A HANDBOOK
OF
METHODOLOGY OF RESEARCH

Editors

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FOREWORD

We are happy to bring out this revised publication on Methodology of Research. Many of our institutions of higher learning are involved in Research. Research is also a requirement for post-graduate students in many progressive universities. This book, it is expected, will be useful for all those interested in programmes of Research.

The Vidyalaya is grateful to the Editors and others who have participated in the Seminar and helped in bringing out this publication.

Sri Ramakrishna Mission
Vidyalaya
August 11, 1976

(T. S. AVINASHILINGAM)
Founder - Director

WORKSHOP COMMITTEE

Dr. Rajammal P. Devadas

Dr. K. Kulandaivel

Dr. H. Visvesvaran

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EDITORS' NOTE

A Workshop on Research Methodology was conducted by Sri Ramakrishna Mission Vidyalaya College of Rural Higher Education during May 1967, and as an outcome of that workshop "A Handbook on Methodology of Research" was brought out. Many research workers and institutions found the Handbook useful, and the copies were soon sold out. Hence this second edition was necessitated.

In order to revise and enlarge the Handbook and add some more useful material, a second workshop was conducted by Sri Ramakrishna Mission Vidyalaya Teachers College during November-December, 1974. This edition of the "Handbook on Methodology of Research" has emerged from the workshop. An attempt has been made in this Handbook to collect in one place, a number of general principles and techniques for conducting research in various fields of life sciences and social sciences and to explain them in as simple terms as possible.

The Handbook carries chapters written by experts in the fields of Agriculture, Nutrition, Industry, Biology, Statistics, Economics, Education and Extension. The required mathematical treatments have been kept as basic as possible. Several experts have assisted in bringing out this publication. We acknowledge gratefully the help given by Dr. B. C. Muthayya, Dr. M. Radhakrishnan, Dr. K. Kulandaivel, Dr. H. Visvesvaran, Thiru T. R. Soundararaja Rao, Thiru T.N. Rajarathnam, Thiru M. Feroze, Thiru P.A. Gurusamy, Dr. Godavari Kamalanathan, Dr. Usha Chandrasekar, Dr. Nirmala Murthy, Tmt. Lakshmi Santha Rajagopalan, Selvi S. Sithalakshmi, Dr. E. G. Vedanayagam, Dr. Janabai Giri and Thiru N. Krishnamurthy for their valuable contributions.

We are thankful to Dr. H. Visvesvaran, Principal of Sri Ramakrishna Mission Vidyalaya Teachers College for his immense help in co-ordinating the workshop, compiling the manuscript and for having seen the script through the press. We also thank Thiru T. R. Soundararaja Rao, Professor, Sri Ramakrishna Mission Vidyalaya Teachers College, for the valuable assistance rendered.

It is impossible to express in words our gratitude to our Founder Sri T. S. Avinashilingam for the valuable opportunity given, and for his continued inspiration and guidance.

DR. RAJAMMAL P. DEVADAS
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CHAPTER 1

MEANING AND FUNCTION OF RESEARCH

Rajammal P. Devadas

Meaning of Research

Curiosity has been the unique characteristic of man since his appearance on earth. He has been endeavouring constantly to satisfy his curiosity, turning all stones. Seeking answers and clarifications to his many questions and doubts has been his drive from time immemorial. From such incessant efforts human civilization has resulted. Man's insatiable thirst after discovering the unknown has laid the foundation for scientific advancements and technological inventions.

Research, in its simplest form, is a matter of raising a question, and then trying to find an answer. It is not something remote or set apart on a pedestal but very much part of our everyday happenings. Research means inquiry based on logical systematization of ideas, appreciation of scientific procedures and application of statistics. It is the scientific, orderly and intensive process of fact finding, experimentation, analysis of data and arriving at valid conclusions (Best, 1963). Thus research is essentially a systematic inquiry born out of an urge to seek answers to problems and ways and means to change the *status quo*, that is, the existing conditions.

According to Schlater (1970) research is the systematic, controlled empirical investigation or hypothetical proposition about presumed relations among phenomena. Being systematic and controlled, research gives the scientist confidence in the outcomes. Being empirical, research provides a means for testing beliefs or hypotheses against objective reality.

Research seeks facts through objective methods (Gopal, 1964). It involves selection of the research problem, exploration towards developing the methodology, standardising the approaches and measurements and achieving results.

Over the course of time, man has used several methods to find answers to his questions on mythology, supernatural phenomena, personal experiences, customs, traditions, voice of authority and syllogistic reasoning. His endeavours have given rise to the growth of scientific knowledge and scientific method of research accompanied by mathematical precision, accuracy, objectivity, statistical verifiability, impartiality and expertness. The scientific method eliminates the weaknesses and drawbacks inherent in the ordinarily used arbitrary speculations, assumptions and methods.

Functions of Research

Man's capacity to enjoy and improve the world around him has been shaped by scientific research. His progress, today, is directly proportionate to his ability to understand, appreciate, apply and enjoy the fruits of scientific research. What he has learned from the natural science has influenced the material things used in daily life. It has an impact on the political institutions-domestic and international. It influences the extent of his self-regard, understandings and attitudes. Research applications help him to enhance his abilities and extend his powers freeing himself from the limitations imposed by ignorance and age-old superstitions.

To understand the empirical world, facts must be discovered and theories developed. Such theory, which is intricately related to facts, is the basis of science. It is generally believed that theory and facts are opposites. Theory is regarded as speculative and facts as definite. But scientists view theory as meaningful ordering of facts and factual relationships to explain and predict different phenomena. Theories cannot be developed without research based data. Research alone can suggest studies for testing the validity of theories. Therefore, research contributes to development and testing of theories, by clarifying concepts and initiating, reformulating, and restructuring theory.

Research and theory development must proceed together to increase the quantum of knowledge. A scientist may start with either of these, but eventually he must consider the bearing of his work on their interrelationships. Viewed thus, the problems which require investigation are endless in any field of study. New areas for exploration open up every day, and discoveries already made, suggest limitless possibilities for further research (Schlater, 1970).

Research gathers new knowledge or data from primary or first hand sources. While placing emphasis upon the discovery of general principles, research goes beyond the specific groups and situations investigated and infers qualities of the entire population from those observed in the smaller units by careful sampling and procedures.

Characteristics of Research

Research is logical and objective, applying every possible test to verify the data collected and the procedures employed. It endeavours to organize data in quantitative terms. Patience in exploration, plodding without hurry, scientific integrity are the cardinal foundations for research. These qualities require great courage and vision.

Good research has its findings carfully recorded and reported. Every term is defined clearly and all the procedures are described in detail. The limiting factors are recognized and spelt out. Statements of figures and opinions are carefully documented. Results of research are presented and discussed with objectivity. Conclusions and generalizations are arrived at cautiously with due consideration for the limitations of methodology, data collection and errors in human interpretations (Aggarwal, 1966).

Good (1959) explains the characteristics of good research in the following statement :

" If he questions his explanations, the stage is set for research;
If he goes further and challenges the methods by which he arrived at his conclusions,
If he critically and systematically repeats his observations,
If he devises special tools for taking, recording and analysing his observations,

If he tests the reliability and validity of these tools and evaluates his data,

In other words, if he scrutinizes the thought processes by which he passes from one step of his logic to another,

If he refines his content of what he is trying to explain and considers anew the necessary and sufficient conditions for proof,

If at every step he proceeds with the utmost caution, realizing that his purpose is not to arrive at an answer which is personally pleasing, but rather one which will stand up under the critical attacks of those who doubt his answer,

If he can meet these criteria and steadfastly hold to his purpose,

then he is doing research ".

Steps in research

Schluter (1966) has listed 15 steps, as characterising creditable research. They are :

1. Selecting the field, topic, or subject for search.
2. Surveying the field to perceive (apprehend) the research problem.
3. Developing a bibliography.
4. Formulating or defining the problem.
5. Differentiating and outlining the elements of the problem.
6. Classifying the elements in the problem according to their relation (direct or indirect) to the data or evidence.
7. Determining the data or evidence required on the basis of the elements in the problem.
8. Ascertaining the availability of the data or evidence required.
9. Testing the solvability of the problem.
10. Collecting the data and information.

