of major programme objectives in the first two years of the primary school. Materials for the higher classes of the primary school were still being developed when this study was begun, and hence, they were not included in the evaluation.

The programme objectives for the first two years of the primary school were stated by the programme authors as specifically aiming at the children's practice of process skills (observation, classification, inference, prediction, etc.), encouraging children to ask questions about the world around them, and then actively involving them in seeking answers to those questions (Young, 1974:1).

In order to assess the attainment of the major programme

objectives, the study sought to find answers to the following questions;

1. Do children in PEIP schools perform significantly better than children in non-project schools on a test designed to measure their ability to practice process skills?

2. How successful do the teachers rate the programme in terms of;

a. children's interest in the lessons
b. children's practice of process skills
c. children's active participation in the lessons
d. children's understanding of the lessons
e. ease of preparation and implementation of the lessons for the teachers
f. availability of materials for teaching the lessons?

In an attempt to answer the following questions the following hypothes s were tested:

Ho_1 : The teachers of PEIP Classes One and Two will not have a positive attitude to the programme. This will be indicated by an overall mean response of less than or equal to 3, on a scale of 1-5 regarding the following criteria:

(i) children's interest

(ii) children's practice of process skills

(iii) children's active participation in the lessons

(iv) children's understanding of the lessons

(v) ease of preparation and implementation of the lessons

(vi) availability of materials for teaching the lessons.

Ho_2 : After one year's exposure to the programme, project school children will not perform significantly better in terms of total test scores than will children in non-project schools ($\alpha = .05$).

Ho_3 : After two year's exposure to the programme, project school children will not perform significantly better in terms of total process test scores than will children in non-project schools ($\alpha = .05$).

Ho_4 : Boys in project schools will not attain significantly higher total process test scores than will boys in non-project schools at the same level ($\alpha = .05$).

Ho_5 : Girls in project schools will not attain significantly higher total process test scores than will girls in non-project schools ($\alpha = .05$).

Ho_6 : Boys will not attain significantly higher total process test scores than will girls at the same

class level (α = .05),

(i) in project schools, and

(ii) in non-project schools.

3.3 Summary of Procedure

In order to test the hypotheses, two types of instruments were designed to collect data. These were:-

1. Opinionnaires for the teachers of PEIP Classes One and Two.
2. A process test for children in project schools as well as non-project schools.

In the opinionnaires, teachers were asked to respond to statements on ten randomly selected lessons from each of the teachers' guides. Statements were made for each of the lessons, corresponding to the six criteria in hypothesis Ho_1. The teachers who completed the opinionnaires were chosen from seven randomly selected centres where the PEIP operated. A maximum of 42 teachers was envisaged to complete each opinionnaire on the teachers' guides, making a total sample of 84 teachers. The opinionnaires were validated by a panel of judges before they were used.

Children who were tested with the process test were selected from four centres where the PEIP operated. The selection of centres was governed by the availability of personnel

proficient in the language of the area in which the test was administered. In each of the four centres, two project and two non-project schools were used. The selection of the project schools was random. The project schools were then paired with a non-project school considered to be equivalent in terms of buildings and other facilities. Children were tested in the first week of the school year in Classes One, Two and Three. There were twelve children tested in each class and, in all, 576 children were tested.

It was reasoned that since there was no formal selection system for children entering primary school, the children tested in Class One would not score significantly differently in project and non-project schools (a) within each centre and (b) across the whole sample of class one children. It was also assumed that the average ability of children to practice process skills would not differ significantly from one year to another over a few years.

Children beginning Class Two in the project schools had been exposed to PEIP for one complete year, while those beginning Class Three had been through two complete years of the programme. Their counterparts in non-project schools had been exposed to other science programmes produced by the Ministries of Education in the States, for the corresponding period of time. The children were tested in the local language by trained research assist-

ants. Evidence of test validity had been previously obtained by means of judges. Further evidence of validity and reliability was obtained from the results of the test.

5.4 Summary of the Results of Teacher Opinionnaires

Out of the expected response by 84 PEIP teachers, (42 for each of the opinionnaires) only 22 (52 percent) Class One and 26 (62 percent) Class Two teachers returned opinionnaires completed or partially completed. There were several reasons for this poor response.

1. Some teachers had recently been transferred to the PEIP schools and were not yet familiar with the programme.

2. Some of the schools had Grade II students doing their teaching practice in the classes and the regular teachers were difficult to locate.

3. Some teachers admitted that they did not teach science because (a) they did not feel competent to do so, and (b) the materials for it were not available.

The responses of the Class One teachers who completed the opinionnaires on Primary Science One were significantly above 3.0 (α = .05) towards all the six criteria being tested

in hypothesis Ho_1. The highest ratings were given to children's Practice of Process Skills, (4.07) and Children's Interest in the Lessons (4.06). The least highly rated were Ease of Preparation and Implementation of the Lessons (3.60) and Availability of Materials (3.83). Further analysis of the responses showed that the most successful lesson, out of the ten selected in Primary Science One, was Lesson 19 "Impressions in Clay". The least successful lesson was Lesson 16 "Mr. Sauna Observes Liquid Volume".

The responses of the teachers who completed the opinionnaire on Primary Science Two, were also significantly above 3.0 ($\alpha = .05$) towards the six criteria, although the ratings were not as high for Primary Science One. The teachers gave the highest ratings to Children's Interest in the Lessons (3.87). Least highly rated were again, Ease of Preparation and Implementation (3.53) and Availability of Materials (3.45). The most successful lesson out of those selected was Lesson 16, "Seed Germination" and the least successful was Lesson 24 "Air in A Bag".

The responses of teachers to both opinionnaires indicated that the objectives concerning the children, i.e. interest, practice of process skills, active participation and understanding were all being achieved to a fairly high level in both classes. Less highly rated were the ease of preparing

and teaching of lessons and availability of materials for the lessons.

5.5 Summary of the Process Test Results

The results of the process test were first used to establish test validity and reliability. Evidence of construct validity was obtained by comparing the children's sub-test and total scores with class level. Children in higher classes obtained significantly higher scores (α = .001), on all the sub-tests and in the total scores than children in the lower classes. Reliability of the test was established in two ways. Internal consistency was demonstrated by a value of reliability equal to 0.76 using Kuder-Richardson formula for the whole sample of children tested. Reliability was further established by significant correlations (α = .001) of sub-test and total scores with age and class level.

Analysis of the responses of children who were tested at the beginning of Class One showed that project school children did not score significantly higher total TOPS scores than non-project children, (a) within each centre, and (b) across the whole sample of Class One children. Boys however, scored significantly higher total scores than girls in both project and non-project schools (α = .05).

The analysis of the responses of children tested at the beginning of Class Two revealed that children in project schools scored significantly higher (α = .05) in their total scores than children in non-project schools. The general picture of the results was shown in Chapter 4. The breakdown of the total scores into sub-test scores showed that project school children scored higher on six of the seven sub-tests.

When allowances were made for sex differences and the scores of Class Two boys were compared, project school boys scored higher total scores than non-project school boys but the difference was not significant (α = .05). Class Two project school girls also scored higher total scores than non-project school girls but again the difference was not significant. Project school boys did not score significantly higher than project school girls but in the non-project schools, boys did score significantly higher than the girls (α = .05).

When the scores of children tested at the beginning of Class Three were compared project school children did not score significantly higher total scores than non-project school children. Project school boys also did not score significantly higher than non-project school boys, nor did project school girls score significantly higher than their counterparts in non-project schools. The boys in non-project schools scored significantly higher than girls, but in the project schools, boys did not score significantly higher, at the Class Three level (see

Figure 4.16, p.188). It was clearly shown that girls during their first year of PEIP Science made the most rapid improvement, although their rate of improvement dropped off during the second year. The scores of the boys in the PEIP schools followed the same pattern as the girls and their increase in scores also dropped off during the second year. The scores of the non-project boys and girls both improved steadily throughout the two years, in an almost linear fashion. During the first year, their scores improved less than the scores of children in project schools, but during the second year they improved more.

It is only possible here, to suggest possible explanations for these results. One possibility is that, in the first year, children in project schools due to extra exposure to activities involving process skills, became more competent in these skills than their counterparts in non-project schools. During the second year, the children in project schools may have made less rapid progress because of lack of materials and/or because their teachers were finding it increasingly difficult to prepare and teach lessons for which they had received little training. The refusal of some of the teachers to complete the opinionnaires because they had received little or no training for the PEIP seemed to confirm this possibility. Another explanation might have been that the children in project schools reached a plateau of learning in the practice of these process skills. Because

of additional practice in these skills project school children may have reached a plateau earlier than children in non-project schools. Such plateaus are expected in the learning of psychomotor skills and are sometimes associated with changes from a lower to a higher order learning (Hilgard et al., 1971:211), although it was not possible in this study to identify what these stages might have been. Further research along the lines described by Price-Williams (1969:201-210) might help clarify what these stages were. It was also not possible in this study to thoroughly investigate the reasons why project school children improved less during their second year of PEIP. It is intended that further study will be carried out on this subject in the future.

5.6 Generalisations

The teachers who completed the opinionnaires were those who were actually teaching the PEIP Science and they rated the programme as highly successful in terms of children's interest, practice of process skills, active participation and understanding. They considered the programme as less successful in terms of the preparation and teaching of the lessons and the availability of materials. A large number of teachers, however, did not complete the opinionnaires because they said they were not teaching science. This they explained was due to a feeling of incompetence with regard to science and because materials for

teaching science were not available. This information from the teachers indicated that PEIP *Science* was a potentially successful programme but full success was limited by the lack of properly trained teachers and an inadequate supply of science materials. The situation was made worse by the frequent transfer of trained PEIP teachers to non-PEIP schools, and their replacements by teachers with no knowledge of the PEIP methods and materials. (Institute of Education, 1976:30).

The process test performance of the children showed that, after one year of exposure to the PEIP, children in project schools performed significantly better than children in non-project schools. After two years, however, the difference between the two groups was no longer significant, although project school children still scored higher. Girls in project schools seemed to benefit most from the programme, particularly in the first year, Whereas, in non-project schools, boys scored significantly higher in their total TOPS scores than girls, in project schools this difference was not significant.

The test results showed that in spite of the difficulties pointed out by the teachers, the science component of the PEIP was to a limited extent attaining its objectives. It may be concluded that with a properly organised system of teacher training and an improved supply of science materials to the schools, the programme would be highly successful in teaching the practice

of process skills to Class One and Two children.

