SCIENCE EDUCATION RESEARCH PLANNING METHODOLOGY AND REPORT WRITING

REPORT ON TRAINING COURSE

1-5 DECEMBER 1980

NATIONAL SCIENCE COUNCIL OF SRI LANKA
47/5, MAITLAND PLACE,
COLOMBO 7.

REPORT

on the

Training Course

in

Science Education Research Planning
Methodology and Report Writing
1-5 December 1980

National Science Council of Sri Lanka

Ministry of Education

FOREWORD

Perhaps no one is in a better position to carry out science education research in secondary schools than the science teacher whose day to day work brings him in constant contact with all practical aspects of science education. Nevertheless, the number of applications for National Science Council (NSC) grants for science education research is extremely small. One reason for this is that the organization of a research project on scientific lines, its implementation, and the writing of a clear and analytical report on the findings, are out of the range of skills of most science teachers. The Science Education Research Committee (SERC) of the NSC therefore decided to organize a workshop and training course for teachers in science education research planning, methodology and report writing. The workshop was held from 1-5 December, 1980. The Curriculum Development Centre (CDC) of the Ministry of Education co-sponsored the workshop.

Applications for participating in the workshop were invited from senior teachers in different parts of the island. Far more applications were received than could be accommodated in the workshop and a selection had therefore to be made to pick out 30 participants.

Prof.V.Basnayake, Chairman, SERC, and Mr A.M. Ranaweera, Director of Education and Member, SERC, were the co-directors of the workshop. A number of experts in different selected fields addressed the participants and assisted in instruction work.

Work connected with the organization of the workshop was handled by the staff of the NSC, particularly Mr N.Anbalagan, Scientific Officer. Messrs U.Abeywardena, Education Officer, CDC, and Mr T.C. Wijesinghe , Scientific Officer, NSC, functioned as rapporteurs.

Our thanks are due to the course directors, lecturers, and the staff of the NSC who spared no efforts to ensure the success of the workshop.

This document contains the proceedings of the workshop. The views expressed here are those of the teachers and are not necessarily those of the National Science Council.

R.P. Jayawardene

Secretary-General

NATIONAL SCIENCE COUNCIL

PREFACE

Professor V.Basnayake, Chairman/ Working Committee on Science Education Research, National Science Council.

The idea of holding the workshop arose in the Science Education Research Committee in September 1980. The Committee felt that they were failing to attract a sufficient number of persons to undertake grant-supported research projects in science education. They wished to repair this defect. Various lines of action were proposed. These could be divided into two categories: advertisement of research grants, and persuading persons by a more direct approach. The workshop belongs to the latter category. The idea to get hold of a set of promising persons, get them committed to work on a science education research problem of their choice, give them training and financial grants, and pursue them closely until the research study is completed and written up.

The support of the Ministry of Education was absolutely vital for such a workshop. The Committee was fortunate in having Ministry representation in the Committee, and Mr A.M.Ranaweera volunteered to use the resources of the Ministry to do the identification of persons for training and the award of grants. He also agreed to be co-director of the workshop.

The estimated cost of the residential workshop for 30 participants in Colombo was of the order of Rs. 30,000/-, to be borne by the National Science Council Additionally the Council also provided all the secretarial services. The staff of the Council gave their fullest support to the workshop.

The lag time between the initial proposal for the workshop and the actual holding of the workshop was therefore three months. The reasons for this period being so remarkably short were the decision to run the workshop with entirely local resources without waiting for foreign resources such as foreign grants and foreign experts, the willingness of the Committee to set instantly to work, and the needs to choose a time when the school system would allow participants to leave station.

The programme of the workshop was adjusted as we went along. This was felt to be necessary in the interest of consolidating a certain amount of ground rather than trying to cover superficially a vast area of ground. Two days

Cont'd...

were spent on the selection and definition of a problem - not half a day as in the original timetable. The design of the participants' proposed study required two further days. The plan to get each participant to commence the study during the workshop itself was altogether abandoned.

The main technique of teaching that was used at the workshop was that of learning by doing. Each participant had to do the following, with assistance from the staff and fellow participants: identify a problem; define the problem, narrowing it down so that it could be studied within one year; designing a method of studying the problem; filling up an application form for a grant.

A Group cooperative spirit was cultivated by making the workshop a residential one; holding a party with food, beverages and entertainment (on the third day of the workshop); and making use of group discussion throughout the workshop.

There are many people whom I must thank for their help in running the workshop. I have tried to do so briefly in the speech at the closing session.

C O N T E N T S

LIST OF TABLES

L I S T O F F I G U R E S

INTRODUCTION

The Science Education Research Committee (SERC) was duly constituted as a statutory working committee in May 1976 under the National Science Council Law No. 36 of 1975, published in the gazette of the Republic of Sri Lanka of 3rd January 1975. The inaugural meeting was held on 4th July of the same year with Prof.V.Basnayake as the Chairman. At the outset the Committee outlined its areas of work as follows;

(i) The critical examination of the existing Science Education system and to make suitable recommendations for changes

(ii) The Committee would also be prepared to give expert advice on policy matters arising out of Science Education Research to be supported by the Committee.

The main programmes identified by the Committee are;

(i) Encouragement of research in Science Education through the award of research grants to individual research workers from the Universities, Schools and the Education Department and elsewhere.