11. Systematizing and arranging the data preparatory to their analysis.
12. Analysing and interpreting the data and evidence.
13. Arranging the data for presentation.
14. Selecting and using citation, references and footnotes and
15. Developing the form and style of the research exposition.

Research in pure and applied sciences and behavioural sciences

The approach and methodology for research in physical and life sciences and social sciences are similar and the objectives common, namely, *human happiness*. However, there are some basic differences between their qualities and hence in their measurements.

The basis for research in behavioural and social sciences lies in the real world. The laboratory for behavioural research is in the human organisations, banks, factories, markets, governments, villages, temples, schools, colleges, clubs, associations and families. On the other hand, investigations in physical and biological sciences use mostly materials, equipment, mechanical lines and improvisations as the basis for their research studies. Table 1 shows the differences between research in pure sciences and behavioural sciences.

Table 1. *Differences between Research in Pure Sciences and Research in Behavioural Sciences*

Sl. No.	Behavioural Sciences	Pure Sciences
1	2	3
1.	The measurements are especially subjective, the data being opinions, reactions, impressions and statement of values	The measurements are mostly objective, since they measure physical dimensions and parameters.
2.	The measurements are generally qualitative.	The measurements are quantitative, through precision equipment and measures.

1	2	3
3.	Difficult and almost impossible to get paired or matched samples for experimental and control groups.	Easy to get paired samples such as litter mates in animal experiments, inbred colony, and minimised genetic variations for agricultural and microbiological work.
4.	Experimental conditions and variables are difficult to be controlled.	Control can be established adequately.
5.	Standardisations are not feasible.	Standardisations are easily achievable.
6.	Emotional factors cannot be eliminated.	Emotional factors do not come into play.
7.	Size of the sample is limited.	Any size in sample is easily obtainable.
8.	Heterogeneity in sample is inevitable.	Homogeneity in sample is feasible.
9.	Not easy to reproduce results	Results can be reproduced easily
10.	Moral considerations are important.	Moral considerations are not limiting factors.

Co-ordinated (inter-disciplinary) research

Co-ordinated research is characterised by flow and channelising of ideas from one discipline to another. In coordinated research, because of the contribution of several disciplines or areas, hidden facts become uncovered quicker and discoveries are made fruitful. Instead of groping in the dark in an isolated manner and flitting from interest to interest without achieving results, co-ordinated research helps to pin point action and is conducive to consistent effectiveness and productive scholarship.

As coordinated research advances, ideas accumulate and the earlier ideas take on new meanings. As a result, fresh opportunities for exploration are disclosed rapidly and frequently. Much time, money and effort are saved in constructively coordinated research. Examples of coordinated research abound in the educational field. At present, educational research is undergoing a period of great expansion due to the factors listed below :

1. Increase in scientific applications and values within our society.
2. The tremendous gains in scientific discoveries have opened our eyes as to what can be achieved through research.
3. The rapid technological changes have brought about an increase in educational problems. Both the layman and the educator have recognised that only through research we can have better educational methods and make sweeping curriculum changes to meet the educational challenges of a highly technical and rapidly changing society.

Factors which hinder research

The factors which exert a retarding influence on research are:

1. Old time traditions in personal life or in the community.
2. Lack of time, energy and resources.
3. Failure of previous research activity.
4. Opinions of administrators that a particular research project is not conducive to benefit, profit or welfare.
5. Difficulties in research procedures.
6. Assumption that research is the business of a few armchair academicians.
7. Super-sensitive and temperamental research workers and influential administrators.

The research worker needs patience in abundance. He needs to be kind towards his fellow workers. Thus for a career of scientific investigation, curiosity, imaginative insight, crucial judgement, honesty, retentive memory, patience, good health and generosity are essential. When researchers disagree or when a mistake has been made, the announcement of the correct observations or criticism of the erroneous report should be so expressed as not to cause hurt to anyone.

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CHAPTER 2

IDENTIFICATION OF THE RESEARCH PROBLEM

Rajammal P. Devadas, K. Kulandaivel & T. N. Rajarathnam

Introduction

Scientific research has helped man to increase his capacity to enjoy and improve the world around him. Learnings from physical and natural sciences have influenced the material things that shape his life. The staggering advancements of the present times are outcomes of research. Thousands of people have been working on several research projects all over the world. Planned training, specialised equipment and systematic work have given clear insights into the intricacies of scientific principles. They have changed the human systems and enhanced man's understanding of himself. They have helped man to increase his ability to appreciate his resources and free himself from the limitations imposed by the material world, ignorance and superstitions.

Identifying and analysing a problem is a prerequisite for research. Exploratory Research and Problem Assessment (ERPA) aim at identifying natural problems suitable for analysis and solution, using the methods of science and technology. In addition ERPA help in the development of improved means for forecasting the impact of new technologies on man and his environment.

Research is born out of man's problems. To satisfy man's craving for more understanding, to improve his judgement, to add to his power, to reduce the burden of his work, to relieve suffering and to increase satisfactions are the fundamental goals of research. Thus research becomes a tool of great power in finding answers to man's quest after knowledge. All the great advances in science, technology and behavioural research, and the vast body of scientific facts we now have at our disposal have come out of man's persistent efforts in research. As civilization progressed many social changes emerged embracing all fields of knowledge such as, the basic and applied sciences, sociology, economics, psychology and others. As scientific thought advanced man's needs increased with his aspirations extending their horizons, with an ever increasing assembly of problems. Today every aspect of life is full of difficulties and problems, the solutions of which demand the research approach.

When we meet problems, we seek their solutions. Many problems need to be resolved in today's world. For example, poverty, malnutrition, human interactions, environmental pollution, price rise, inflation, relationships and work simplification are some of the pressing problems.

Solutions to some problems are in the form of behavioural adjustments involving changes in outlook, aspirations, understandings, approaches, reactions and responses. Solutions to others deal with effecting changes in the infra-structure and external environment. "Thus research is born out of problems and man's determination to solve problems."

A host of problems await solutions with variables such as, time, place. cost, community, administration, organisation, learners, teachers and the curriculum. However one often meets with inability to identify research problems that are clearly discernible. Ability, perception and insight are essential to recognize problems. A background is necessary to sense the processes which need clarification in the homes, school and society. The practical issues and their research perspectives need to be perceived. A great deal of thinking and reading are needed for perceiving the research problem. As Pasteur said, " In the field of observation, chance favours only the prepared mind ". The careful observer notices and interprets clues.

Goals and Criteria for Identifying Problems for Research

Schlater (1970) gives some of the following goals as frame work for identifying research problem, for evaluating current research programmes and for determining programming adjustments need to make research viable.

1. To improve the conditions contributing to man's psychological and social development.
2. To improve the conditions contributing to man's physiological health and development.
3. To improve the physical components of man's near environment.
4. To improve consumer competence and family resources use.
5. To improve the quality and availability of community services which enrich family life. and
6. To improve citizenship, and foster patriotism and national integration.

Research goals, problems and areas of study are interrelated. Identifying research problem areas involves the use of the following criteria. The area should be one which :

1. Is well defined and significant to the development and well-being of individuals and families in our society and other societies as well.
2. Is capable of having the major subject achieve the stated goals through basic and applied research.
3. Contains specific questions or hypotheses that can be answered or illuminated by research findings.
4. Combines research efforts with action programmes: but does not deal with them exclusively. and
5. Is relevant to Society's present and future concerns and identifies particular contributions of the investigator.

The sequence in which problem and areas of investigations are listed does not imply priority of importance. Establishing priorities for research activity is the concern of the institution undertaking research It involves taking into account the most pressing and imperative needs, their urgency, personnel, available consultants, co-operators, services and other resources necessary for carrying out the research.