5.7 Recommendations

The PEIP is now operating in eleven states in Nigeria in well over 1000 primary schools. It has proved itself to be the most widely accepted curriculum project in recent years for primary schools in Nigeria. The project will most probably continue to expand into more schools and some states are reported to be considering adopting the PEIP for all their schools as has happened in Rivers State. The science component of the PEIP has been evaluated in this report to some extent and it has been shown to be achieving some success limited by (1) the lack of properly trained teachers, (2) the constant transfer of PEIP teachers (Institute of Education, 1976:30) and (3) an inadequate supply of science materials. The recommendations made here, chiefly concerned overcoming these three limitations by improving relationships with State Ministries, Grade II Colleges and Local Education Authorities, as well as establishing closer ties with the Advanced Teachers Colleges and the University Faculties of Education. A chart showing how links between the Institute of Education and these institutions could be organised is shown in Figure 5.01.

The withdrawal of the UNICEF from the PEIP in 1978 means that the Institute of Education will have to rely on the

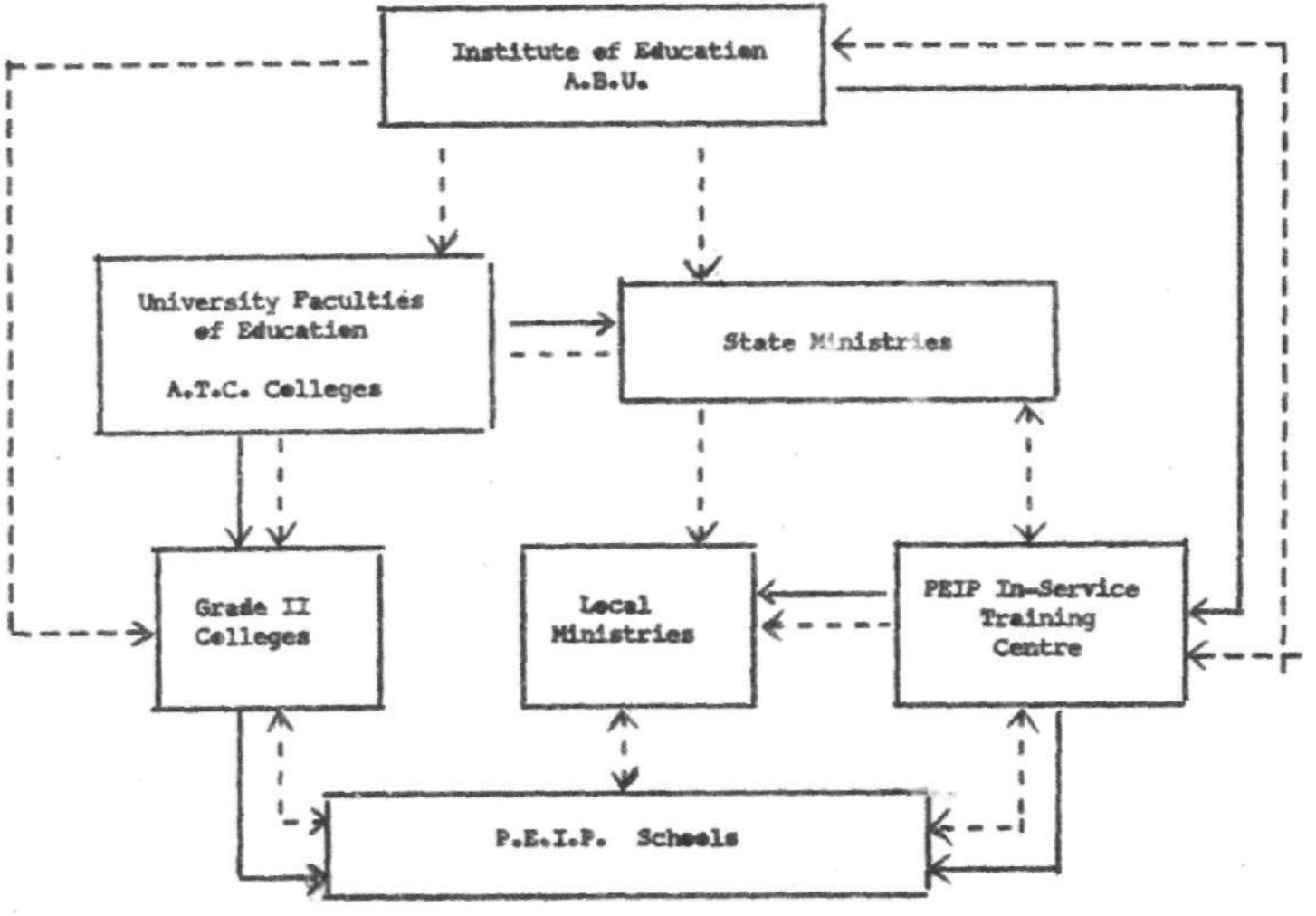


Fig. 5.01 — Plan for dissemination of information and training of PEIP teachers.

——— Direction of training
- - - Direction of information

State Governments for the financial support needed to successfully expand and implement the project. In some states, the grants to the PEIP have been quite generous while in others, they have been insufficient or non-existent. A more active dissemination of information directed at the Ministries is essential to achieve better financing of the PEIP. As it is at present, some Ministry Officials know very little about the project and as a result tend to neglect it when it comes to the yearly budget. The Institute of Education could work through the PEIP State Coordinators to keep the Ministries informed and up to date on the latest project developments.

The new Federal Grade II Syllabus written in 1974 makes specific mention of the PEIP and gives a brief explanation of the process approach (Federal Ministry of Education, 1974:410). The Grade II Science examination based on this new syllabus is currently set by the Institute of Education in collaboration with the State Ministries. Since the PEIP is a fairly recent development, many science tutors in Grade II Colleges know little or nothing about the project. It would, therefore, seem to be the ideal time for setting up of conferences and workshops on the new syllabus for these tutors who could be informed at the same time about the approach adopted by the PEIP. With sufficient information and training the tutors would be able to help train their students and inform them about what

the project was trying to achieve. In order to ensure that the future population of Grade II science tutors be well informed about the PEIP, closer ties should be formed with the Advanced Teachers Colleges and the University Faculties of Education. After all, it is in these institutions that Grade II Science tutors are trained, and it is only through the Grade II Colleges that PEIP teachers can be trained properly and in sufficient numbers. It is therefore, recommended that the Institute of Education organise a workshop to inform the science specialists in the Advanced Teachers Colleges and the Faculties of Education of the Universities about the PEIP. During such a workshop, the staff members attending could familiarise themselves with the materials, the approach adopted, and the problems being encountered by the project. They would then be in a better position to prepare their students, many of who are likely to be posted to Grade II Colleges, after graduation.

Since it takes 3-5 years to train a teacher in a Grade II College, there is a need for an improved short term plan to provide in-service training for the teachers recently qualified or already in the field. Some states that have shown interest in the project have already set up their own PEIP In-Service Training Centres, consisting of classrooms, offices and store rooms. It is strongly recommended that all the states in which the PEIP is operating adopt this same plan. Courses could then

be organised for new MTTs and project school teachers in each state on a regular basis. The course of the MTTs could resemble the one year Infant Methods Course already being run for the teachers in the higher classes of the primary school. The training of the new project school teachers could be for a shorter period of a few months only so that several groups could be trained within a year. If the states would consider primary school teachers specialising in only one subject, as is now the case in Kano State, a shorter period of training might be envisaged. The centre could also be used to familiarise the staff of Local Education Authorities about the project, many of whom have, up to the present time, not much understanding of what is going on in PEIP schools. Some states have been posting MTTs to the L.E.A. offices and this practice has helped to improve relationships, mutual understanding, and reduced the rate of transfer of PEIP teachers to non-PEIP schools.

The supply of materials for the PEIP schools, which has posed a problem in most states, could be carried out through the state PEIP In-Service Centres. Materials could be supplied to the schools by the centre which would operate as a centralised purchasing unit. The centre could arrange with the MTTs and the L.E.As. for the annual distribution of the required materials to the schools. This would stop individual teachers having to ask for money from the LEAs for the purchase of materials locally.

It is believed that if the foregoing recommendations were implemented the science component of the PEIP would be more successful in achieving its programme objectives.

The evaluation described in this report has given rise to possibilities for further study, and some of them are discussed here. In the Primary Education Imporvement Programme, the first specifically oriented process approach to the teaching of science in Nigerian primary schools was developed. The evaluation of that programme, described in this report, involved the design of a testing instrument to measure the attainment by the children of process skills. The Test of Process Skills (TOPS), developed over a period of two years (1975-1977), was the first known test of its kind to be used in Nigeria. The TOPS was designed for use in the lower classes of the primary school but it could, with adaptations, almost certainly be used in the higher classes. It could also serve as a basic model for the design of new tests of this type. This report described an evaluation of the attainment of PEIP Science objectives in the first two years of the primary school in the opinions of the PEIP teachers and through testing changes in children's behaviour. Further studies now need to be carried out with reference to the higher classes of the primary school in order to extend the present evaluation, and make it more comprehensive. Other evaluational strategies might be developed to measure changes in the teachers' attitudes,

methods of teaching and views on the nature of science attributable to using the PEIP approach. Ways of assessing student-teacher interactions, which would cause little disturbance to the normal classroom environment, might also be investigated. It would be interesting to know whether the PEIP approach caused changes in the pattern of these interactions.

This study raised some questions which will need further study before any definite answers can be found. It was observed that the children's scores on the TOPS increased with age up to nine years. Between the ages of nine and ten the scores remained fairly static after which they increased once more (Figure 4.13, p.163). It was suggested in the discussion that the children might be passing from a stage of lower order learning (pre-operational) to a higher order of learning (concrete-operational). If some Piagetian type tasks were chosen for the children to perform, it should be possible to obtain more information about the stages the children have reached at these age levels. It might also be possible to investigate whether children exposed to a process approach curriculum pass through these stages at the same age as those children exposed to other types of primary science curricula.

In this study, the scores of children in PEIP schools were compared with those of children following more traditional and to some extent out-dated Ministry Schemes of work. A study

could be made in which children taught under the PEIP were compared with those taught under MPSP. Both of these programmes have been recently developed, and although their approaches to the teaching of science are different, it would be interesting to compare the performance of children taught under each, in problem solving situations. The weaknesses and strengths of the two programmes might then be more apparent.