(ii) Publication of journal on Science Education titled "Science Investigations" catering to investigative work carried out in the Schools.

(iii) Preparation of supplementary reading material on science topics relevant to Sri Lanka.

Science education is a relatively new area of research in Sri Lanka. The SERC conducted a Workshop on the scientific method and research methodology for its research grantees in August 1977. This workshop was conducted under the guidance of Prof.Richard Kempa, Professor of Education, University of Keele, United Kingdom.

The Training Course in Science Education Research Planning, Methodology and Report Writing conducted in the first week of December 1980, is a continuation of the interest shown by the Committee in training and developing a competent team of research workers in Science Education. This training course diferred with the former workshop in both approach and the method of selection of participants. The participants were selected after careful

scrutiny of master teachers, teachers and education officers recommended by the Curriculum Development Centre (CDC) of the Ministry of Education.

An application form/questionnaire specially designed for this purpose was sent to the persons recommended by the CDC. The duly completed forms were screened by the Course Directors with a view towards identifying suitable persons. Efforts were made to give the training course a nation-wide outlook by including at least one participant from each district.

The primary objective of the training course was to take the participants through a process of thinking and planning which would lead to the preparation of well thought out project proposals for support by the SERC.

The success of the programme as a whole could be evaluated only by the progress made in completing and publication of results of these projects at the end of one year following the training course.

SUMMARY OF PROCEEDINGS

1-5 December, 1980

DAY 1 (1st DECEMBER 1980)

1. INTRODUCTORY TALK BY PROF.V.BASNAYAKE, COURSE DIRECTOR AND CHAIRMAN SCIENCE EDUCATION RESEARCH COMMITTEE (SERC)

Prof. Basnayake welcomed the participants to the training course and introduced them to the basic ideas of research and the thinking of the Committee. Research, he said, involved three main activities;

(i) Catching (for problems)
(ii) Trying (to solve problems)
(iii) Publication (of results)

Prof. Basnayake said that the main objective of the Science Education Research Committee (SERC) was to encourage research in science education. In order to achieve these objectives the SERC had prepared a list of priority topics for research and had initiated a scheme of research grants in 1976. The Committee had realised that Science Education Research was relatively a new activity in Sri Lanka. In order to train research grantees in the field of Science Education Research a workshop on the Scientific Method and Research Methodology had been conducted in August 1977, with Prof. Richard Kempa, Professor of Education of the University of Keele, United Kingdom, as the Director to the Workshop. This Workshop was restricted to research grantees of the Committee.

Prof. Basnayake said, that the aim of the present training course was to train a group of potential research workers in the art of research planning, methodology and report writing. The training course was expected to culminate in the formulation of about 25 research projects which will be considered for financial support by the SERC. The duration of each project is expected to be around 1 year.

The participants of this training course were hand-picked people who would be willing to identify the problems in science education and undertake research projects. He stressed the need for completion and publication of results of the research projects within the stipulated time.

Identifying some aspects of research, Prof. Basnayake requested the participants to;

(i) Identify a problem which is interesting
(ii) Study relevant literature
(iii) Study the use of questionnaire and how to tabulate data
(iv) Statistical analysis
(v) Practise writing

Emotion, he said, is not a part of research publications, and it could be with the systematic study of a problem. He outlined the fundamental aspects of the task before them and urged the participants to work with awareness, mindfulness, non-attachment and to work out the solution to these problems with diligence.

2. LECTURE I: PROBLEMS OF SCIENCE EDUCATION RESEARCH
by MR M. RANAWEERA, COURSE DIRECTOR

In order to identify the problems of science education, Mr M.Ranaweera introduced the participants an input - output analysis of the science education system in the country. He illustrated (see Figure I) the school science education system under three aspects viz.

(i) Inputs
(ii) Organization
(iii) Outputs

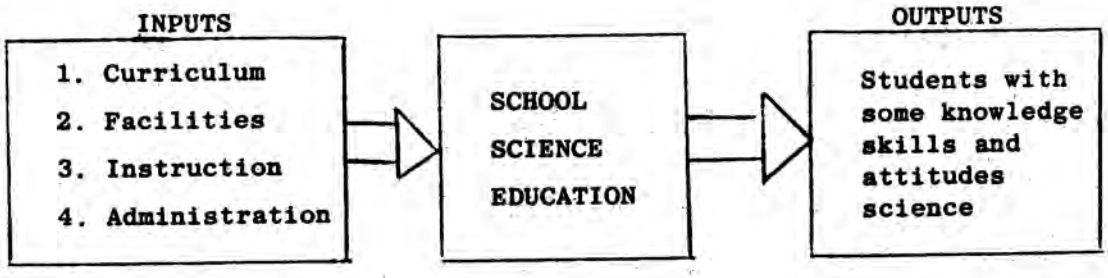

FIGURE I

Input - Output Analysis of the School Science Education System

These three aspects were further analysed as follows;

(a) Inputs

The inputs into the school education system are,

(aa) Curriculum

The school curriculum contains;

(i) Objectives

(ii) Content/Learning experience

(iii) Teaching Methodology

(iv) Evaluation

(ab) Facilities

Another input may be considered as facilities that are required for any teaching purpose such as,

(i) Laboratories

(ii) Material

(iii) Text books, Supplementary Reading Materials

(ac) Instruction

Given the curriculum and facilities any education system must have an instructional system consisting of

(i) Teachers

(ii) Methodology, Field work, Activities etc.