Goal I - Improve the conditions contributing to man's psychological and social development

The family is the basic unit in the social structure. Since the child's earliest moral, social, psychological and physical development occurs in the family, his early background and interactions with his family are crucial. For building a stable and viable democracy, we need to learn more about the behavioural aspects of the different segments of our population which is the greatest national resource. The most fundamental social unit of this resource is the family. In the present time, people of all ages, especially, the young need to re-examine their traditional roles and values and behavioural patterns in the context of the problems encountered in the changing and merging roles of men and women. They need to identify the problems and cope with the turbulent changes which are rocking contemporary society. The family can play a unique role in dealing effectively with these issues. Throughout history, families have coped with a variety of problems. However, the present differs from the past, in that technological, economic, social and political changes have been so far-reaching, swift and global in their effects, that the results are confusion, frustration and conflicts, arising from individual and family loss of identity. Therefore the family needs the knowledge which research alone can provide.

This leads to the fundamental issue of improvement in education, which has emerged as a national problem. Educators, administrators, officials, and private citizens are all searching for the type of educational systems and approaches which will enable each individual to develop to his maximum potential, with a strong foundation of national identity. Research can help to identify the many issues of concern to individuals and families which require new knowledge about the inter-relationships between man and his physical and social environment.

The broad research problem areas related to this goal are :

1. Social, emotional development
2. Cognitive development
3. Family structure and functions in the changing context
4. Roles and role behaviour
5. Family relationships
6. Parent-Child relationships
7. Family planning and
8. Impact of social and technological changes.

Goal II - Improve the conditions contributing to man's physiological health and development

Human physiological development is intimately bound together with the psychological and social aspects. Modern concept of health means more than the absence of disease. It encompasses the total physical, social, mental, emotional and spiritual well-being of the individual.

In the past, research in physiological health had been largely in the areas of disease control, nutrition and food sciences. Treating, as an entity, the physiological and psychological components which are inextricably knit together, is signal in effecting a research break-through in the future. The influence of the family and community environment on physiological health and development should be explored.

Research endeavours need to concentrate on alleviating hunger and malnutrition. Efforts must be expanded towards assessing the adequacy of available food supplies, finding new foods and better distribution methods, and communicating to the people effectively the relation between nutrition and health. A new field for investigation is the interrelationships between nutrition and a variety of addictions, which are now reaching critical levels in some sub-population groups, staking the health of not only this generation but also that of the generations to come. The broad research problem areas related to this goal are :

1. Nutrient requirements and metabolism.
2. Nutritional status
3. Food supply, composition and safety
4. Food patterns
5. Health related variables

and 6. Food service systems

Goal III - Improve the physical components of man's near environment

The interdependence of man and his environment has implications for all the research goals. The immediate external physical components are housing (shelter) and clothing. This immediate environment of housing has significant social implications. It should satisfactorily accommodate man and his many activities and interactions. In addition to accommodating man's social needs, it should provide comfort, contentment, health and economic, psychological and aesthetic satisfactions.

Housing is the spatial environment in which man exists and interacts. Clothing comprises the most proximal near environment which influences man's many interactions with others. These reflect also the wider social environment with many inherent problems of research. The highly populated and industrialized environment has created many new and pressing problems. The widespread disregard for the aesthetic and humanizing aspects of man's environment has resulted in indescribable ugliness in many parts of the nation. The relationships between blighted environment and blighted human beings should be understood by both industry and government and high immediate priority must be given immediately to correct the damages already done.

The broad research problem areas related to this goal are :

1. Housing and environs : human needs
2. Housing and environs : economic aspects
3. Housing and environs : Psycho-socio-cultural aspects.
4. Housing and environs : aesthetic aspects

5. Clothing : human needs
6. Clothing : economic aspects
7. Clothing : Psycho-socio-cultural aspects
8. Textile and textile products : properties and performance
9. Clothing : creation and design.

Goal IV - Improve consumer competence and family resources use

The consumer is often forced to make decisions without adequate and valid information. Consumerism has not received the attention necessary in India to protect the consumers' health and provide security to them. The consumer needs to be informed about resource and credit management, legal and civil rights, and the channels for maintaining them. He must be educated to communicate his needs to business and industry.

Research is needed to provide new insights into consumer behaviour, to supply valid information about goods and services, and to add to the understanding of behavioural factors. Knowledge is also needed about the management and decision making processes to understand consumer choices. Management, with its essential elements of values, goals and resources, is especially important to consumer competence. The ability of families and individuals to identify values, formulate goals, and use effectively their resources affects not only consumer satisfaction, but satisfaction in all other aspects of living as well.

Research in the area of levels of living presents one of the greatest challenges today. Goods and services acquired in the market need to be subjected to quantitative measurements. More difficult is the assessment of the intangible attributes of preferences, fashions, notions and objections and their motivations.

The broad research problem areas related to this goal are :

1. Consumer service needs
2. Consumer values and behaviour
3. Consumer choice making and behaviour

4. Consumer and the marketing system
5. Management and decision making
6. Processes and situations
7. Resource development, allocation and use
8. Levels of living

Goal V - Improve the quality and availability of community services which enrich family life

The early society consisted of self contained and self sufficient individual units. But now it is characterized by many complex interrelationships at the community, state and national levels. Numerous governmental and private agencies and services carry out programmes to strengthen and enrich certain aspects of the community. How far they are successful is doubtful. Existing weaknesses in different family and community programmes may be attributed to faulty planning and public apathy. The organizational and administrative handicaps under which these agencies operate, constitute a fertile field for research.

It is human tendency to be concerned about one's own family and property but neglect public undertakings and property although they are part of the larger family - the community and the nation. This lack of concern manifests itself in many ways. One is the limited support for and participation in family planning and other programmes. Another is the failure of the public to consider the effects of anti social expression on the family.

Goals need to be defined and accomplished for establishing programmes which contribute to the well-being of all the families. Team approaches to problem-solving are necessary in both research efforts and action programme at the community, state and national levels. Current challenges and opportunities for contributing to social programme are great. They will provide a base for fruitful and co-operative research efforts. The existing programme need to be expanded or modified and new ones developed.

The broad research problem areas related to this goals are :

1. Community programmes and needs
2. Health delivery systems, safety and recreation programmes
3. Youth problems
4. Continuing education programmes
5. Feeding and day care programmes for pre-school children
6. Family influence on and response to public programmes.

and 7. Minority Groups : Their needs.

Goal VI - Improve citizenship, patriotism and foster national integration

One of the tragic developments after independence is the growth of fissiparous factors which impede national integration. Linguistic divisions and conflicting goals of state governments have created isolationist tendencies and fear for the future security of people. The nation cannot become strong with these dividing forces. Research is needed in the following areas :

1. Defining national character
2. Factors which bind the nation together
3. Factors which impede national integration
4. Methods of inculcating citizenship qualities in children
5. Eliciting the participation of the community in national efforts

and 6. Testing literature and other aids to foster national spirit.

The ultimate goal of research is to maximise the satisfactions and well-being of individuals and families through increasing knowledge and understanding of man and his immediate environment in his physical, cultural and social milieu. This goal must focus attention upon the reciprocal relationships between man and the quality of his near environment. Earlier research considered man and his immediate environment as distinct entities with scarce attention to the interactions between them. Future research should reflect more concentration and effort at the interfaces. A major impediment in dealing with the problems of the environment and the effective utilization of natural resources is our lack of understanding of the basic mechanisms in population biology and ecology. Better biological insights will help towards the solution of many urgent problems facing society today such as lack of sanitation, environmental pollution, diseases, inflation and other maladies. These problems are all real. But they cannot be solved by inactivity or pooling ignorance. Extensive data collection and analysis, with formulation and testing of alternative technical and social solutions are required. In order to accomplish these, best scientific insights have to be gained.

Environmental improvement is costly but feasible with judicious application of technology based on sound research. The toxic materials need not be added to air, land or water in significant amounts, although zero tolerances will never be possible. The greater the recycling, the easier will be the solution. This will require an immense amount of research. Again energy is the key to the future well-being of mankind. By skilful planning, intensive research and analysis we will be able to enhance our material standard of living with the physical resources which Mother Earth has bestowed on us. Out of satisfactory conditions of living, will then emerge a just society.