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APPENDIX A

TABLES ON TEACHERS' OPINIONNAIRES

Table 1

Teachers' Responses Concerning Children's Interest in the Lessons (Primary Science One)

Teacher Number	Lesson Numbers										Mean Lesson Response
	9	12	13	14	15	16	19	21	23	25	
1	5	4	2	5	4	2	5	4	4	5	4.00
2	3	4	4	4	X	4	5	X	4	X	4.00
3	5	4	4	2	2	3	4	4	5	2	3.50
4	5	4	5	5	5	5	5	5	5	4	4.80
5	4	2	4	4	5	2	4	4	2	5	3.60
6	X	X	X	X	X	X	X	X	X	X	X
7	2	4	4	4	4	4	4	4	4	4	3.80
8	3	X	4	5	3	4	5	4	5	3	4.00
9	4	4	2	4	4	2	4	4	2	2	3.20
10	4	4	3	4	4	4	1	5	4	4	3.70
11	5	4	4	5	5	4	2	5	3	4	4.10
12	1	5	5	5	5	5	5	5	1	5	4.20
13	4	4	4	4	3	5	4	5	2	4	3.90
14	2	X	X	X	X	X	X	X	5	X	3.50
15	5	4	4	4	4	4	5	4	5	5	4.40
16	4	4	5	5	5	4	5	5	5	X	4.67
17	5	5	4	5	4	4	4	4	4	4	4.30
18	4	4	4	X	4	4	4	X	X	X	4.00
19	4	4	4	4	4	3	4	X	4	X	3.88
20	5	4	4	5	5	4	5	5	4	5	4.60
21	X	X	X	X	5	5	5	X	X	X	5.00
22	4	5	5	5	X	X	X	X	X	X	4.75
Mean Teacher Response	3.90	4.06	3.95	4.39	4.17	3.79	4.21	4.47	3.78	4.00	

Table 2

Teachers' Responses Concerning Children's Practice of Process Skills (Primary Science One)

Teacher Number	Lesson Numbers										Mean Lesson Response
	9	12	13	14	15	16	19	21	23	25	
1	5	4	2	5	5	4	5	5	4	5	4.40
2	3	5	5	4	X	4	4	X	4	X	4.14
3	4	2	4	2	2	2	4	4	2	2	2.80
4	2	5	5	5	5	4	4	5	2	5	4.20
5	4	4	4	4	4	2	4	4	2	5	3.70
6	4	4	X	X	4	X	X	X	X	X	4.00
7	4	4	4	2	4	4	4	4	4	4	3.80
8	4	5	5	4	4	5	5	4	5	2	4.30
9	4	5	4	4	5	4	5	4	4	4	4.30
10	4	3	2	4	5	4	4	4	5	4	3.90
11	4	5	4	4	4	5	4	4	4	4	4.20
12	5	5	5	5	5	5	5	5	4	5	4.90
13	4	4	4	4	2	4	4	5	4	4	3.90
14	4	X	X	X	X	X	X	X	1	X	2.50
15	4	4	4	4	4	4	4	4	4	4	4.00
16	4	4	4	4	5	4	5	5	4	X	4.33
17	4	5	4	4	4	4	4	4	4	4	4.10
18	4	4	4	2	4	2	4	X	X	X	3.43
19	3	3	4	X	5	4	4	X	4	X	3.86
20	5	5	5	5	5	5	4	4	5	4	4.70
21	X	X	X	X	5	4	4	X	X	X	4.33
22	5	5	5	5	X	X	X	X	X	X	5.00
Mean Teacher Response	4.00	4.25	4.11	3.94	4.26	3.89	4.26	4.33	3.66	4.00	

Table 3

Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science One)

Teacher Number	Lesson Numbers										Mean Lesson Response
	9	12	13	14	15	16	19	21	23	25	
1	4	4	4	4	4	4	5	4	4	4	4.10
2	3	4	X	4	X	X	5	X	4	X	4.00
3	4	1	4	2	2	2	4	4	3	2	2.80
4	4	4	5	1	4	4	5	4	2	4	3.70
5	4	2	4	4	5	4	4	4	2	4	3.70
6	X	X	X	4	X	X	X	4	4	X	4.00
7	4	4	4	2	4	4	4	4	4	4	3.80
8	X	4	4	5	4	5	5	5	2	4	4.22
9	4	3	4	4	4	4	4	4	4	4	3.90
10	3	1	5	5	4	4	X	4	5	5	4.00
11	4	3	4	3	5	5	4	4	4	4	4.00
12	5	5	5	5	5	4	5	5	5	5	4.90
13	4	3	4	4	2	4	4	5	4	4	3.80
14	4	X	X	X	X	X	X	X	5	X	4.50
15	4	4	4	4	4	4	4	2	4	4	3.80
16	4	4	5	4	4	4	5	4	X	X	4.25
17	4	4	4	4	4	4	4	4	4	4	4.00
18	2	4	2	2	4	1	4	X	X	X	2.71
19	4	3	5	3	4	3	4	X	4	X	3.88
20	4	4	4	4	4	5	4	5	4	4	4.20
21	X	X	X	X	5	4	4	X	X	X	4.33
22	4	4	5	4	X	X	X	X	X	X	4.25
Mean Teacher Response	3.84	3.42	4.22	3.60	4.00	3.83	4.33	4.13	3.78	4.00	

Table 4

Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science One)

Teacher Number	Lesson Numbers										Mean Lesson Response
	9	12	13	14	15	16	19	21	23	25	
1	4	2	4	4	4	3	4	4	4	4	3.70
2	5	5	4	4	X	5	4	X	4	X	4.43
3	1	4	2	2	4	4	2	4	4	2	2.90
4	2	5	4	5	4	2	4	5	4	4	3.90
5	4	4	4	4	4	4	4	4	2	4	3.80
6	X	X	X	X	X	4	4	X	X	4	4.00
7	4	4	4	2	4	4	4	4	4	4	3.80
8	4	4	4	5	4	4	5	1	4	4	3.90
9	4	4	4	4	4	3	5	2	2	2	3.40
10	4	5	1	4	4	2	5	2	4	3	3.40
11	4	2	4	4	4	4	5	4	4	4	3.90
12	5	5	5	5	5	5	5	5	5	5	5.00
13	4	4	X	4	2	4	4	4	4	4	3.78
14	4	X	X	X	X	X	X	X	4	X	4.00
15	4	4	4	4	4	4	4	4	3	4	3.90
16	4	X	5	4	5	4	5	4	4	X	4.38
17	5	4	4	4	4	4	4	4	4	4	4.10
18	2	4	4	1	3	2	4	X	X	X	2.86
19	4	3	2	3	4	1	4	X	3	X	3.00
20	4	4	4	4	4	4	4	4	4	5	4.10
21	X	X	X	X	5	5	4	X	X	X	4.67
22	5	5	5	5	X	X	X	X	X	X	5.00
Mean Teacher Response	3.85	4.00	3.78	3.79	4.00	3.60	4.20	3.67	3.72	3.80	

Table 5

Teachers' Responses Concerning Ease of Preparation and Implementation of Lessons (Primary Science One)

Teacher Number	Lesson Numbers										Mean Lesson Response
	9	12	13	14	15	16	19	21	23	25	
1	4	2	2	4	1	2	4	5	4	4	3.20
2	3	4	X	4	X	5	4	X	4	X	4.00
3	5	5	2	2	2	4	4	5	3	2	3.40
4	2	5	5	5	4	4	4	5	4	4	4.20
5	4	3	2	X	5	3	5	4	5	4	3.89
6	X	X	X	X	X	X	X	X	X	X	X
7	4	4	2	4	2	2	4	2	2	4	3.00
8	4	X	3	4	1	5	5	X	3	1	3.25
9	4	2	2	4	2	2	4	2	2	2	2.60
10	5	2	1	2	1	1	4	3	3	3	2.50
11	4	4	3	4	4	3	4	3	3	2	3.40
12	4	5	1	5	5	5	5	4	4	5	4.30
13	4	4	4	4	2	5	4	4	4	4	3.90
14	4	X	X	X	X	X	X	X	4	X	4.00
15	4	4	4	4	4	3	4	3	4	4	3.80
16	4	4	1	5	4	4	4	4	4	X	3.78
17	4	4	4	5	4	4	4	4	4	4	4.10
18	4	4	3	2	2	5	4	X	X	X	3.43
19	4	3	4	4	1	1	2	X	4	X	2.88
20	5	4	4	4	5	5	4	4	4	4	4.30
21	X	X	X	X	5	5	4	X	X	X	4.67
22	5	5	5	4	X	X	X	X	X	X	4.75
Mean Teacher Response	4.05	3.78	2.89	3.89	3.00	3.58	4.05	3.71	3.61	3.36	

Table 6

Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science One)

Teacher Number	Lesson Numbers										Mean Lesson Response
	9	12	13	14	15	16	19	21	23	25	
1	4	5	4	4	4	2	5	2	5	4	3.90
2	3	5	5	5	X	5	4	X	4	X	4.43
3	5	1	4	4	2	2	4	2	3	2	2.90
4	5	5	5	5	4	5	4	2	4	4	4.30
5	4	1	5	4	5	2	5	4	2	4	3.60
6	X	X	X	X	X	X	X	X	X	X	X
7	4	4	4	4	2	2	2	2	2	4	3.00
8	4	X	5	5	5	4	4	3	5	4	4.33
9	5	4	5	4	5	4	5	4	4	4	4.40
10	2	5	4	4	3	3	3	4	4	4	3.60
11	5	5	4	4	4	4	2	2	2	4	3.60
12	5	5	4	5	5	5	5	5	4	5	4.80
13	4	4	4	4	1	4	3	4	4	4	3.60
14	4	X	X	X	X	X	X	X	4	X	4.00
15	4	4	4	4	4	4	2	2	4	4	3.60
16	5	4	5	5	4	4	4	2	4	X	4.11
17	4	4	4	5	4	4	4	4	4	4	4.10
18	4	2	2	2	4	2	4	X	X	X	2.86
19	3	1	4	4	4	2	2	X	X	X	2.86
20	4	4	5	4	4	4	5	2	5	5	4.20
21	X	X	X	X	5	4	3	X	X	X	4.00
22	4	5	5	5	X	X	X	X	X	X	4.75
Mean Teacher Response	4.10	3.78	4.32	4.26	3.83	3.47	3.68	2.93	3.76	4.00	

Table 7

Teachers' Responses Concerning Children's Interest in the Lessons (Primary Science Two)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
23	4	4	5	3	5	3	5	2	4	2	3.70
24	5	4	5	4	4	4	5	5	5	3	4.40
25	4	X	X	X	X	5	5	X	X	X	4.67
26	5	4	5	4	5	4	3	5	X	4	4.33
27	4	3	4	4	4	3	3	3	4	3	3.50
28	4	4	4	2	4	2	4	4	4	2	3.40
29	4	4	2	4	4	4	4	4	4	4	3.80
30	4	4	2	X	4	4	4	2	3	2	3.22
31	4	5	4	5	4	1	4	4	5	4	4.00
32	4	X	5	X	4	4	5	X	X	X	4.40
33	4	X	5	4	5	4	4	X	X	X	4.33
34	X	X	X	5	5	4	4	5	5	4	4.57
35	4	5	1	4	4	5	1	4	2	2	3.20
36	4	X	4	5	3	4	5	X	4	1	3.75
37	4	X	5	4	4	5	5	X	4	X	4.43
38	4	4	5	4	5	5	5	4	5	3	4.40
39	4	3	3	3	4	4	3	4	X	X	3.50
40	4	2	4	X	5	X	X	2	3	X	3.33
41	1	2	X	X	X	2	2	X	1	X	1.60