(ad) Administrative set-up

Last but not the least administration is yet another vital input into this system. This takes the form of,

(i) Rules and Regulations

(ii) Supervisors

(iii) Supply

(iv) Maintenance

(b) Organization

Organization for school science education may be analysed as follows-

(i) Size of classrooms

(ii) Number of periods

(iii) Selection of studies

(c) Output

The output is in the form of students who have,

(i) Knowledge

(ii) Skills

(iii) Attitudes

The output is measured both quantitatively and qualitatively. It is important to know the output in terms of the number of students as well as whether their learning is sufficient and relevant, whether they are employable and whether the teaching is relevant to life skills.

Problems of science education may arise due to weaknesses at any of the levels described above. However, solutions to problems have to be preceded by their identification and study of them in a methodical manner. Mr Ranaweera then identified the following criteria for consideration in the selection of research problems.

(i) The problem must be in an area worthy of investigation and of relevance to present situations

(ii) Insignificant or trivial problems should not be selected

(iii) It should be possible to complete a selected problem within the resources and time available

Mr Ranaweera then proceeded to discuss examples from the list of priority projects in science education which have been formulated by the SERC (see Appendix IV).

3. LECTURE II : PROBLEMS IN SCIENCE EDUCATION
by MR D.A. PERERA, CONSULTANT/LECTURE
TO THE TRAINING COURSE

The theme of Mr Perera's lecture was that the impact of science education of the community, especially on

the rural sector has been neglegible. He said, that the purpose of science education is to improve the life of the community in terms of health, environment etc. However, despite decades of free education in the country, basic knowledge regarding the above is still lacking in the villages.

The average villager, he said, was still ignorant of the basic ideas of nutrition, preservation of food and health. The villager was not aware of elementary health care, basic body function, the need to boil water and immunisation against diseases. Around 40% of the villagers suffer from mal-nutrition in some areas, basically due to a lack of awareness on the part of the villager. In conclusion, he said that the ultimate measure of effectiveness of an educational system is its impact on educational, economical, social, cultural and practical well being of the rural people. He urged the participants to select problems which stressed the importance of the above facts.

4. SELECTION OF A PROBLEM BY EACH PARTICIPANT

Each of the participants was requested to select a problem for research. These were discussed by the Course Directors and participants.

Prof. Basnayake analysed the problems in terms of the area of research (see Table I).

TABLE I

Analysis of a sample of projects with respect to Research Areas

RESEARCH AREA	SCHOOL		
	PRIMARY	SECONDARY	
		LOWER	UPPER
AIMS		11	
CONTENT	1	1	
METHOD		I	II
EVALUATION		11	

A project title of a sample of projects (see Figure II) were analysed in order to illustrate the art of studying research problems. It was emphasized that a problem statement must be very brief and precise and yet give adequate information to convey the main aim of the research. At the conclusion of the first day of the training course, each participant was given the task of re-writing their problem statement in the light of the above discussion.

RESEARCH AREA		PROJECT TITLE
AIMS	Before :	Aims of Mathematics as stated by curriculum makers and as perceived by teachers and pupils
	After :	Aims of Mathematics Education at Lower Secondary Level as stated by the Ministry of Education and as perceived by teachers and pupils
CONTENTS	Before :	The content of Health Education in school science syllabuses
	After :	The effectiveness of the learning of Health Education topics by G.C.E.(O.L.) students
METHODS	Before :	Performance of students in relation to qualifications and experience of teachers
	After :	Performance of G.E.C.(O.L.)students in science in relation to the teachers' qualifications and experience

FIGURE II

A sample of redesigned Project Titles

DAY 2 (2nd DECEMBER 1980)

5. LECTURE III : INTRODUCTION TO INFORMATION RESOURCES by MR N.U.YAPA, CONSULTANT/ LECTURER TO THE TRAINING COURSE

Mr Yapa stressed the main feactures of any research study as,

(i) Identification of a problem
(ii) Survey of relevant literature
(iii) Design of the study
(iv) Execution of the study
(v) Writing of research papers
(vi) Publication

He emphasized the important part played by information in any research study. Information exploitation involves a methodical study to obtain correct and reliable information. The problem of obtaining information required a comprehensive understanding of both sources of information and the methodology of collection. Mr.Yapa summarized the most important sources and types of information as follows:

(a) Information sources

(aa) Primary sources

(i) Research Report
(ii) Journal, Magazines, Periodicals
(iii) Books
(iv) Conference proceedings

(ab) Secondary sources (to locate primary sources)

(i) Indexes
(ii) Abstracts
(iii) Bibliographies
(iv) Catalogues

(ac) Tertiary sources (used to locate primary and secondary sources)

(i) Review Reports
(ii) Directories of Research Projects
(iii) Bibliographies of Bibliographies
(iv) Guides to literature

(b) Types of Information Services

(i) Guides to sources of information
(ii) Dictionaries
(iii) Encyclopaedias
(iv) Encyclopaedic Dictionaries
(v) Year Books
(vi) Annual Reports
(vii) Educational Reports
(viii) Directories

Mr Yapa introduced the participants to the main considerations in the organization of a library as follows;

(i) The reader should be able to easily locate information
(ii) Collections of books and periodicals etc. in most libraries are arranged according to the Dewey Decimal Classification (DDC)

He illustrated the working of the DDC system with an example from science education (see Table II).