Perception of the Research Problem

Life is full of problems. An intelligent and efficient man progresses in life by identifying his problems and by solving them one by one like one who proceeds into the forest by cutting the thorns and clearing the bushes in his way. A dull and inefficient man does not realise the problems he is facing, and even if he dimly realises them sits idle and confused, unable to solve them. Millions of people before Newton saw apples or other fruits falling down from trees. But it did not pose any problem to them. They thought it as a normal thing and did not consider it worth bestowing any attention. But Newton's alert and inquisitive mind saw a problem in the falling of an apple and solved it by the discovery of the law of gravitation. The same was and is the case with all inventors and discoverers.

John Dewey in his famous book 'How We Think' points out that reflective thinking, which is the special feature of human beings, takes place only when there is, a problem-solving situation. One who does not have any problem does not and need not think constantly and solve them. Dewey lists the following five steps for developing reflective thinking.

1. The occurrence of a felt difficulty
2. Definition of the difficulty in terms of a problem statement
3. Occurrence of a suggested explanation or possible solution-a guess, hypothesis, inference or theory.
4. The rational elaboration of an idea through the development of its implication by means of the collection of data (evidence)
5. Corroboration of the idea and formation of a concluding belief through experimental verification of the hypothesis.

So identification of problems and solving them are essential for developing reflecting thinking.

Why is it that some people are able to identify problems out of what seem to be normal phenomena while others are not able to do so ? The answer is that these people who identify and solve problems have some special traits which are conducive to research while others do not have them. "The hold of Aristotle's organised information and generalizations on the medieval mind is well known. Disagreement with his written word was not permitted in the first universities. It was not until the time of Francis Bacon (1561 - 1626) that definite suggestions began to bear fruit in a more effective attitude toward the problem of living. His irrepressibly curious mind doubted everything in terms of endless induction and comparison. His exposition of better ways for considering and doing things gave impetus to a swifter shift of methods of attaining human knowledge from authority, through shallow speculation, to hypothesis and experimentation". These special traits induce people to see problems, solve them and expand the frontiers of knowledge. Bacon in the following introspective analysis gives the special traits possessed by him which obviously made him a great thinker and discoverer.

" I found in my own nature special adaptation for the contemplation of truth. For I had a mind at once versatile enough for that most important object—I mean the recognition of similitudes—and at the same time sufficiently steady and concentrated for the observation of subtle shades of difference. I possessed a passion for research, a power of suspending judgement with patience, of meditating with pleasure, of assenting with caution, of correcting with fault impressions with readiness and of organising my thoughts with scrupulous pains. I had no hankering after novelty, no blind admiration of antiquity. Imposture in every shade I utterly detested. For all these reasons, I considered that my nature and disposition had, as it were, a kind of kinship and connection with truth".

An anaylsis of the common personality traits of outstanding research men show that they all possessed traits such as "reasoning power, accuracy, intellectual honesty, open mindedness, objectivity, originality, discernment, excellent memory, independence, persistence, purposefulness, alertness, application, executive ability and the like. While some of these traits may be inborn most of them can be acquired by proper training, experience and acquiring adequate mastery in the field. So it is necessary to institute courses and organise seminars and workshops to prepare the research workers and inculcate in them the above traits.

Besides these traits there are other important factors that are important to identify problems for research. One such factor is the passion for knowledge or the intense feeling, or the feeling of identity one has with the particular area of knowledge. While groundnut did not pose any problem to millions of people all over the world it posed many problems to Washington Carver, the Negro Scientist, and he was able to discover many things about groundnut. It was his intense feeling for the welfare of the groundnut cultivators that made him take interest in groundnut and identify many problems and solve them.

Take for example the establishment of Sri Ramakrishna Mission Vidyalaya. Why did the founder start Vidyalaya? His intense love for his countrymen, and his passion to the freedom of India and its reconstruction made him identify some of the pressing problems in the field of education. He felt the need for giving the young men and women a spiritual and national education which would develop them into spiritual minded patriotic citizens who would work for the amelioration of this country. While thousands and thousands of educated people did not identify this problem Rev. Ayya Avl. could do it and solve it to some extent by starting the Vidyalaya here and the women's institutions at Coimbatore.

Another important factor is having adequate mastery in that branch of knowledge. A novice to a field does not feel any problem. Everything is new to him and his time is mainly spent in understanding things. He is not able to think critically or identify problems that stand in the way of progress. After getting considerable experience and mastery of the field one is able to go beyond, penetrate through the facts and information and see problems. When Gandhiji returned to India from South Africa, his Guru, Gokhale, gave him a sound advice. He told Gandhiji " Don't go about lecturing about the problems of India and their solution. Be silent for a year. Go round the country, observe things and have first hand experience. When you feel that you have understood the problems of the country then begin offering solutions". Gandhiji followed this advice implicitly and gained enormously. When we admit candidates for the M. Ed. Degree course we have always felt a teacher with five or ten years teaching experience is able to identify more problems in education than a newly trained teacher.

Thus mastery and acquaintance with the field of knowledge does not increase simply in proportion to the number of years of service one has put in. But it increases with the contacts which are established with the field of knowledge. Study of books, magazines, research reports, attending teachers association meetings and listening to and participating in the discussions, academic conversations with fellow teachers, listening to the learned talks of experienced persons in the field and establishing contacts with such persons increase one's mastery in one's area of knowledge and help to identify problems. When we study about the educational institutions and achievements of students and teachers in other countries we can compare our situations with them. These will help us to identify many problems in Indian education. Sometimes while teaching in classes we come across many problems. But they strike our mind like lightning, like a flash and vanish immediately. We should make note of these problems then and there and give shape to them at leisure. When we study research reports they point out further areas of research that can be pursued by others. These may kindle one's imagination and one may be able to find suitable problems for research from these suggestions.

U. A. McCall of Teachers College, Columbia University lists five ways to discover experimental problems.

1. The best way to find genuine experimental problems is to become a scholar in one or more specialities as early as possible.
2. A second way to discover fruitful problems is to read, listen and work critically and reflectively.
3. A third method of discovering fruitful problems is to consider every obstacle an opportunity for the exercise of ingenuity instead of as an insuperable barrier.
4. A fourth method of finding problems is to start a research and watch problems bud out of it.
5. A fifth method of finding problems is not to lose those already found.

A. M. Rose says that "scientific genius reveals itself in the choice of problems that it makes ...... And this ability to see and formulate a meaningful scientific problem is an artistic gift."

The art is that of having original insight into "important" issues. This requires that one should be well-informed regarding the facts and theories in his field and have a great deal of patient thinking.

Sources of problems

As far as the beginners in research are concerned, the foremost problem is identifying a suitable problem for their studies. It is often found that many research students come to their guides either with problems already investigated by their predecessors or with problems that are too broad in scope. This may be due to their lack of clear understanding of the nature of research and their over enthusiasm and desire to solve an important problem quickly and immediately. "It is often repeated that our College and the University students are problem blind. They have eyes, but they do not see. They have ears, but they do not hear. They go to their guides with a vacant mind." So it is pertinent now to discuss in some detail the sources from which one may get a research problem or from where one can develop a sense of problem-awareness.

1. *Specialisation*

The scholarship that one gets as a result of specialisation in one or more of the chosen fields will reveal the problems already covered by research and the problems yet unsolved. Specialisation helps us as a background in the identification and solution of the problems. For example, a student who is studying Sociology at his Master's Degree level can choose 'Leadership' as his area of interest or specialisation. Though many studies are available on this subject, still there are problems which await scientific investigation. For instance, "This changing pattern of Leadership" particularly with reference to Panchayati Raj Institutions and Cooperatives yet remain unexplored or little explored. These being the basic institutions of our villages, such studies are very urgent and important in the context of the growing importance of Community Development Programme and Cooperative Movement in India. That is to say that every research student must thoroughly and completely review the literature in the field or in the area of his interest. If a researcher obtains an extensive background in a special field, he may challenge the existing theories. Moreover contradictory findings that are reported in the literature may alert him to the existance of a problem.