Table 7 (cont'd)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
42	4	5	4	4	4	5	4	4	4	4	4.20
43	5	5	5	X	2	5	5	5	4	4	4.44
44	4	3	4	3	4	4	5	2	5	4	3.80
45	4	4	4	4	4	4	2	3	4	5	3.80
46	4	4	3	4	4	5	3	2	4	3	3.60
47	4	5	4	4	4	5	4	4	4	4	4.20
48	5	4	X	4	5	2	5	X	4	4	4.14
Mean Teacher Response	4.04	3.90	3.95	3.90	4.17	3.88	3.96	3.58	3.90	3.26	

Table 8

Teachers' Responses Concerning Children's Practice of Process Skills (Primary Science Two)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
23	4	4	4	4	2	4	5	3	4	5	3.90
24	4	4	4	3	4	3	5	4	5	4	4.00
25	5	X	X	4	X	5	4	X	X	X	4.50
26	X	5	5	5	5	4	5	2	5	2	4.22
27	4	4	4	4	3	3	4	3	4	3	3.60
28	4	4	4	4	4	2	4	4	4	2	3.60
29	4	4	4	4	4	4	4	4	4	2	3.80
30	4	4	3	4	3	2	4	2	3	3	3.20
31	4	5	4	4	5	4	5	4	4	1	4.00
32	4	X	4	2	5	4	5	X	X	X	4.00
33	4	X	4	4	5	5	4	X	X	X	4.33
34	X	X	X	4	5	4	4	5	4	5	4.43
35	4	4	1	4	1	1	1	3	1	5	2.50
36	X	X	2	4	2	4	4	X	5	1	3.14
37	3	X	4	4	2	3	4	X	4	X	3.43
38	5	5	4	5	2	4	5	2	5	4	4.10
39	4	4	4	4	4	4	3	4	X	X	3.88
40	4	3	X	X	4	X	X	3	3	X	3.40
41	1	4	X	4	X	4	4	X	5	X	3.67

Table 8 (cont'd)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
42	4	4	4	4	4	4	4	4	5	4	3.67
43	5	5	4	4	2	4	4	4	4	4	4.00
44	4	4	5	4	5	4	5	3	2	4	4.00
45	2	5	4	4	4	4	2	2	2	2	3.10
46	3	3	2	4	4	4	2	2	4	4	3.20
47	4	4	4	4	4	4	4	4	4	4	4.00
48	4	4	X	4	5	5	4	X	4	4	4.25
Mean Teacher Response	3.83	4.15	3.71	3.96	3.67	3.72	3.96	3.26	3.68	3.32	

Table 9

Teachers' Responses Concerning Children's Active Participation in the Lessons (Primary Science Two)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
23	2	4	5	4	4	4	4	4	5	4	4.00
24	5	3	4	4	4	4	4	4	4	3	3.90
25	3	X	X	5	X	5	4	X	X	X	4.25
26	2	5	4	5	5	5	3	4	5	1	3.90
27	2	4	4	4	4	3	4	3	4	3	3.50
28	2	4	4	2	4	2	4	4	4	2	3.20
29	4	4	2	4	4	4	3	2	4	2	3.30
30	4	2	4	4	4	2	4	2	X	3	3.28
31	4	5	5	5	4	4	5	4	4	4	4.40
32	2	X	5	2	4	4	4	X	X	X	3.50
33	2	X	5	5	5	4	4	X	X	X	4.17
34	X	X	X	5	4	4	5	5	5	5	4.71
35	2	4	4	1	X	2	2	2	3	4	2.67
36	5	X	4	5	4	4	4	X	4	1	3.88
37	3	X	4	5	5	4	X	X	4	X	4.17
38	5	4	3	5	4	4	4	4	4	3	4.00
39	3	4	4	4	4	4	4	4	X	X	3.88
40	2	3	X	X	1	X	X	1	5	X	2.40
41	4	4	X	4	4	4	5	X	1	X	3.71

Table 9 (cont'd)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
42	5	4	4	4	4	4	4	4	4	4	4.10
43	5	4	5	4	5	4	4	5	4	4	4.40
44	5	2	5	3	5	4	4	3	5	4	4.00
45	2	4	4	4	X	4	2	2	1	2	3.11
46	4	4	3	4	3	4	2	3	4	2	3.30
47	5	4	4	4	4	4	4	4	4	4	4.10
48	4	4	X	2	4	2	5	X	4	4	3.63
Mean Teacher Response	3.44	3.80	4.10	3.92	4.04	3.72	3.83	3.37	4.05	3.11	

Table 10

Teachers' Responses Concerning Children's Understanding of the Lessons (Primary Science Two)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
23	4	2	5	3	4	2	4	2	4	2	3.20
24	4	4	5	4	5	3	4	4	5	3	4.10
25	5	X	X	4	X	5	4	X	X	X	4.50
26	5	5	5	X	5	4	4	4	4	3	4.33
27	4	4	4	4	3	4	4	3	4	3	3.70
28	4	4	4	4	4	2	4	4	4	2	3.60
29	5	4	4	4	5	2	2	4	X	1	3.44
30	4	3	3	4	3	2	4	2	2	2	2.90
31	1	4	4	4	4	4	4	4	5	2	3.60
32	4	X	5	4	4	3	4	X	X	X	4.00
33	4	X	4	4	4	4	4	X	X	X	4.00
34	X	X	X	5	4	5	2	5	5	5	4.43
35	4	1	1	X	4	1	1	3	1	2	2.00
36	4	X	3	4	4	4	4	X	4	3	3.75
37	4	X	3	4	5	4	4	X	4	X	4.00
38	3	4	4	5	4	5	4	3	4	3	3.90
39	4	3	4	4	4	3	4	3	4	X	3.67
40	4	4	X	X	2	X	X	2	5	X	3.40
41	1	4	X	4	X	4	4	X	X	X	3.40

Table 10 (cont'd)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
42	5	4	4	4	4	4	4	4	4	4	4.10
43	4	2	5	3	4	X	4	4	4	4	3.33
44	4	3	4	3	4	4	4	2	4	5	3.70
45	5	4	4	5	4	4	2	3	4	4	3.90
46	4	3	4	4	4	4	3	3	3	4	3.60
47	5	4	4	4	4	4	4	4	4	4	4.10
48	4	4	X	4	4	4	5	X	4	4	4.13
Mean Teacher Response	3.96	3.50	3.95	4.00	4.00	3.54	3.64	3.32	3.90	3.16	

Table 11

Teachers' Responses Concerning Ease of Preparation and Implementation of Lessons (Primary Science Two)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
23	4	5	5	4	4	4	5	X	4	2	4.11
24	1	4	3	4	5	4	4	X	4	4	3.67
25	4	X	X	2	X	4	5	X	X	X	3.75
26	1	1	2	4	2	4	5	X	4	2	2.78
27	3	4	4	2	3	3	4	3	4	3	3.30
28	2	4	4	4	4	2	4	X	2	2	3.10
29	5	4	2	4	4	5	2	X	4	4	3.78
30	2	2	3	4	3	2	4	X	2	2	2.67
31	2	4	1	5	5	4	4	X	4	4	3.67
32	4	X	4	5	3	2	4	X	X	X	3.67
33	2	X	4	2	4	4	4	X	X	X	3.33
34	X	X	X	2	4	4	5	X	5	4	4.00
35	5	4	1	2	X	2	4	X	5	4	3.38
36	1	X	2	5	2	4	4	X	2	1	2.63
37	4	X	4	3	3	2	4	X	3	X	3.29
38	5	5	3	5	5	4	4	X	4	2	3.89
39	2	4	4	3	4	4	3	X	X	X	3.43
40	5	5	X	X	4	X	X	X	2	X	4.00

Table 11 (cont'd)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
41	4	4	X	2	X	4	5	X	3	X	3.67
42	5	4	3	5	4	4	4	X	4	4	4.11
43	4	5	4	4	5	4	2	X	2	4	3.78
44	4	2	4	4	4	4	4	X	4	4	3.78
45	4	4	2	4	4	4	4	X	4	2	3.56
46	4	4	2	4	4	4	4	X	4	2	3.56
47	5	4	2	5	4	4	4	X	4	4	4.00
48	4	4	1	2	4	4	4	1	2	2	2.80
Mean Teacher Response	3.44	3.85	2.91	3.60	3.83	3.60	4.00	—	3.45	2.95	

Table 12

Teachers' Responses Concerning Availability of Materials for the Lessons (Primary Science Two)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
23	5	5	5	2	5	4	4	X	5	5	4.44
24	3	4	4	3	4	3	4	4	4	2	3.50
25	4	X	X	3	X	2	4	X	X	X	3.25
26	4	2	5	3	4	5	1	4	4	5	3.70
27	3	4	4	4	4	3	4	3	4	3	3.60
28	4	4	4	4	2	2	4	4	2	2	3.20
29	4	2	4	4	4	1	2	2	4	2	2.90
30	4	4	2	2	2	2	X	2	4	2	2.67
31	4	4	4	5	4	4	4	4	4	4	4.10
32	2	3	X	1	2	2	4	X	X	X	2.33
33	3	X	5	5	5	2	4	X	X	X	4.00
34	X	X	X	5	4	4	4	5	5	5	4.57
35	4	1	2	4	4	4	4	2	5	4	3.40
36	4	X	1	4	2	4	4	X	5	1	3.13
37	4	X	5	2	1	4	3	X	3	X	3.14
38	4	4	5	4	5	4	4	4	5	2	4.10
39	4	4	3	4	3	4	4	4	X	X	3.75
40	2	5	X	X	1	X	X	X	5	X	3.25

Table 12 (cont'd)

Teacher Number	Lesson Numbers										Mean Lesson Response
	3	7	9	11	12	14	16	18	20	24	
41	1	2	X	4	X	2	5	X	3	X	2.83
42	4	4	3	4	1	4	4	4	5	4	3.70
43	4	4	4	X	1	4	4	X	2	4	3.38
44	4	3	4	4	3	2	5	3	4	4	3.60
45	4	2	4	4	2	4	2	X	4	2	3.11
46	X	4	2	2	4	3	2	X	2	2	2.63
47	4	4	3	4	1	4	4	X	4	4	3.56
48	2	4	X	4	2	2	5	X	4	2	3.13
Mean Teacher Response	3.54	3.48	3.65	3.54	2.92	3.16	3.71	3.46	3.95	3.11	

APPENDIX B

INTRODUCTION TO TEACHER OPINIONNAIRES ON PRIMARY SCIENCE ONE AND TWO

As you are aware attempts are being made to evaluate all of the materials being used in the Primary Education Improvement Programme. These opinionnaires on Primary Science One and Two will help to assess the success or failure of these materials. We would appreciate your co-operation in filling in these opinionnaires.