T A B L E II

Illustration of the Dewey Decimal Classification
for Science Education

Level I	Level II
000 Generalities	300 Social Science
100 Philosophy	310 Statistics
200 Religion	300 Political Science
300 Social Science	330 Economics
400 Languages	340 Law
500 Pure Science	350 Public Administration
600 Technology	360 Social Problem
700 The Arts	370 Education
800 Literature	380 Commerce
900 Geography & History	390 Customs, Folklore

Level III	Level IV
370 Education	372 Elementary Education
371 Generalities of Education	372.1 Generalities of Elementary Education
372 Elementary Education	372.1 Levels of Elementary Schools
373 Secondary Education	372.3 Science Health
374 Adult Education	372.4 Reading
375 Curricula	372.5 Creative & Manual Arts
376 Education of Women	372.6 Language Arts
377 ---	372.7 Mathematics
378 Higher Education	372.8 Other Studies
379 Education & the State	372.9 Historical & Geographical Treatment of Elementary Education

Level V	Level VI
372.2 Levels of Elementary Schools	372. 21 Pre - schools
372.21 Pre-schools	372. 216 Nursery Schools
372.24 Elementary Schools	372. 218 Kindergartens

In libraries titles and location of books, periodicals etc. available are usually given in the card catalogue. The card catalogue is usually arranged by subject and author.

In conclusion Mr Yapa invited the participants to utilize the facilities offered by the Sri Lanka Scientific and Technical Information Centre (SLSTIC) of the National Science Council.

6. PRACTICAL WORK IN INFORMATION GATHERING

Mr Yapa divided the participants into three groups. Each of these groups then visited the libraries of the Curriculum Development Centre, the National Science Council, the British Council and the University of Colombo. They were given practical demonstrations in the following;

(i) How to find relevant literature through author Indexes
(ii) How to find relevant literature through subject Indexes
(iii) How to refer the unionlists
(iv) How books are classified and arranged in the British Council Library
(v) Reference in a special branch of a library. i.e. University of Colombo Library
(vi) Search for a journal article
(vii) How to get an extract from a journal article available in the Union List of Periodicals or even out of Sri Lanka

7. LECTURE IV MATTERS FOR CONSIDERATION IN UNDERTAKING A RESEARCH STUDY

by MR W.S.PERERA, CONSULTANT/LECTURER TO THE TRAINING COURSE

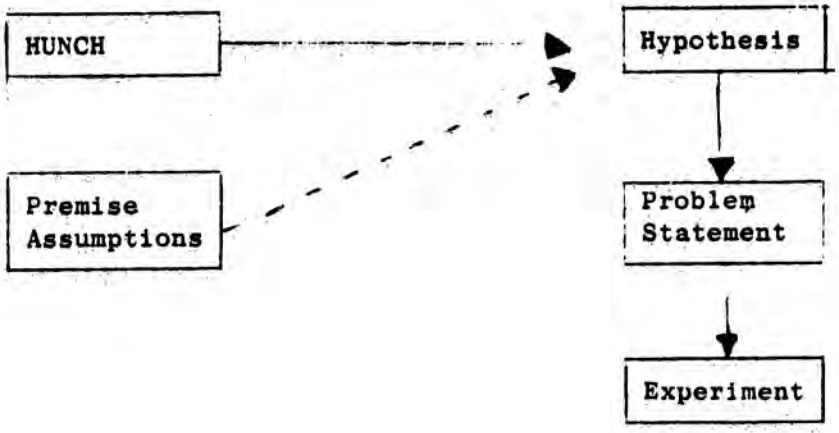

FIGURE III

Development of a Hunch to a Research Project

Mr W.S.Perera outlined the process through which research problems are identified and the historical process of evolution of the experimental method of proving basic assumptions. He said that research problems began with a hunch (idea) in the mind of the researcher. His concern for investigating these problems gave rise to a statement of the problem. Precise statement of the problem, together with the premise (or assumptions) and design of experiments to test the hunch takes place later.

Prior to the evolution of the experimental method of proving a hypothesis, an investigator usually came to conclusions non empirically. He quoted the writings of Aristotle to prove his statement. However, with the development of the experimental method, proof is undertaken by a designed experiment which measures changes which could be repeated with the same results under the same conditions. The statement of the problem is usually in the form of a null-hypothesis which will be either prove or disproved through experiments. In the design of the experiment determinants have to be isolated and an experimental group is tested for changes against a control group for various values of the determinant. Statistics plays a vital part in the design of an experiment and proof is accepted only within the range of statistical significance.

Subsequent to a lively discussion the sessions were concluded around 10.00 p.m.