2. *Observation*

Observation is recognised as one of the important tools of data collection not only by physical sciences but also by social sciences. It is said Science begins with observation and ultimately returns to observation for its final validation. Observation does not stop with mere seeing; it is more than that. Research-oriented observation is different from routine observation. Here the observation is planned systematically, recorded scientifically, is made on the basis of a central proposition and checks are made for the validity and reliability of the data. Therefore every student of Social Research must cultivate a sense of keen observation so that he may understand what is going on around him, for it may lead him to properly identify the problems that must be taken up for research. For example, the cooperatives are functioning in our country at various levels. Sometimes their functioning in a democratic manner is questioned. A student of cooperation has ample opportunity to confirm or deny this statement. He must therefore keep his eyes open and ears alert to obtain all relevant information to come to a decision on such a controversial issue. In short, only a keen observer can locate the real problems, facing his society or nation.

3. *Consultations*

For the research students who work at any level, an important source of problem is their research guide and the other faculty members. Their teachers having done some research of their own and having studied the existing literature in the field are placed in a better position to properly guide their wards in choosing the problem for research. Therefore the research scholars must hold frequent discussions and consulations with their teachers either for locating a problem or for delimiting it. However, the students' own interest in the problem must not be sacrificed.

4. *Repetition or extension of investigations*

There are numerous problems in humanities that remain open for solution. Social problems are not settled for all times to come. It has become increasingly necessary to repeat some studies because of changes in time and regional differences. For example, the determinants of rural leadership may undergo change over a period of years. Caste may be a consideration at one point of time and education and political affiliation may be considered important at another time in the same community. Under these circumstances, repeat surveys assume greater importance. Another type of repetition is regarding the geographical area covered by the study. The diffusion and adoption of improved agricultural practices is a case in point. A number of studies on this subject has been made in U. S. A., but such studies are yet to make progress in India.

Similarly some studies may have to be repeated by extending their scope and refining their methods of attack. In this way some studies which are exploratory may be converted into analytical studies with more rigorous methods of data collection and statistical analysis.

Other sources for identifying research problems are :-

1. Various stages of the instructional programme which brings to light gaps and lacuna in knowledge.
2. Keeping notes.
3. Exposure to professional stimulation through attending seminars, meeting experts and so on.
4. Examining the existing practices and needs.
5. Extension programmes and investigations.

6. Field studies and action programmes.

7. Industry.

8. Developing a critical outlook.

Apart from these sources, the student may also turn to studies in progress for hitting upon a problem. Any one of these sources independently or a combination of the sources may be tried for selecting a problem.

Besides the factors considered so far, the choice of a research problem is influenced by certain personal and social considerations which are discussed below.

Personal Consideration

1. *Calibre of the researcher vis-a-vis the problem*

It is often said that the researcher must be equal to the problem under investigation. In other words, the problem should be neither too big nor too small for the researcher. In the former case it may lead to the failure of the project because the problem is too unwieldy and unmanageable for the researchers. In the latter case there may not be real challenge to the researcher with the result the study may not be carried through its completion in a manner which may be desired.

2. *Interest*

The problem should be such as to attract the investigator instinctively. Without substantial interest in the problem, the investigator will not be able to go all out for its investigation. Scientific and intellectual interests help to identify a wide variety of research topics. But at the same time he must see that he is free from strong biases towards the problem.

3. *Novelty and avoidance of unnecessary duplications*

The problem must have novelty. While selecting the problem the investigator must make sure whether enough research has been already done on it or not. Futile problems, i. e., problems that have been solved already are not worth considering for research.

4. *Training and personal qualifications*

While selecting the problem for research, the researcher should see whether he possesses the requisite qualifications to solve it. Qualifications do not mean mere educational qualifications. In addition to educational qualifications, he must be well acquinted with the methodology of research. For example, a student who wants to take a research study in Sociology must not only thoroughly acquint himself with the classical and modern developments in the subject but also keep pace with the development of Social Research Methodology.

5. *Availability of data and methods*

Data are the raw materials for research. They may be of two kinds. i. e., Primary data and Secondary data. What type of data are needed in a given study depends to a large extent on the nature, scope and objectives of it. In some studies only secondary data may be sufficient. In some other studies both primary and secondary data may be necessary. In any case the researcher must make sure whether the data on the problem are readily and easily accessible to him. If the required data are not forthcoming readily, it is advisable to either drop that problem or modify it in a suitable manner. There are several such problems in humanities where collection of data is very difficult. For example when studying problems connected with genesis and development of institutions like co-operatives and panchayats, all relevant records and documents are not easily made available by the authorities to the researchers. They may at the most give only those records which may present a rosy picture about the functioning of these institutions. Under these circumstances, it is impossible to arrive at any objective conclusions on the subject of investigation.

More important than the data is the availability of suitable methods of attack regarding the problem. There are some problems in social research which are not amenable to the existing set of methods and tools of research. Here there is need for devising new approaches. This is not always easy, particularly, for the beginners. So they must reconsider the choice of the problem.

6. *Availability of time, money and personnel*

These factors are very important from the point of view of student researchers. They have only a very short time at their disposal, say, one year or two years. They must complete the whole study within this short span of time. So only problems that can be tackled very quickly must be taken up for investigation.

The cost of investigation of the problem must be reasonable. This is particularly so for the students who more often than not do not receive any financial assistance from any outside agencies. They must spend from their own pockets. Huge problems which involve a lot of expenditure are out of the purview of the students.

Related to the time and cost factors, is the problem of personnel. Big research projects must engage a large number of personnel for their successful completion. From the project director to the field investigator there are so many kinds of functionaries involved in research. While selecting a problem, attention must be paid to the availability of suitable hands to fill up all such vacancies. Research being mostly a team work, its success depends to a large measure on the ability, training, hard work, devotion and such other qualities of the persons doing research and their interpersonal co-ordination.

7. *Sponsorship and administrative cooperation*

The question of sponsorship arises in connection with large-scale research projects. Since they are time consuming and involve a lot of money, an individual cannot take up such projects without some kind of financial assistance from outside agencies. In India we have the Indian Council of Social Science

Research, the Research Programmes Committee of the Planning Commission and such other agencies to support research in social sciences. An investigator must make sure whether his problem will be accepted by such bodies most of which have some priority areas of their own.

For tackling some problems, the administrative cooperation may be very essential. Here also the problems must be such that the administrators must extend their cooperation without much hesitation. It usually happens with the Government officials that they are not willing to furnish data relating to distant past from the Government records.

8. *Hazards, Penalties and Handicaps*

In the selection of certain types of problems, the worker may well consider other special hazards, penalties or handicaps of a personal, social or professional character, not necessarily with the thought of avoiding or giving up a particular study but of making the choice with open eyes. Pressure groups and institutional taboos have handicapped the investigation of problems of social hygiene and sex in the fields of sociology, psychology and education. Opposition is frequently voiced against the reporting of results that run counter to the beliefs or programmes of certain economic, social, patriotic or religious groups.

Social considerations

1. *Practicability and applicability*

The problem must be of practical value to the investigator and others. In these days of research and more research, problems that produce mere averages of current opinions and practices do not enthuse and interest any one. Nor do problems that produce mere statistical information evoke any interest although such type of information is necessary to strengthen the cause of research. The nature of the problems should be such that their solution brings immediate improvements in the conditions of the people and the society. This does not however, mean that attention should not be made to solve the fundamental social problems. The practicability and applicability of a problem assumes more importance in the context of developing countries like India. These countries have the financial constraints and therefore they cannot spend more money for fundamental research at this stage. So, more problems which are of practical value should be considered by the researcher.

2. *Urgency*

The researcher must be aware of the urgent problems that are facing his society. They must be given priority because solutions of such problems will immediately benefit the people. Timeliness of the problem is an important consideration in selecting a research problem. There are so many such urgent problems in our country today. Take for example, the role of nationalised banks in meeting the credit requirements of our farmers. These banks have only very recently ventured into the sphere of agriculture. We do not know adequately whether they are moving in the right direction or not. Here an assesment of their working is an urgent need of the hour.

3. *Contribution to the subject*

Social Sciences are at their infant stage. Though they have accumulated a substantial body of scientific knowledge, within a short span of life, they are yet to make progress in building scientific theories. Most frequently the physical scientists question the scientific status of the social sciences mainly on the ground that they do not employ scientific methodology to solve the problems. This challenge can be met only when the social scientists take up such scientific problems, the solutions of which will significantly advance knowledge in their fields. That is to say the problem under investigation must make some contribution to the development of the field of specialisation of the researcher.