Selected chapters or lessons from each of the books have been chosen. You are to respond to each of the statements by circling one of the numbers 1, 2, 3, 4, and 5. The numbers correspond to the following:

1 = Strongly Disagree

2 = Disagree

3 = Undecided

4 = Agree

5 = Strongly Agree

If you cannot remember some of the lessons you can consult the Primary Science Books I and II to remind yourself of these lessons.

Please return the completed opinionnaires to the research assistant before he returns to Zaria.

By completing these opinionnaires you will be helping both the writers in the Institute of Education and all those interested in the Primary Science Improvement Programme.

Thank you for your co-operation.

D. P. Brown
(Lecturer in Science Education)
Department of Education, A.B.U. Zaria

APPENDIX 2

Teachers' Opinionnaire on Primary Science One

Lesson 9 - Another look at the school compound

	SD	D	U	A	SA
1. At the end of the lesson the pupils understood the words right, left, near, far, under and above.	1	2	3	4	5
2. Outside the class the pupils observed objects and their positions relative to one another.	1	2	3	4	5
3. The objects to be observed were available outside the classroom.	1	2	3	4	5
4. The lesson was easy to prepare and teach.	1	2	3	4	5
5. The pupils made observations and described the positions of objects.	1	2	3	4	5
6. The pupils did not show interest in this lesson.	1	2	3	4	5

Lesson 12 - Colour and Size

1. After this lesson the pupils were able to use the two properties colour and size.	1	2	3	4	5
2. The pupils sorted and counted the buttons.	1	2	3	4	5
3. Buttons of different sizes and colours, together with match boxes, were available for this lesson.	1	2	3	4	5
4. This lesson was difficult to prepare and teach.	1	2	3	4	5

	SD	D	U	A	SA
5. The pupils were involved describing the different combinations of buttons.	1	2	3	4	5
6. This lesson was interesting to the pupils.	1	2	3	4	5

Lesson 13 - Grab Bag

1. At the end of this lesson the pupils could compare different objects on the basis of their properties colour and size.	1	2	3	4	5
2. The pupils observed their buttons in order to match the teacher's buttons.	1	2	3	4	5
3. Buttons of different sizes and colours were available for the lesson.	1	2	3	4	5
4. The game 'grab bag' was difficult to prepare and to teach.	1	2	3	4	5
5. The pupils played the grab bag game with the teacher.	1	2	3	4	5
6. This lesson was successful.	1	2	3	4	5

Lesson 14 - Mr. Sauna observes a burning candle

1. At the end of the lesson the pupils had learned some of the properties of a burning candle.	1	2	3	4	5
2. The pupils experimented with a burning candle.	1	2	3	4	5
3. The necessary apparatus for this lesson was not available.	1	2	3	4	5
4. This lesson was easy to prepare and teach.	1	2	3	4	5

	SD	D	U	A	SA
5. The pupils observed the burning candle and listed its properties.	1	2	3	4	5
6. This lesson was interesting to the pupils.	1	2	3	4	5

Lesson 15 - Mr. Sauna observes change

1. At the end of the lesson the pupils understood the word 'change'.	1	2	3	4	5
2. The pupils observed changes in the balloon during the lesson.	1	2	3	4	5
3. The necessary apparatus was available for the experiment in this lesson.	1	2	3	4	5
4. The experiment was easy to prepare and to perform.	1	2	3	4	5
5. The pupils observed and described the changes in the balloon.	1	2	3	4	5
6. This lesson was successful.	1	2	3	4	5

Lesson 16 - Mr. Sauna observes liquid volume

1. After the lesson the pupils understood the terms "full", "partly full" and "empty".	1	2	3	4	5
2. The pupils experimented with different jars of water.	1	2	3	4	5
3. The necessary materials for this lesson were available.	1	2	3	4	5
4. This lesson was difficult to prepare and to teach.	1	2	3	4	5
5. The pupils played with water in containers of various sizes.	1	2	3	4	5

	SD	D	U	A	SA
6. This was a successful lesson.	1	2	3	4	5

Lesson 19 - Impressions in clay

1. Pupils learned how to make models with clay.	1	2	3	4	5
2. The pupils practised modelling with clay.	1	2	3	4	5
3. There were sufficient materials for the pupils.	1	2	3	4	5
4. This lesson was easy to prepare and to teach.	1	2	3	4	5
5. The pupils were actively involved modelling with clay.	1	2	3	4	5
6. The lesson did not interest the pupils.	1	2	3	4	5

Lesson 21 - Mr. Sauna and Mirrors

1. By the end of the lesson the pupils understood the word 'reflection'.	1	2	3	4	5
2. The pupils observed their reflections in the mirrors.	1	2	3	4	5
3. There were enough mirrors for the pupils.	1	2	3	4	5
4. The lesson was difficult to prepare and to teach.	1	2	3	4	5
5. The pupils were actively involved using the mirrors.	1	2	3	4	5
6. The pupils were excited when they observed their reflections in the mirrors.	1	2	3	4	5

	SD	D	U	A	SA
Lesson 23 - Longer than and shorter than					
1. At the end of the lesson the pupils understood the terms "longer than" and "shorter than".	1	2	3	4	5
2. The pupils measured objects using string.	1	2	3	4	5
3. Pieces of string were available for this lesson.	1	2	3	4	5
4. This lesson was difficult to prepare and to teach.	1	2	3	4	5
5. The pupils were busy measuring and comparing objects like pieces of cloth, chalk etc.	1	2	3	4	5
6. This lesson was not interesting to the pupils.	1	2	3	4	5
Lesson 25 - The number tree					
1. At the end of the lesson the pupils knew a seed-bearing pod.	1	2	3	4	5
2. The pupils counted the number of seeds in the seed-bearing pods they were given.	1	2	3	4	5
3. Albisia seed pods containing different number of seeds were available.	1	2	3	4	5
4. The lesson was easy to prepare and to teach.	1	2	3	4	5
5. The pupils opened their seeds pods and counted the number of seeds in each pod.	1	2	3	4	5
6. The pupils were interested in this lesson.	1	2	3	4	5

APPENDIX D

Teachers' Opinionnaire on Primary Science Two

Lesson 3 - Comparing and Ordering Objects by Weight

	SD	D	U	A	SA
1. The pupils were able to distinguish between heavy and light objects by the end of the lesson.	1	2	3	4	5
2. The pupils classified different objects by weight.	1	2	3	4	5
3. There were enough tins required for the lesson.	1	2	3	4	5
4. A lot of difficulties were encountered preparing and teaching this lesson.	1	2	3	4	5
5. The pupils were not active for the greater part of the lesson.	1	2	3	4	5
6. The lesson was interesting for the pupils.	1	2	3	4	5

Lesson 7 - Round and Round the Circle

1. At the end of the lesson the pupils understood the meaning of perimeter.	1	2	3	4	5
2. The pupils drew large circles on the ground and walked round them to compare the distances.	1	2	3	4	5
3. This lesson was easy to prepare and to teach.	1	2	3	4	5
4. There were no difficulties in obtaining the necessary materials for this lesson.	1	2	3	4	5

	SD	D	U	A	SA
5. The pupils were active throughout the lesson.	1	2	3	4	5
6. The pupils did not show much interest in the lesson.	1	2	3	4	5

Lesson 9 - The Ant-lion and His Pit

1. At the end of the lesson the pupils were able to identify the ant-lion and some of its activities.	1	2	3	4	5
2. The pupils were able to observe the ant-lion pits.	1	2	3	4	5
3. Ant-lion pits were available for this lesson.	1	2	3	4	5
4. Not many difficulties were encountered in the preparation and teaching of this lesson.	1	2	3	4	5
5. The pupils were actively engaged throughout this lesson.	1	2	3	4	5
6. This lesson was a successful one.	1	2	3	4	5

Lesson 11 - Length and Distance

1. The pupils understood the terms "longer than", "shorter than", "same as", by the end of the lesson.	1	2	3	4	5
2. The pupils practised measurement using match boxes.	1	2	3	4	5
3. There were enough match boxes for the pupils.	1	2	3	4	5
4. It was difficult to collect the necessary materials to prepare for this lesson.	1	2	3	4	5

	SD	D	U	A	SA
5. The pupils were busy measuring lengths and distances throughout the lesson.	1	2	3	4	5
6. This lesson was a successful one.	1	2	3	4	5

Lesson 12 - Building Match Box Figures

1. By the end of the lesson the pupils had experience in making a number of geometric shapes.	1	2	3	4	5
2. The pupils worked individually in making the different geometric shapes.	1	2	3	4	5
3. About 120 match boxes were available for the lesson.	1	2	3	4	5
4. This lesson was easy to teach.	1	2	3	4	5
5. The pupils built different figures out of match boxes.	1	2	3	4	5
6. The pupils were keenly interested throughout the lesson.	1	2	3	4	5

Lesson 14 - A Liquid Volume Problem

1. By the end of the lesson the pupils understood the measurement of liquid volumes.	1	2	3	4	5
2. The pupils counted the number of jars full of water.	1	2	3	4	5
3. Such items as large container of coloured water, large jars of different sizes were made available for this lesson.	1	2	3	4	5
4. This lesson was difficult to prepare and to teach.	1	2	3	4	5

	SD	D	U	A	SA
5. The pupils were engaged in filling the jars with water and comparing the volumes.	1	2	3	4	5
6. The pupils were not interested in the lesson.	1	2	3	4	5

Lesson 16 - Seed Germination

1. By the end of the lesson the pupils were able to recognise the important steps in plant growth.	1	2	3	4	5
2. The pupils performed the experiment of germinating beanseeds.	1	2	3	4	5
3. The necessary materials for the lesson were made available.	1	2	3	4	5
4. The germination of beanseeds was easy to carry out.	1	2	3	4	5
5. The pupils were actively involved in this lesson.	1	2	3	4	5
6. The lesson did not interest the pupils.	1	2	3	4	5

Lesson 18 - Measuring Time by Counting

1. By the end of the lesson the pupils understood the differences between the phrases "faster than" and "slower than" to describe the beats of pendulums.	1	2	3	4	5
2. The pupils practised measuring time using the pendulum.	1	2	3	4	5
3. The pupils all counted the swings of the pendulum.	1	2	3	4	5
4. The pupils seemed interested throughout the lesson.	1	2	3	4	5

	SD	D	U	A	SA
5. This lesson was difficult to prepare and to teach.	1	2	3	4	5
6. The materials for this lesson were available.	1	2	3	4	5