DAY 3 (3rd DECEMBER 1980)

8. LECTURE V: SELECTING A SAMPLE
by PROF. B.BASNAYAKE

Prof. Basnayake stressing the improtance of using statistics introduced the participants to the basic concepts of statistical design. He said that it was not possible to study an entire population, especially if it is very large. Thus, it becomes necessary to select a representative sample of the population for the purpose of the study. The selection of a sample is a task which should be undertaken with great care. Every

member of a sample must have an equal chance to get into the sample. A sample selected in this manner is called a random sample. The opposite of a random sample is called a biased sample. The size of the sample depends on the level of the reliability and can be given by the following relationship.

$$\text{Reliability} \propto \sqrt{\text{Sample size}}$$

The selection of random sample is usually undertaken with the use of a table of random numbers. Following the discussion the participants were given a practical exercise in the use of random tables for the selection of a sample. If the population has certain group characteristics or divides into strata the sample selection is called a Stratified Random Sampling (SRS).

The next important step, Prof. Basnayake said, is the development of the instruments of the study. The instruments in the case of Science Education Research may be given as;

(i) Questionnaire
(ii) Interview
(iii) Test
(iv) Other forms of measurement

The participants were requested to commence the design of their tests and questionnaires in greater detail. They were required to find solutions to questions such as:

(i) "How many in the sample?"
(ii) "What is the form of the questionnaire?"
(iii) "What schools to select?"

Prof. Basnayake said that the design of the questionnaire required careful preparation. As a prelude to the preparation of questionnaires, participants were trained in the preparation of a table of specification (see Table III). This provides a guide to the preparation of the questionnaire.

TABLE III

Table of Specifications

TOPIC	Question Number			
	1	2	3	---------- 50

Each of the participants were requested to prepare the table of specifications to suit his project. The Course Directors then proceeded to discuss further the projects of the participants and to identify their main features and proposed approach to the study. A table containg;

(i) A project title
(ii) Type of project
(iii) Type of sample
(iv) Type of instrument

was prepared after discussion with each of the participants (see Table IV).

TABLE IV

A Sample of the Basic Features of Research Projects

PERSON	TITLE PROJECT	TYPE OF PROJECT	TYPE OF SAMPLE	TYPE OF INSTRUMENT
Abdul Rashed	Science Skils	Survey (Current)	Random Sample	Test of Practical skills
Abeysekara	Sc. Knowledge	"	"	Test of Knowledge
Alphonsus	Sc.Content	"	"	Questionnaire
Ambihivaran	Sc.Knowledge	"	"	Test of Knowledge
Ariarasah	Maths Aims	"	"	Intervies? Questionnaire? Test?

Mr Ranaweera and Dr Ratnayake then proceeded to outline the main features of each project in greater detail.

9. PROJECT ASSIGNMENTS

The participants were allowed free time during the post tea session so that they may complete the following assignments.

Assignment I

(i) Make a written statement of their proposed sample of schools etc.

(ii) How these schools are to be stratified

(iii) Within each school what further stratification is required

(iv) Number of subjects that are to be considered for each group

Assignment II

(i) Draw a table of specifications

(ii) Prepare a sample questionnaire/test material

They were required to submit to the Course Directors, their work on the next morning.

DAY 4 (4th DECEMBER 1980)

10. LECTURE VI: DATA PROCESSING IN A RESEARCH PROJECT - CONCEPTS OF STATISTICS by DR WINSTON E. RATNAYAKE, CONSULTANT/LECTURER TO THE TRAINING COURSE

Dr Ratnayake introduced the participants to the basic concepts of statistics and data processing during the course of which he covered briefly the items given below;

(a) Introduction

(i) Arrangement of statistical data

(ii) Distribution of population

Population distributions such as, Normal distribution, Binomial distribution, Poisson distribution were covered

(iii) Parameters that could be measured

Many parameters such as, mean, medium, mode were introduced

(iv) Spread of a population

The spread of a population in this distribution was discussed. Parameters such as, variance and standard deviation were covered

(b) Sampling Techniques

The study of the characteristics of a large population is usually achieved by the study of a representative sample. In order to make a sample representative a technique called 'random sampling' is adopted. This involves the selection of members in such a way as to give each member an equal chance in being selected. Variations of this method catering to certain group characteristics can be categorized as;

(i) Proportional stratified sampling
(ii) Equal size stratified sampling
(iii) Stratified sampling
(iv) Cluster sampling
(v) Systematic sampling

(c) Statistical Tests for Significance

The following concepts and tests for significance were discussed.

(i) Confidence intervals
(ii) Coefficient of variation
(iii) Students 't' test
(iv) Chi-square test
(v) Analysis of variance

II. LECTURE VII : GUIDELINES IN CARRYING OUT RESEARCH
by MR W.GUNAPALA, CONSULTANT LECTURER
TO THE TRAINING COURSE

Mr Gunapala said that his aims in this lecture was to present a set of guidelines which would help to carry out the research project. These guidelines should be down to earth and should enable one to arrive at a suitable research design.

Research may be of various types. Come of these are;

(i) Historical research

(ii) Descriptive research

Descriptive research may be, survey research, correlational research, causal-comparison research or ex-post facto type of research

(iii) Experimental research

Most early education research in this country has been of the historical type. While, survey research involves the gathering of information through survey questionnaires, correlational research involves searching for relationships between data so gathered.

The following factors have to be taken into consideration in the planning of a research study.