4. *Anticipation*

The researcher must possess the quality of anticipating things. This is necessary because the Social and Economic conditions are rapidly changing with the result that so many new problems may crop up in the immediate future in his society. The researcher may not wait till the problem is recognised widely by the people. He can beforehand study such problems and help the society to solve them well in advance. For example, urbanisation is not so serious a problem in India today as it is in the western societies. So we can safely anticipate that in the future in India too we may have to face this problem and its attendant consequences. Students of urban sociology must be alert to such issues which may accompany urbanisation in our society.

To conclude, the identification of a suitable research problem is itself a problem to the research students. They must take up this challenge of locating meaningful socio-economic problems facing our society and thereby help to solve them in their own humble way. All sources of problems like specialisation, observation, consultations and repetition or extension of investigations may be used to locate the important problems of research. They must not forget the considerations including their interest, availability of data and methods, time limitation, cost, urgency, utility, etc., while making a choice of the problem.

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CHAPTER 3

QUALITIES OF A RESEARCH WORKER

Rajammal P. Devadas & M. Radhakrishnan

Research

In dictionary, Research means to search again or to carry out systematic investigation to augment the quantum of knowledge. Semantists state that the definition of words is not with words but in ourselves. The word Research does not mean the same thing to every one in the field of education. However, there is one element common to all research studies and that is the systematic study.

A neophite will be very much benefited by going through the life history of reputed persons in the field. An intimate knowledge of such persons in the field and a careful analysis of their personalities will stimulate their own concrete self analysis. By careful introspection or through judgement and rating of others, one can very well know the possible lacuna among the total of personal traits and abilities. This knowledge ought to be the first step towards the making of a new and better research character.

Research carried out in sociology, research done in literature and the research work in science are slightly different from each other. But the general procedure followed is the same for all. Whatever may be the field of research, one has to select the problem and attack it from different angles, gather data and arrive at some fruitful conclusions. When one carries out such research work, he must bear it in mind that he is going to add some more useful information to the already existing quantum of information in the field. If one is fortunate enough sometimes one may strike upon a new discovery or may give out a much useful and general hypothesis.

Characteristics of Research

Research is not a mysterous activity. It is more or less a formal, systematic and intensive process of carrying out the analysis in a scientific method and generalization. It is, in general, done either by an individual or by a team, very often in institutions or in factories. It involves tremendous manpower, time and money. It is in research new truths are discovered.

Research places emphasis upon new discoveries or general principles. It gathers new knowledge and contributes to human welfare by adding more and more information to the already existing knowledge.

Research gathers information from first-hand sources and it is done in a systematic way. To carryout this work in a more correct way, one must have a good knowledge of the information that is already available regarding the problem concerned. Otherwise the work sometimes will become a mere repetition of what has already been done resulting in waste of time, energy and money.

Research involves systematic investigation. The researcher knows what has already been done about his problem. Based on this knowledge he plans his procedures and gathers data. For this purpose he makes use of the necessary instruments. The data are analysed carefully and conclusions are drawn on the result obtained.

Research is logical and objective. So, every possible test is applied to find out the validity of the data recorded and the conclusions drawn at the end. While doing so one should not give room for personal feelings and prejudices. The objective should be to analyse the data to test the hypothesis. One should not be tempted to gather data in such a way as to support one's hypothesis. So, one's aim in drawing inferences in research should be to test the conclusions or hypothesis with the data collected.

Research needs patient and unhurried involvement. One will realise that significant findings are obtained not by impatient and hurried procedures and drawing conclusions in a hurried way. One must have enough patience, carryout the entire procedure carefully, be ready to repeat the procedure if necessary, to gather data avoiding all possible errors and to analyse the data arriving at sound and useful conclusions. There must be scientific spirit and scientific method in research.

Research is carefully recorded and reported. One must be clear in defining the terms used and the hypothesis followed. There should not be any ambiguity in understanding the terms, hypotheses and the procedure. All assumptions and limitations must be clearly stated. While drawing conclusions after analysing the data, one should be careful and cautious giving the considerations for all limitations of methodology and experimental errors without giving any room for his emotions and feelings. One need not hesitate to give the conclusion even if it happens to contradict the already established theories provided the hypothesis is supported by sound proof and logic.

Qualities of a research worker

The essential qualities a researcher should possess are curiosity, imagination, honesty, carefulness, powers of observation, knowledge of statistics, memory power, ability to write, patience, generosity, health and humility. Curiosity is the spring board for initiative. Together with persistent industry, curiosity is a prime requisite for a career of exploration. Imagination serves an important purpose both in designing an experimental study and later when the freshly discovered facts demand interpretation. At both stages, an inquiring attitude should balance imaginative enthusiasm.

The investigator must be honest. He must face facts as they arise in the course of the experimental procedure, whether or not they are favourable to his idea. In accepting truth, he must be ready to surrender his theory at any time, if facts proved to be adverse. The tragedy of scientific enquiry, as Huxley once remarked, is "the slaying of a beautiful hypothesis by an ugly fact".

All the procedures should be carefully followed and data collected scrupulously. The analysis and inferences should be carefully checked to ensure that they do not reach beyond the point which the facts justify.

The investigator needs to possess keen powers of observation. He should be alert and watchful as events transpire in the course of the experiment so that nothing escapes his vigilance. Generally, one readily beholds the familiar but may over-look the unfamiliar. Therefore careful observation is important.

Knowledge of the applications of mathematics, especially statistical methods, is a valuable asset to the researcher. A retentive and facile memory is a highly important qualification. A research worker needs ability to write clear, well-defined reports of his aims, methods, results and conclusions.

The investigator needs patience in abundance. As he enters unexplored territories, he may encounter hindrances, complications and consequent disappointments. He requires patience to meet these eventualities.

The investigator should be generous towards his fellow workers. When working cooperatively with colleagues, he should strive to imbibe qualities which can consistently exist in others' company and promote effectiveness. Generosity may be expressed in one respect by not rushing into anothor's field, the moment it is opened. Humility is an attitude of a man of science. Health is the most prized possession of a research worker. Health gives him stamina, zest and endurance.

An investigator may be rich in suggestions and ideas. But if he is indolent, he may become sterile. He may be a hard worker but secretive about his results and suspicious of his fellow workers: consequently he may be despised by them. He may be an earnest experimenter but inconsiderate to his helpers. He will then find that help does not come to him. He may be prone to display an attitude of superiority and consequently be subjected to derision, expressed or silent. Sometimes an investigator's excellence in important aspect is so great, that it overbalances his defects.

Thus for a career of investigation, curiosity, imaginative insight, critical judgment, honesty, a retentive memory, patience, good health and generosity are essential. When researchers disagree or when a mistake has been made, the announcement of the corrective observations of criticism of the erroneous report should be so expressed as not to cause hurt.

Team work and role of leader

One who knows something about research knows well that research is a search for truth and it involves orginality which takes a great deal of time and money. Research done by a team always yields better results than the work done by individuals. In team work, the problem is attacked in different ways by different people. They could pool their knowledge, work for a long period and obtain good and reliable results which will form a contribution to human welfare. Great many discoveries are due to the cumulative effort of many.

The leader of a group engaged in research should be generous in the care and treatment of those with whom he is working. Through frequent conversations and conferences the leader must assure the workers of his cooperation and coordination. A novice in research needs instructions and supervision to give him a correct start. He needs guidance and encouragement towards developing habits of good workmanship from his first attempts. When ideal performance is demanded, the desire to accomplish what is expected of him becomes a motive for striving, provided there is appreciation along with the demand.

Sometimes great discoveries have been announced by accident, but such accidental discoveries happen very rarely. To quote an example, the discovery of Radioactivity by John Becquerrel was accidental. While he was attempting to make some studies on X-rays and fluorescence, he happened to observe accidentally that certain elements emit a new kind of radiation due to nuclear phenomenon and this was announced as Radioactivity. In fact, this discovery, though accidental, has helped very much in nuclear physics particularly to know about the structure of the nucleus and the atom as a whole, nuclear force etc.