Lesson 20 - More Fun with Mirrors

1. The pupils learned to understand the meaning of reflection.	1	2	3	4	5
2. The pupils experimented in groups with mirrors.	1	2	3	4	5
3. There were insufficient mirrors for this lesson.	1	2	3	4	5
4. Mirrors and blotting papers were not difficult to obtain and use.	1	2	3	4	5
5. Pupils were busy observing the images of objects using the mirrors.	1	2	3	4	5
6. This lesson was successful.	1	2	3	4	5

Lesson 24 - Air in a Bag

1. This lesson was too difficult for the pupils to understand.	1	2	3	4	5
2. The pupils worked in groups to conduct the floating experiment using polythene bags.	1	2	3	4	5
3. The apparatus (e.g. polythene bag, rubber tubing, water etc.) was available for this lesson.	1	2	3	4	5
4. The materials for the lesson were not easy to prepare and use.	1	2	3	4	5
5. The pupils were involved in the floating of the polythene bags containing the stone.	1	2	3	4	5

	SD	D	U	245 A	SA
6. This lesson was not very successful.	1	2	3	4	5

APPENDIX B

TEST OF PROCESS SKILLS (TOPS)

TEST ITEM	INSTRUCTION TO TEST ADMINISTRATOR	DIALOGUE WITH CHILD
1. Dog (2 marks) (75 seconds)	Assemble the pictures in 1-5 one at a time to show the child. Mix up the pieces and then ask the child to reassemble them. Allow 75 seconds for the 1st trial and if he fails allow him another trial. 2 marks for the successful 1st trial and one mark for the 2nd trial. No mark for more than 2 trials.	Here is a picture of a dog that has been cut up. Let us put it together so that it will look alright. You put it together the right way.
2. Village Scene (2 marks) (75 seconds)		This is a picture of a village scene that has been cut up. Let us assemble it in the right way. Now, you arrange the picture as I did.
3. Train (2 marks) (75 seconds)		This is a picture of a train cut into four pieces. Let us arrange the pieces so that it is alright. Now, you arrange the pieces as I did.
4. Lorry (2 marks) (75 seconds)		This is a picture of a lorry. Can you see it well? Now, you arrange the pieces as I did.

TEST ITEM	INSTRUCTIONS TO TEST ADMINISTRATOR	DIALOGUE WITH CHILD
5. Cut-out Man (2 marks) (75 seconds)		This is a picture of a man that has been cut into pieces. Let us assemble it in the right way. Now you arrange the pieces as I did.
6. Pipe Water (2 marks) (75 seconds)	Ask the child to arrange the pictures in the correct order without showing him first how to do it.	This is a picture of pipe-water flowing into a bucket. Arrange the pictures to show how the bucket is filled.
7. House Building (2 marks) (75 seconds)	The same as above.	These are 4 pictures which show the stages of house building. Now, you arrange them in the right way.
8. Long and Short (2 marks) (75 seconds)	Arrange the pieces in the correct order and then ask the child to arrange them.	See how I will arrange these pictures according to their lengths — shortest down to the longest. Now, you arrange these pictures by yoursel as I did.

Note 1. crossing an imaginary line into a major blind alley is one error.

2. crossing any line is one error.

3. lifting the pencil is one error

Maze	Errors allowed	Time limit
A	2	30 seconds
B	2	30 "
C	2	30 "
1	3	30 "
2	3	45 "
3	5	60 "

Scoring: Mazes, A, B, and C.

Within the time limit and no errors = 2 points

Within the time limit and no more than allowed errors = 1 pt.

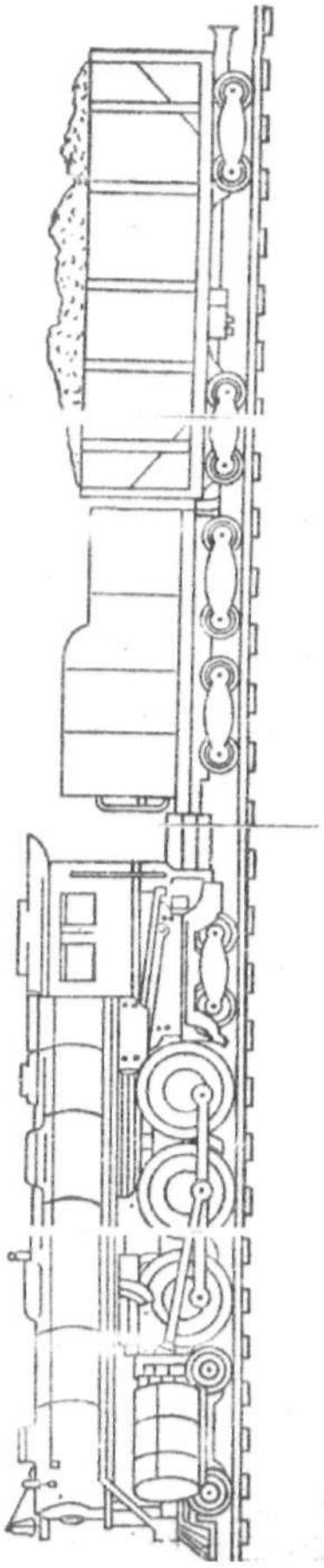
Scoring: Mazes 1 - 3

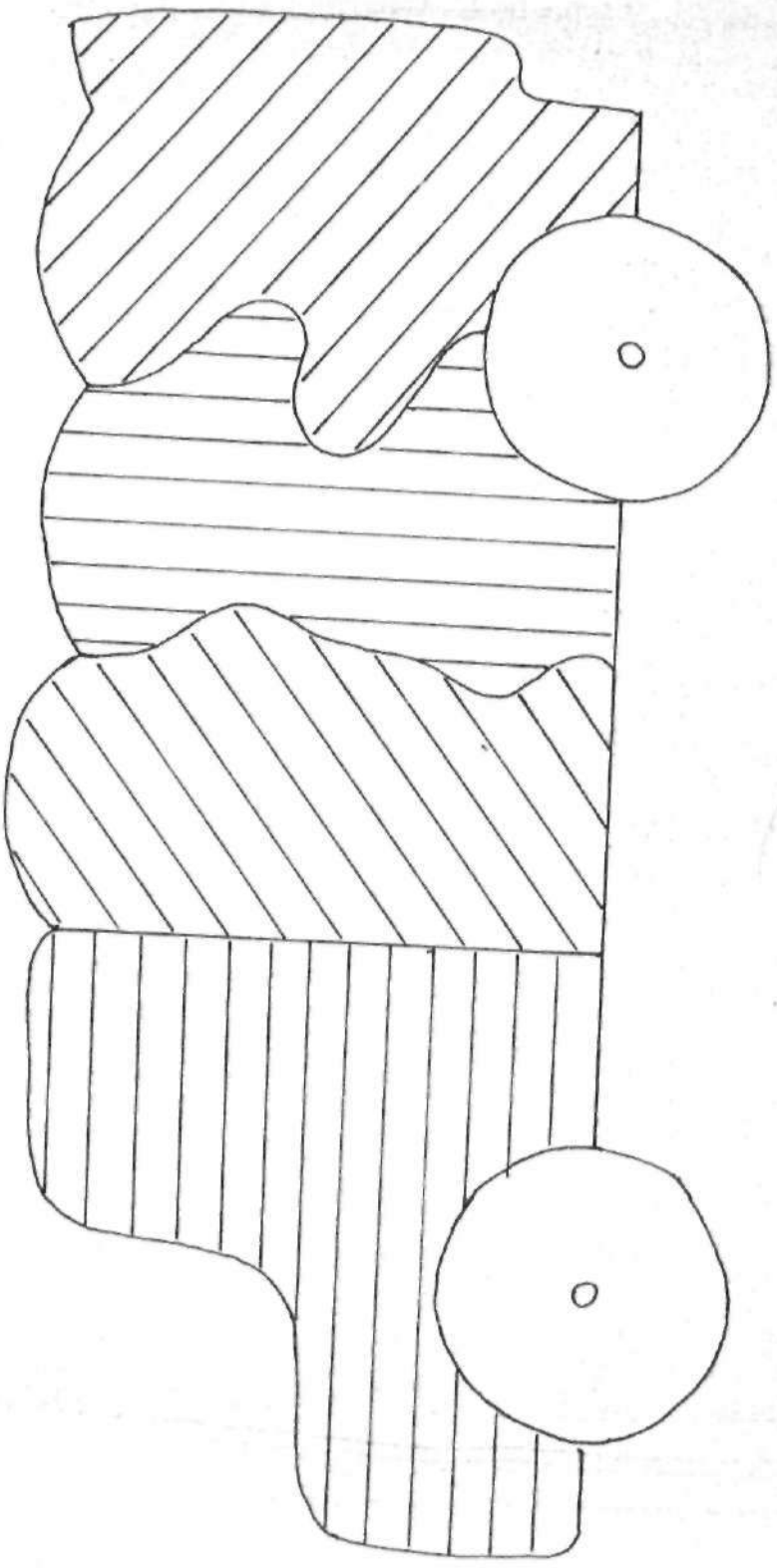
Within the time limit and no errors = 3 points

Within the time limit and only 1 error = 2 points

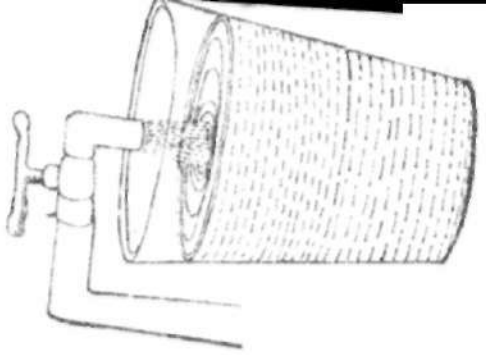
Within the time limit and 2 but no more than the maximum number of allowed errors = 1 point.