(i) Material and financial resources
(ii) Manpower resources
(iii) Time available
(iv) Constraints from the field

A careful assessment of the above factors has to be undertaken at the implementation stage and suitable modifications made in the aim and hypothesis or the research model/plan.

The type of questionnaire to be prepared depends on the purpose and is primarily of two types;

(i) Survey questionnaire
(ii) Opinion or attitude questionnaire

Mr Gunapala summarised the preparatory work in connection with the design of questionnaires into nine steps as follows;

(i) Drawing up of a list of themes
(ii) Writing of questions or statments under each time
(iii) Use of language and terms to suit the target population
(iv) Check each question and remove redundant ones
(v) Validating the instruments by obtaining views, suggestions and modifications
(vi) Give the questionnaire to a sample group
(vii) Check the response - note the weak or omitted responses and eliminate or modify such items
(viii) Calculate the reliability of the instruments by a suitable method and eliminate or modify the questionnaire
(ix) Draw up the final version of the questionnaire

Prof. Basnayake, Mr Gunapala and Dr Ratnayake then proceeded to discuss some problems raised by the respective participants.

12. LECTURE VIII: WRITING OF A RESEARCH PAPER by PROF. K.N.SENEVIRATNE, CONSULTANT/LECTURER TO THE TRAINING COURSE

Prof. K.N.Seneviratne explained the forms of scientific communication in a research study. There are several methods in which scientific information could be conveyed, among them were;

(i) Scientific lecture

(ii) Journal articles

(iii) Film

(iv) Scientific reports

(v) Dissertations/theses

Each of these has very special characteristics, advantages and dis-advantages. The most important medium of communication of results of research is the Scientific Journal. A 'Scientific Journal' consists of articles which have a special form and structure has been adopted as an accepted form of presentation. It usually consists of;

(i) Title page

The title page consists of a short and compact title sentence followed by the name of the author and the institution to which he belongs, and (or) the place where the reported work was done.

(ii) Abstract

The abstract is a short synopsis of the research article.

(iii) Contents

A list of contents becomes important in the case of a large volume of material. This gives an easy guide to reference.

(iv) Introduction

The introduction states the objectives of the research and identifies the problem clearly and provides background knowledge related to the problem. It also formulates the hypothesis which the study is designed to test.

(v) Materials

This section gives a description of material used for the study and where appropriate an indication of the sampling system uses.

(vi) Method

The method specifies the instrument, techniques used, the design, summary of questionnaire, validity and reliability of the method etc.

(vii) Results

This section consists of the basic data or facts gathered, illustrations, tables, drafts and drawings.

(viii) Discussion

The discussion is the area in which the author expresses his opinions, and comments regarding the significance of his results in terms of his stated objectives and hypothesis.

(ix) Summary

This section consists of a clear, short and meaningful synopsis of the article and may be omitted if the summary of the paper is already covered in the abstract.

(x) Acknowledgements

This acknowledges those to whom the author is indebted for their help in the conduct of the research, preparation of the paper etc.

(xi) References

The most relevant information sources which provide the necessary background are given under this section and are listed in a standard manner.

In conclusion Prof. Seneviratne said, that a research paper should be neatly typed, doubled spaced on one side of each page before being presented to the editor of a journal. It is best that the standard procedure be closely followed in the preparation of journal articles.

Prof. Basnayake and Prof. Seneviratne participated in the discussion that followed.

13. APPLICATIONS FOR RESEARCH GRANTS

Prof. Basnayake requested the participants to complete the research grants application forms given to them earlier. This will be considered for financial support at the Science Education Research Committee meeting scheduled for the next day.

Mr Anbalagan, Secretary SERC, explained the types of financial support being made available under the Research Grants Programme of the SERC. The budgeting procedure of the National Science Council and the financial regulations relevant to the preparation of budgetary estimates for projects were covered. The participants were requested to handover the completed forms to the Secretary, SERC.

DAY 5 (5th DECEMBER 1980)

14. REVIEW OF ACTIVITIES

Final research proposals of the participants containing details of the survey instruments of measurement were discussed by the Course Directors. Further polishing up of the project proposals were then completed.

Participants were requested to send in their project proposals along with the table of specifications and survey instruments within one week. The participants were allowed a free afternoon in view of the satisfactory progress achieved during the workshop.

15. AWARD OF CERTIFICATES

The Hon. Ranil Wickramsinghe, Minister of Education was greeted by Prof. Basnayake and Dr R.P.Jayewardene. Prof. Basnayake outlining the proceedings of the training course said, that there was reason to be happy about the progress made by the participants so far. However, the final outcome of the training course could only be measured in terms of the success achieved by the participants in completing their projects and publication of results within one year. As follow up action to the training course it was intended to conduct four progress review meeting during the course of the next year. He wished the participants success in their work. At the invitation of Dr R.P.Jayewardene, the Hon. Minister awarded the certificates to the participants. Prof. Basnayake s speech is given in Appendix V.

The Award Ceremony was followed by a fruit cocktail party and a dinner. The vote of thanks was given by Messrs Mr W.T.De L.Fernando and Mr J.A.D.Alphonsus, participants to the training course.