A Researcher

Francis Bacon, who sincerely tried, as a young man, to be a good researcher, gives the following introspective analysis. "Moreover, I found in my own nature a special adaptation for the contemplation of truth. For I had a mind at once versatile enough for that most important object--I mean the recognition of similitudes and at the same time sufficiently steady and concentrated for the observations of subtle shades of difference. I possessed a passion for research, a power of suspending judgement with patience, of meditating with pleasure, of assenting with caution, of correcting false impressions with readiness and of organizing my thoughts with scrupluous pains. I had no hankering after novelty, no blind admiration of antiquity. Imposture in every shade I utterly detested. For all these reasons, I considered that my nature and disposition had, as it were, a kind of kinship and connection with truth".

So, it is clear from Bacon what a researcher should be. A researcher must be a scholarly person. He must be a person of high imagination and integrity. He must be prepared and willing to spend his time wholly for research without caring for the pains and the other hurdles involved in the process of seeking truth. He is considered to be more a specialist than a generalist. He must have sound knowledge in the subject and a good skill for experimentation, the capacity and capability to interpret the data collected and finally draw conclusions from what he had observed. So, he must be imaginative enough to suggest generalizations from the fruitful conclusions he arrived at. He must apply his knowledge to test the hypothesis formulated by him using the data obtained from different experiments.

Apart from what has been given above, a researcher must show great mental energy and persistence on the trait of discovery. He must be apt in drawing conclusions and must be ingenius in making hypothesis. His sense of logic must be sound to make proper deductions. He must be a person of keen observation who always depends upon his observed facts and data. Above all this, he must have sound and rich knowledge in the subject of the research.

Ethics in Research

1. *Integrity*

First and foremost a researcher must be a person of high integrity. He should not give room for prejudices and personal feelings. He must be prepared to give information and discuss the aspects in a frank way with his colleagues and co-workers. He should never mislead them by giving false information nor should he attempt to spoil the experimental set up nor attempt to damage or meddle with the data collected.

2. *Sincerity*

One should be sincere in carrying out the procedures in research. He must be sincere in making observations, in collecting data and in analysing the data. Sincerity alone will yield good results.

3. *Scientific Spirit*

Research must be taken up with scientific spirit. Even if one needs to repeat the study a number of times to confirm observations, one must not feel worried. The outcome of research, whatever it may be, must be taken up with true Scientific Spirit.

4. *Courage*

This word should be understood in its proper sense. One must be courageous enough in interpreting the results. One should not feel diffident to pronounce the results even if it happens to contradict the well-established statement. But one must be doubly sure that the statements and results are supported by sound data and logic.

5. *Give help and take help*

In research one must be prepared to help other persons without any reservations or any personal feelings or prejudices and take help from them. Though research is being carried out individually, the team spirit must be there. In other words all working in a laboratory or project should feel that they are one group.

6. *Keen and correct observation*

All observations should be made with greatest care, preferably by the researcher personally. If observations are made by other assistants, the research procedures should be so devised as to eliminate all errors of observations as far as possible. Care should be taken that no bias enters the observation at any stage.

7. *Promptness in actions*

A good research worker should always be prompt and alert. He should never postpone things for any reason. An opportunity once lost, may be lost for ever.

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CHAPTER 4

USE OF LIBRARY, REFERENCE READING AND DOCUMENTATION

Usha Chandrasekar, M. Feroze & M. Gopal

Improving Library skills

The library of today is a social agency - an agency of communication and an agency for education. It is not a mere collection of books, it is an important agency for information and for self-education.

The most successful scholars develop the ability to read rapidly. Unless one has the reading skill to go through quickly and pick out unerringly useful materials for the study, the process may consume a vast amount of time. Much of the material in many of the books or articles one reads is likely to prove of no signifiance for the particular study. To waste time on unessential reading would be pointless. However, important paragraphs should be read through very carefully and the notes be taken. Mastery of the skill in rapid reading should be acquired.

Every library has its own arrangement and system of shelving and cataloguing. Usually there is a logical and recognizable classification of the materials. Each research scholar should spend some time in exploring the library to understand the system of arrangement. The best way of economizing time is to consult the librarian and seek his assistance after explaining the project under consideration.

How to go about reference reading

Initially review of research literature is made to develop a background for planning the research, to obtain information concerning techniques, equipment and potential problems, to avoid unnecessary duplicating of work of others. Review of literature is neither an annotated bibliography nor a mere listing of references but is a presentation of earlier research as is related to the present problem of research. Hence, every reference which shows a possibility of containing pertinent and helpful material should be examined. This would enable the researcher to prepare the working bibliography.

The sources which should be examined in marking the working bibliography will vary with the problem, but the general suggestions regarding the sources that should be examined remain the same. Some helpful hints are:

1. Ask learned professors, librarians or others who are familiar with the field to mention helpful references and to suggest leads. The findings of one reference will often be the means of discovering other references.

2. Examine books, monographs, periodicals and other materials that are available in the library. The bibliographies given therein might also serve as leads.

3. Consult the card catalogue of the library. Most standard libraries follow either of the two methods of classification of books namely the Colon classification or the Dewey - Decimal classification.

4. Consult the standard periodical indexes, current awareness lists and the like in the respective fields. For example "Literature sources in the biological sciences, Agriculture index, Current contents" are some of the useful publications in the field of nutrition and biological sciences. Current awareness lists, current literature supplements and likes are also published in some journals.

5. Some libraries have documentation facilities (eg. NICD) by which they have annotated all references available on a particular subject. Indian National Scientific Documentation Centre (INSDOC) provides full range of documentation services to the scientists. INSDOC serves also by locating, procuring and supplying copies of scientific papers from other

foreign languages into English, by providing special facilities like document copying, Xeroxing, electronic stencil cutting, IBM punching aid and the like.

6. Current issues of journals that are most likely to contain pertinent materials should also be examined. "The literature cited" section in all the papers that are read may also be checked for additional reference.

Locating the Sources of Educational Information

The card catalogue is an ever-present friend of the investigator because it tells him whether the library has the item he wants and also tells him under what classification it can be found. Periodicals and back numbers in most libraries are kept in a separate room or section. Most periodicals supply their own annual indexes.

Every scholar begins with the compilation of a working bibliography, a list of the items he needs for his study. He writes down the titles and author of all works on the subject which he has read or has heard about. Next he consults the card catalogue to see other books on the subject. After this he may go to the periodicals section and check the indexes and bibliographies. Finally he can consult unpublished materials and theses. He may also correspond with the bibliographers or the scholars in the field and ask them whether they know of any book, article or unpublished work worth consulting. Thus the scholar should make every reasonable effort to obtain and read each work listed in his working bibliography.

It may be advantageous to form a rough outline of materials to be listed. The following is a list of points to be checked while evaluating a material to be included in the research report.

1. Accuracy and dependability
2. Up-to-dateness
3. Suitability for specific requirements
4 Authority
5. Scope

6. Treatment and style
7. Arrangement
8. Illustrations, tables and diagrams.

Text books, encyclopaedias, digests and other summaries of information for popular consumption may be regarded as secondary sources. To find the full details about a subject and to be sure of exact information, it is necessary to go beyond the encyclopaedias and textbooks and search out the primary sources - official records, research reports, direct observation of evidence and the like. Text books are usually example of tertiary sources of information since they are generally compiled from secondary sources. Young scholars often appear to think that, once they have made a review of all the related literature, the study has been completed. On the contrary, such a summary of studies and opinions of others is merely the first step in any research project.

Technique of Taking Notes

Notes may be recorded in any form. Some use small file cards or slips of papers which offer the advantage of easy handling and filing. Others prefer larger sheets. The important thing is to have, in orderly notes, everything essential to the study. At this stage itself the full name of the author, year of copyright, full title of the work, the place of publication and all other pertinent facts about the source should be taken. Such detailed facts will be at hand for use in footnotes or in the final bibliography. While taking notes, making an abstract or a summary in your own words will often serve your purpose better than a verbatim extract from the source. It would be a useful objective to verbalise the important ideas into concepts. In copying numerical data it is desirable to anticipate how the data are to be organised and summarised

Basic Information Needed for Effective Note-taking

1. Purpose, date, place and condition of the study
2. Identification of the Investigator and the sample used
3. Basis of choosing the sample

4. Methods used in equating groups
5. Methods used in analysing data
6. Salient conclusions drawn.

Three useful suggestions in recording the information are:

Make each note on a separate sheet or card;
Make the entries complete and accurate;
At the time of making the note, record all the information that may possibly be needed.