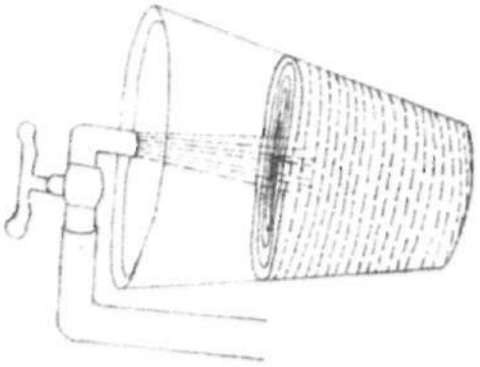
DOG

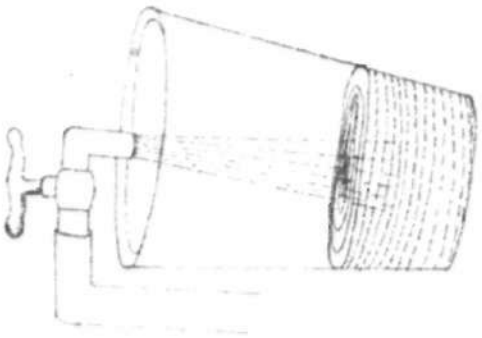


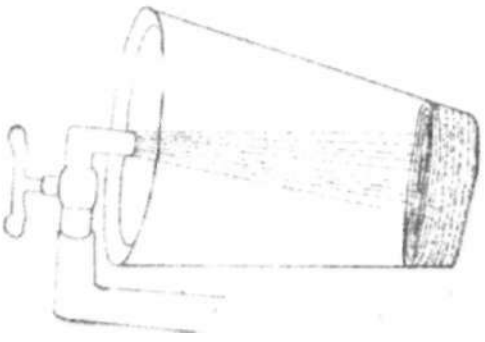


LORRY

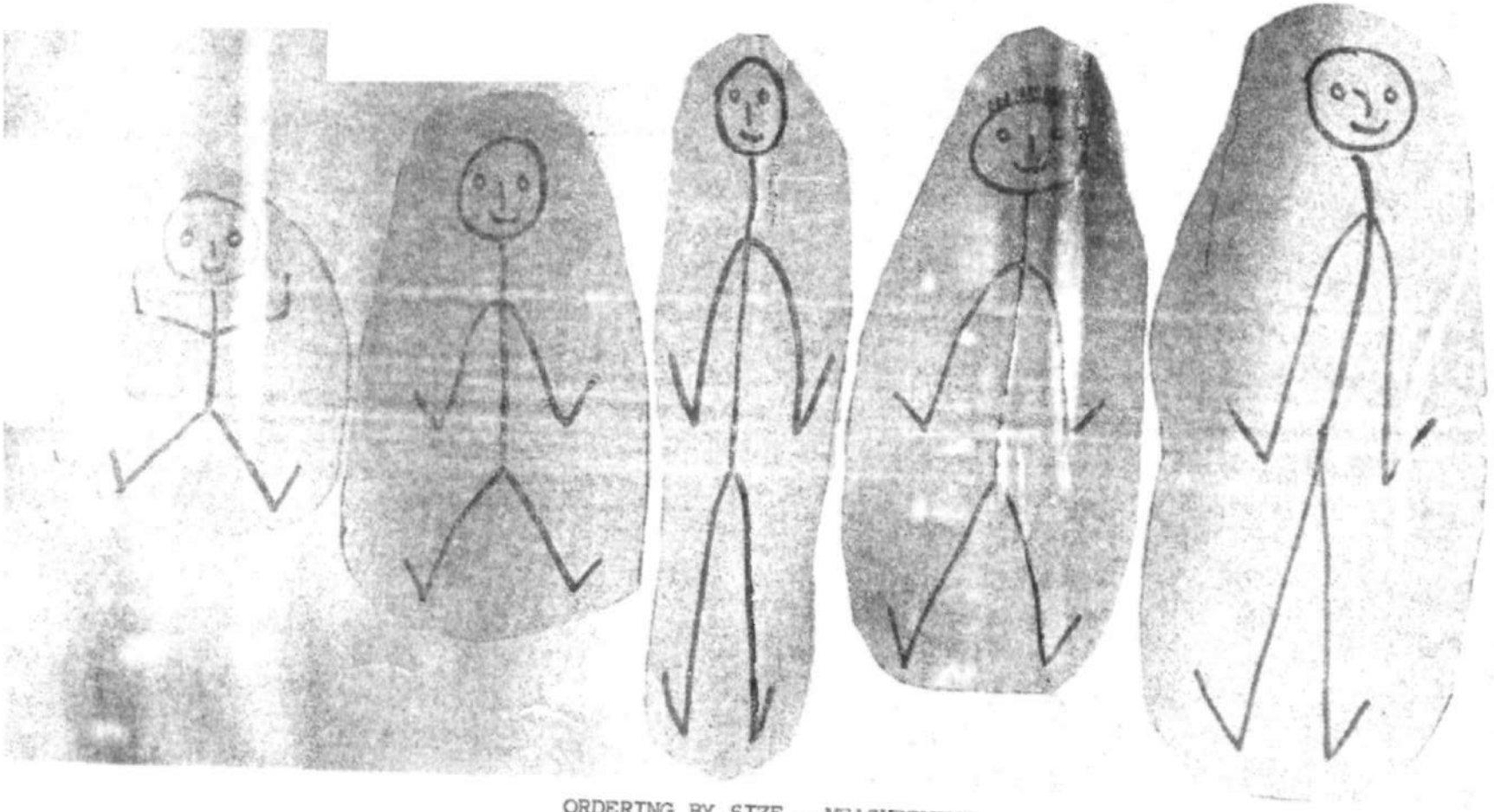




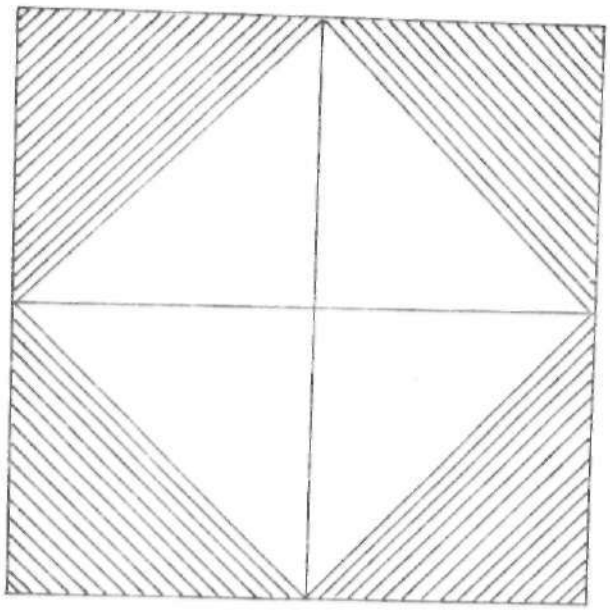


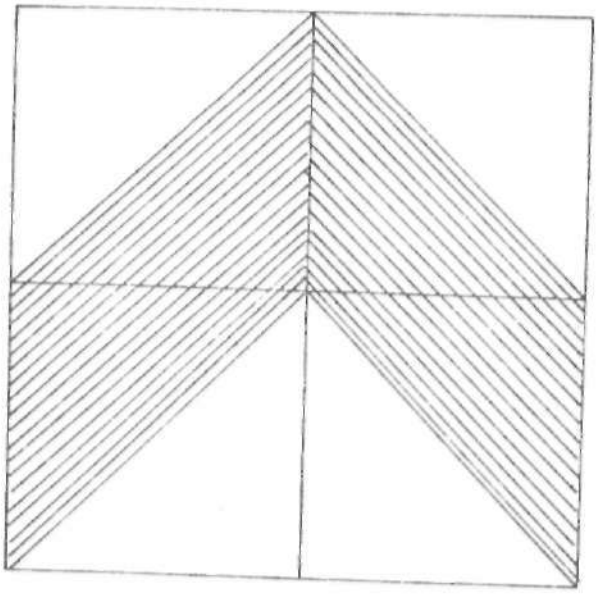


PIPE WATER

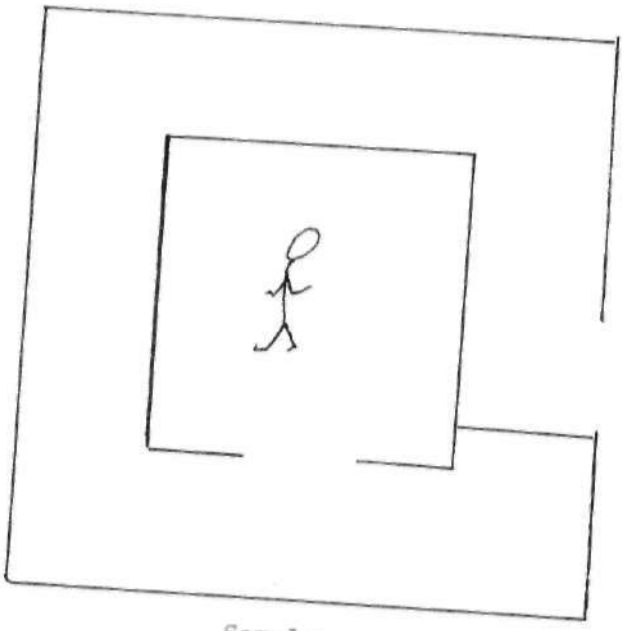


ORDERING BY SIZE - MEASUREMENT