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A P P E N D I X

MEMBERS OF THE SCIENCE EDUCATION RESEARCH COMMITTEE (SERC)

Prof. V. Basnayake	Faculty of Medicine University of Peradeniya Peradeniya.
Prof. J.K.P.Ariyaratne	Department of Chemistry University of Kelaniya Kelaniya.
Prof. C. Dahanayake	Department of Physics University of Kelaniya Kelaniya.
Prof. K. Jayasena	Department of Pharmacology Medical School University of Peradeniya Peradeniya.
Dr R.P.Jayewardene (Ex-Office Member)	Secretary General National Science Council of Sri Lank 47/5, Maitland Place Colombo 7.
Prof. K.K.Y.W.Perera	University of Moratuwa Moratuwa.
Mr A.M.Ranaweera	Curriculum Development Centre Colombo 7.
Dr W.E.Ratnayake	Department of Biological Sciences University of Sri Jayewardenepura Nugegoda.
Mr N. Anbalagan (Secretary)	National Science Council of Sri Lank 47/5, Maitland Place Colombo 7.

APPENDIX II

LIST OF RESOURCE PERSONNEL

COURSE DIRECTORS

Prof.V.Basnayake	Professor of Physiology Faculty of Medicine Univ. of Peradeniya Peradeniya
Mr.A.M.Ranaweera	Director of Education Curricoulum Development Centre Colombo 7.

CONSULTANTS / LECTURERS

Dr.W.E.Ratnayake	Department of Biological Science University of Sri Jayewardenepura Nugegoda.
Prof.K.N.Seneviratne	Department of Physiology Faculty of Medicine Colombo-8.
Mr.N.U.Yapa	Librarian SLSTIC National Science Council of Sri Lanka Colombo-7.
Mr.D.A. Perera	Sarvodaya De Soyza Road, Moratuwa.
Mr.W.Sterling Perera	Director of Education, Educational Planning and Research Branch Ministry of Education, Malay Street Colombo 2.

Mr.W.Gunapala	Lecturer Faculty of Education University of Colombo Colombo.

RAPPORTEURS

Mr.U.M. Abeywardena	Curriculum Development Centre Colombo 7.
Mr.T.C.Wijesinghe	Scientific Officer National Science Council of Sri Lanka 47/5, Maitland Place.

LIST OF PARTICIPANTS

	NAME	ADDRESS
1.	Mrs.M.Abeywickrema	164, Vihara Lane Mulgampola
2.	Mr.J.A.D.Alponsus	22, Nawala Road Nugegoda
3.	Mr.C.Ambihavaran	J/Vigneswara Road, West Karaveddy
4.	Mr.William Ariarasah	5, Moor Road, Colombo-6.
5.	Mr.A.P.Ariyadasa	41/16, 'Siripoda' Ratwatta Mawatha Badulla.
6.	Mr.Y.M.Wijesinghe Banda	P/Ananda Balika M.V. Hingurakgoda.

7. Mr.D.N.A.Devasinghe	539/30, Puttalam Road, Kurunegala.
8. Mr.I.Eriagama	23/36, Siyambalagastenne Kandy.
9. Mr.M.P.W.Fernando	26/1, Walana Panadura.
10. Mr.W.R.P.Fernando	26/1, 'Dharani' Galkatuwa Thimbirigaskatuwa.
11. Mr.W.T.D.L.Fernando	'Sulani' Pahalagama Kakkapalliya.
12. Mr.S.Jayasinghe	'Deepthi' Weraduwa Matara.
13. Mr.J.M.D.Jayatissa	No. 145, 'Aruna Boragodawatta Minuwangoda.
14. Mr.A.Jeganathan	Inservice Teacher Adviser 'Chandrothayam'
15. Mr.B.M.Karunanayake	No.352, Ch/Mahawewa.
16. Mr.N.J.Liyanage	Field Centre, Training College Peradeniya
17. Mr.R.J.A.Navamani	17, Samanala Mawatha Watapuluwa Housing Scheme Kandy.

18. Mr.K.D.T.N.Panditharatna	Education Department Bandarawela.
19. Miss.S.Ponnambalam	No. 4, Saratha Street, Trincomalee
20. Mr.A.G.D.Ranaweera	205, Godagandeniya
21. Mr.V.Sivasithamparam	'Thalakanthai' Thunnalai South Karaveddy.
22. Mrs.S.Subasinghe	35, Wahegedara Road, Maharagama.

23.	Mr.Suraweera Arachchige Wimalasena Suraweera	No.40, Rajapihilla Road Kurunegala.
24.	Mr.Narayanapillai Swaminathan	Idaikdadu Atchuvely.
25.	Mr.Suntharampillai Thadchanamoorthy	14/3, Aponsu Avenue, Dehiwela.
26.	Mr.C.D.R.Wanigasekara	No.6, Ferry Road, Weragampitiya Matara.
27.	Mr.Dayaratne Weerasekara	29, Ariya Vilasa Road, Horana.
28.	Mr.H.P.Wickramasinghe	Education Department Kuliyapitiya
29.	Mr.N.Abdul Rasheed	Education Department Mannar.