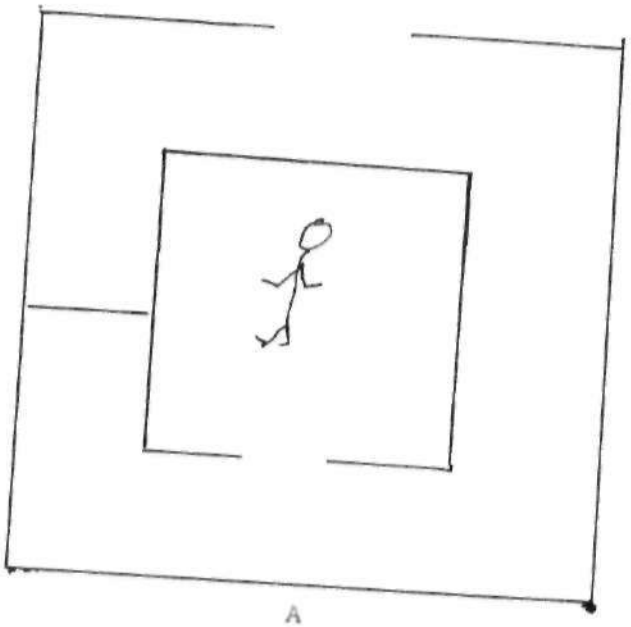




BLOCKS

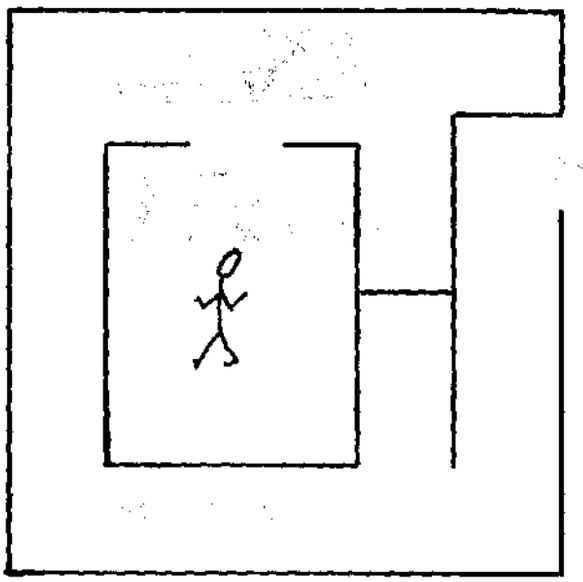


Sample

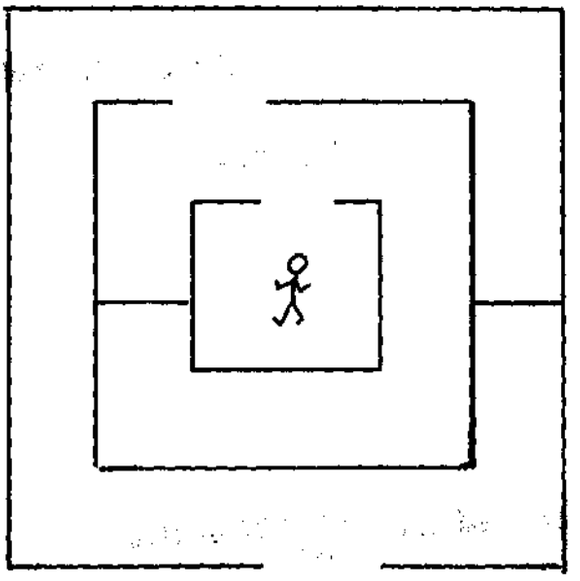


A

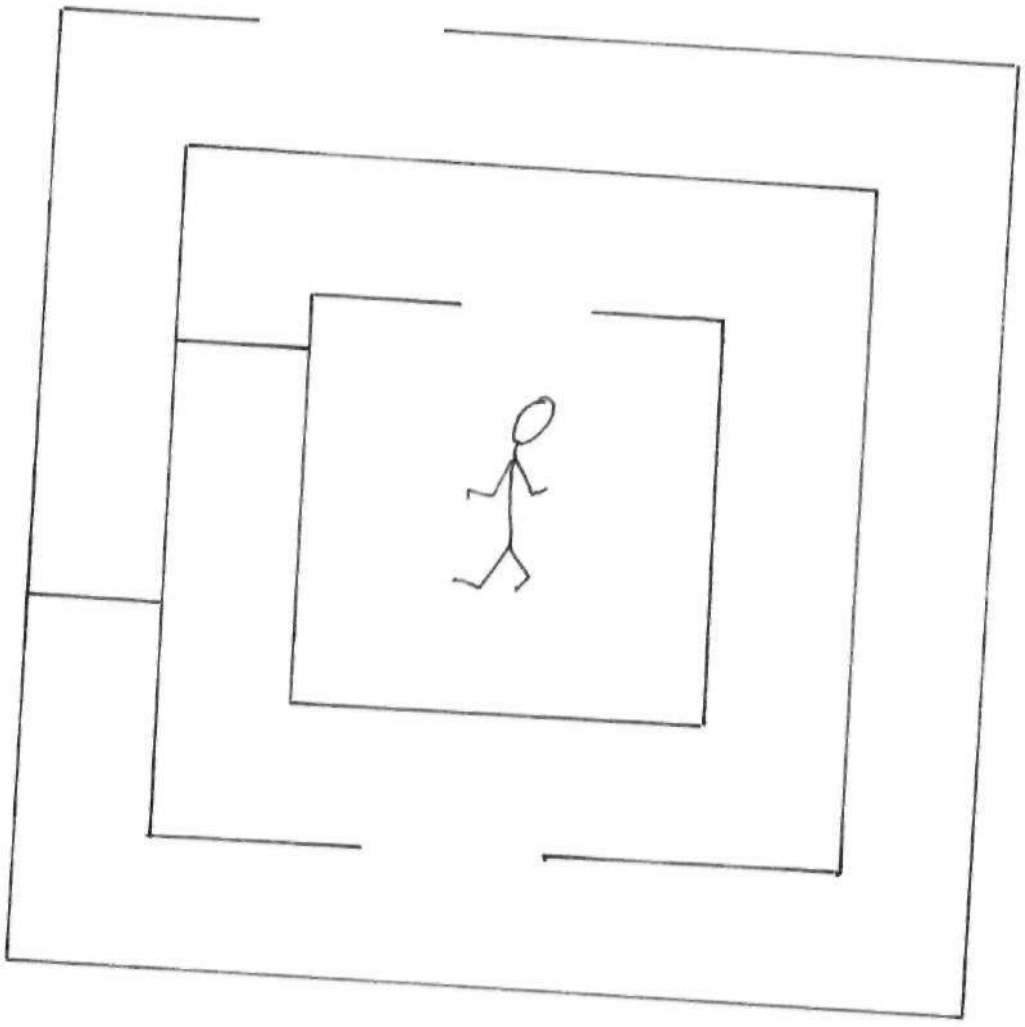
MAZES



B

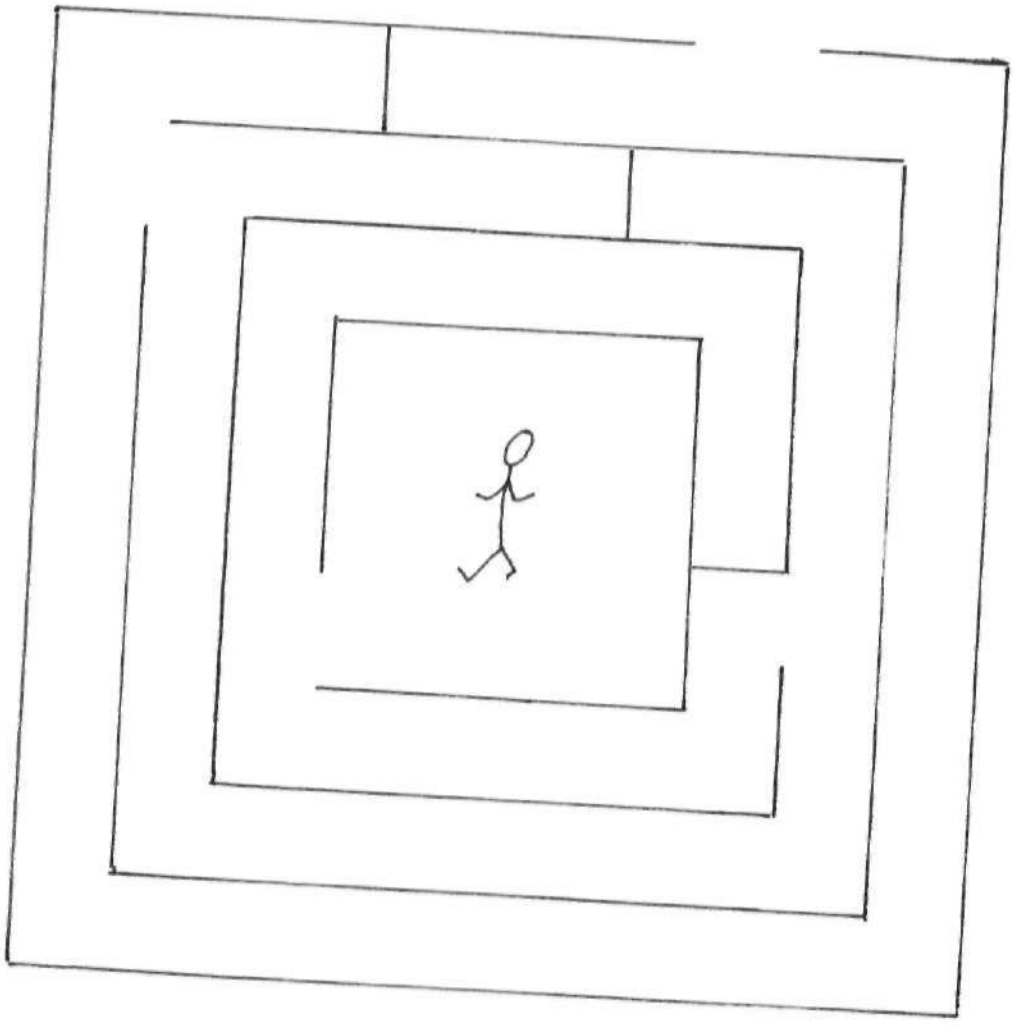


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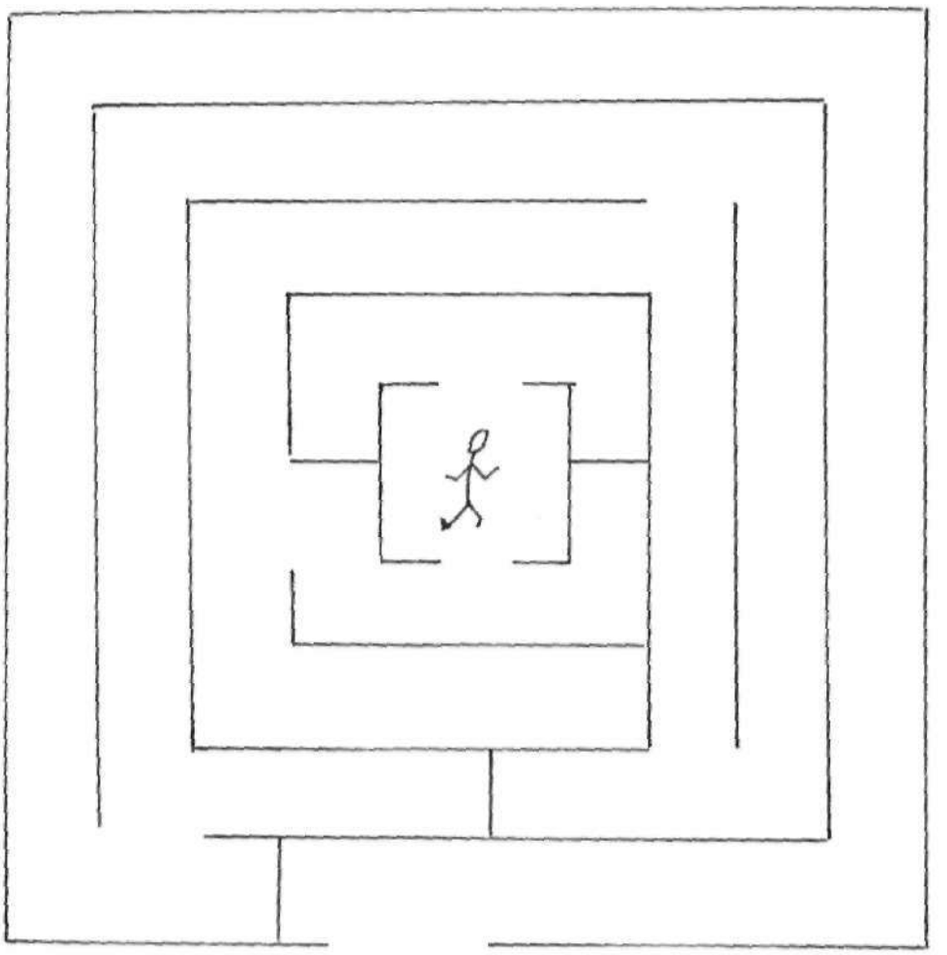


1

MAZES



2



3