List of Priority Areas for Research

1. Problems in science education arising out of the presence of large numbers of (unselected) pupils.
2. Problems of competition among pupils.
3. Problems arising out of the administrative organization of schools.
4. Philosophical conflict between science and other subjects in the school curriculum.
5. Science Education in primary school.
6. Promotion of team work among science pupils.
7. Problems of assessment :
   - (a) Continuous assessment
   - (b) Manintenance of stable objective standards of assessment.
8. Transition from Higher Secondary School to University.
9. Content of science eucation at Junior and secondary levels in relation to:
   - (a) time available to teach it
   - (b) mental development of the pupils
   - (c) resources available
10. Coining of new technical terms in swabasha vis a vis the use of international terms.
11. Social mobility through science education.
12. Textbooks
13. Subsidiary materials. Scientific data books and atlasses for identification of rocks, plants, mammals.
14. Teacher training.
15. Investigational work by science pupils.
16. Innovative procedures in the classroom.
17. Field work in science learning and teaching.
18. Feedback from teachers and pupils.
19. Mechanisms for revision of syllabuses.

20. Decentralisation of examinations.
21. Guidance to teachers for improvisation of apparatus.
22. Facilities available to science teachers to construct apparatus (spare parts, assembleable parts)
23. Bibliographical service to teachers.
24. Setting up of local groups for research in education.
25. Description, demonstration and doing in the process of teaching science.
26. Science reading and reference habits.
27. The transition form Lower Secondary (e.g. NCGE, G.C.E)'Level) to Higher Secondary (e.g. HNCE, G.C.E. A'Level).
28. Aims of science education as stated by curriuculum makers and as perceived by teachers and pupils.
29. Relationship between the content of science education and the mental development of the pupils.
30. Jobs which (are said to) require a background of science education.

MEDIUM PRIORITY TOPICS

1. Village technology and school science
2. Role of the mass media in science education.

LOW PRIORITY TOPICS

1. History of science education in Sri Lanka
2. Foreign aid and science education
3. Scientific literacy of persons who have science education
4. Science education and human behaviours.

SERC WORKSHOP. Closing session, 5.12.80

Speech by Professor Basnayake.

Hon'ble Minister of Education, Dr. Jayewardene, Ladies & Gentlemen,

The method of the Workshop which is now drawing to a close was to get each participant to turn into a Watchman. Look at the body of which you are a part, we told them. Yes, look at the educational system of which you are a part; notice its sores and deformities. ' I show you sorrow', said the Buddha. He also said, 'Be ye mindful'. The present Workshop was an exercise in mindfulness for the educational system. Each participant was asked to list three problems which he/she saw in the educational system; not just any three problems,but three problems which happened also to interest him/her, three problems which he/she would be prepared to study scientifically, with a view eventually to doing his/her small part in healing the sores and correcting the deformities. It is an exercise is self-help. The identification of three problems by each participant was done before the Workshop opened on December 1st, it was done in the application form which all applicants for the Workshop had to fill.

In the Workshop itself all that we did was to provide an atmosphere for the participants now to pick up just one out of the three problems which he/she had put down; and to define the problem accurately and narrowly so that it could be investigated and the investigation completed and written up within one year. Each participant then designed the proposed investigation of the problem. There was a personal commitment on the part of each participant to carry out the design when he/she gets back to station. That's where we are now, a bunch of fellows each with a design, a small scientific design.

The success or failure of the Workshop cannot be judged now, except in regard to lesser matters such as conviviality, of which we had much, and learning new things, of which we had some. The main objective criterion for success or failure of this Workshop will be whether, one year hence, the designs have been executed, the data assembled, analysed, interpreted, and written up in the form of a scientific paper.

In order to assist this long process we intend convening this group for a series of four one-day seminars during the course of the next nine months, in order to monitor the progress of the investigations.

It is the case, therefore, that the Workshop is not really closing. It is like those peculiar flowers which open and close, open again and close again, several times over. So today's closing is only the first closing.

Mr Ranaweera and I, as co-directors of the Workshop, thank you, Mr Wickremasinghe, for gracing this occasion by your presence here. We thank Dr Jayewardene, Secretary-General of the National Science Council, and his staff for the wonderful support they have given us. They did every thing they could, they couldn't have done more. We must make special mention of the services of Mr. N.Anbalagan, Mr.T.Wijesinghe, Mr.J.Chandrasekera, Mr.R.Fonseka & Mrs.V.Galapitage and also of Mr.U.M. Abeywickrema from the Ministry of Education. We thank the Science Education Research Committee of the National Science Council, and the Ministry of Education, for proposing the Workshop and selecting the participants. We thank the visiting lectures who gave us freely of their time and experience; and the librarians of the British Council, the curriuculum Development Centre, and National Science Council, and the Ministry of Education, for proposing the Workshop and selecting the participants. We thank the visiting lecturers who gave us freely of their time and experience; and the librarians of the British Council, the Curriuculum Development Centre, the National Science Council, and the University of Colombo, for showing us their libraries. We also thank each and every participant at the Workshop for their cooperation and hard work.

One of those peculiar flowers which open and close repeatedly is the nelum, sacred to the memory of him who sought to teach us, saying, 'Work out your own salvation with diligence'. All things change, decay and perish. But when this happens to the flower, a proper flower which has fulfilled its functions, would have set seed from which many flowers could eventually blossom.

Thank you.

(Prof. V. Basnayake)