Each reference should be separate because this will facilitate the organisation of material later when the report is to be written. Otherwise a great deal of shuffling of papers will have to be done with the consequent probability of overlooking some information or dealing with it in the wrong sequence. Use of cards of medium size say 4" by 6" or 5" by 8" seems to be the most favourite practice. The essential information required for all reference is:

1. Author's surname and initials (If the author is a woman, it is useful to spell out the first name).
2. The full name of the article or book and the name of the journal or book.
3. The imprint (eg.) place of publication, publisher and the date of publication.
4. Summary of facts or information needed.
   Additional information that may be useful are:
5. The call number of the book or journal
6. The library where the book or journal may be located.

Noting the summary of facts or information

It may be helpful to put a heading at the top of each card to identify the note easily. One important point is that every card or sheet indicates the exact page or pages of the reference. Indicate whether the material is being paraphrazed or quoted or summarized. For each entry, first decide the form in which the information will be used ultimately - as a direct quotation, a paraphrase or a summary and then make the note in the same form in which it will be used later. It is suggested that whenever practicable the material is paraphrased so that the material is in the research worker's own words Direct quotations are to be used only when the original author has written very well and concisely documented or when some statement by some authority is used as an evidence of support. Make the notes neat, accurate, complete and legible.

Only references read by the researcher should be included in the report. Thus, an article should not be cited because it has been discussed in a review paper but has not been read by the research worker. Cross references should be avoided. The references read should be pertinent to the general objectives of the research problem. Probably more articles will be read than are used in writing up the report. If the references concurring the specific problem are limited, studies on related process, products and treatments also can be included. If many papers are available, only those which apply most directly are selected. Catch heading, placed on top of each card is a very useful device. These headings will aid materially when the time comes to sort and organise the cards in the preparations of the final bibliography. After having collected a sufficient number of good notes, the task is to sort them, organise them according to the topical entries in the outline. Then the individual entries are put in a logical sequence within each group and the draft written.

The modern trend in reporting is to remove the scientific illiteracy of the layman. Plain terms are always close to eloquence. Therefore, be brief. Darwin's big book running to two volumes is still unknown to many, while "*On the Origin of Species*" a reduced version of the same in simplified expression is more popular and universally acceptable. Lifting of large sentences and paragraphs is not desirable. Professional ethics require documentation of ideas and direct or indirect quotations from several sources.

Reference reading in educational research never stops with abstraction of ideas. It should involve sorting research findings according to an integrated scheme, summarising empirical findings, noting contradictory results, noting the status of explanatory efforts and insightful synthesizing. Such references should lead to guiding hypotheses and suggestive methods of investigation.

Certain Things to be avoided

A research scholar must try to avoid the following pitfalls in reference reading and documentation.

1. Excessive reporting of fragmentary findings
2. Stereotyping one mould of reporting
3. Poor reporting of backlogs of documents particularly when it is not processed.
4. Drawing conclusions beyond the data collected.
5. Mistaking recommendations as findings.

Library Ethics

Efficient use of the library depends upon the habits and manners of its users. In order to facilitate other users and help in the better management of the library, it is highly desirable that the users of the library follow certain codes of ethics. Some of them are given below.

An orientation course may be conducted by the Librarian for students, regarding the library ethics, in the beginning of the academic year itself.

1. There are more than sufficent library rules and regulations: what is required is that people should have the library sense to follow them.
2. We should treat the books as public property with utmost care for they are to be used by many present and future readers.
3. Deliberate misplacing of books in the library shelves should be avoided. Some students do this to hide the book inside the library for their further reference. This is a highly selfish and unsocial behaviour.

4. No tracing or mechanical reproduction shall be made without the expressed permission from the librarian.
5. No person shall write upon, damage, or make any mark upon any book, manuscript or map belonging to the library.
6. Removing pages or chapters from library books or Journals should be considered as sin and hence should not be done.
7. Before leaving the counter. the member shall satisfy himself, as to whether the book lent to him is in sound condition and, if not, he shall immediately bring the matter to the notice of the librarian.
8. Strict adherence to the Library Rules will create the Library sense in every one of us.

Documentation

"Documentation" is used in two different contexts: (1) Library Science and (2) Research Reporting

In Library Science, Documentation means the retrieval of the particulars relating to a subject, searching for the literature, preparing list and making it available to the researcher. Thus it is an intensive reference service given to the specialist readers for the purpose of their research and study. It is much more than building bibliography of micro-thoughts. Documentation works in the library science involve location of the document, abstrating, classifyuing and cataloguing and documentation service consists in:-

1. Helping the specialist reader to formulate precisely his interest at the time;
2. Locating in catalogue the entries for the documents covering his interest directly or indirectly;
3. Issuing the documents to him as and when required;
4. Procuring for him the documents not available in the library by inter-library loan; and
5. Supplying documentation lists to scholars.

In research reporting, documentation indicates the references to the main source materials, other previous and current works and views, additional data and discussion and suggested further reading on the specific problem as handled by the researchers. It is both an evidence of the thoroughness of the investigation and a guide to further work. Thus a thorough recording of the investigation is as much essential as good amount of reading, taking of notes and form of presentation.

Objectives of Documentation

The objectives of documentation are

1. To support the facts presented;
2. To enable the research worker to acknowledge his debts to others;
3. To point out differences of views, facts and findings in an authentic manner;
4. To lead the reader to further information; and
5. To provide additional or detailed information either in the foot-notes or in the appendices to the report.

Kinds of Documentation

There are 6 kinds of documentation, often used in research reporting– each with its own place and objectives in the research report. 1. Footnotes; 2. Bibliography; 3. Quotations and Translations; 4. Tables, Charts, Diagrams and Maps; 5. Appendices; and 6. Preface.

When citations are made in the footnotes, or bibliography, it is desirable to follow a uniform pattern throughout the research report. Here again there are several physical arrangements in which the citations could be arranged. We give below a few of them.

Easwaran Parvathi., P. A. Sakthivelmani and Rajammal P. Devadas. *Heights and weights of 7, 8, and 9 year old children in selected schools of Coimbatore city.* Ind. J. Nutr. Diet. **11**, 63-71, 1974.

Easwaran P., P. A. Sakthivelmani and R. P. Devadas. 1974. *Heights and weights of 7, 8, and 9 year old children in selected schools of Coimbatore city.* Ind. J. Nutr. Diet., **11**, 63-71.

Swaminathan, M. (1974), *Essential of Food and Nutrition.* Madras: Ganesh and company.

These are only a few examples. But whatever form one chooses to follow, one must follow with consistency throughout the report.

Avoid Simple Mistakes

Experience has shown that our research students commit such mistakes which they regard as very ordinary. For instance, forgetting to give the exact pages referred to after each reference is never considered a serious mistake by them. They often list their references in old fashion and justify their behaviour by citing books as examples. To some of them references of books, journals, encyclopaedias or cross references are all alike. The simple fact that each article in an encyclopaedia is written by a different author is also neglected and every reference is attributed to the editor of encyclopaedia. Many do not even follow the practice of dropping the articles before the titles while listing the references. Though there are several accepted ways of preparing bibliography it should be realised that new changes are always based on certain rationale. For instance, the latest practice of giving the year of publication soon after the name of the author arose out of need. It had been noted that even authorities had revised their view in the light of new evidence. This may be very much different from their authentic earlier works. To indicate the recency of data the year of publication has been brought forward. Such recent developments can be observed only in journals - not even in research methodology books.

Very often the research scholars while documenting misuse *Ibid.* and *Op. cit.* For every type of cross reference they use either *ibid.* or *op. cit.* throughout the research reporting. *Ibid.* an abbreviation of *Ibidem* meaning "in the same place" is used when succeeding uninterrupted citation of a work occurs on the same page or within the space of a few pages. On the other hand *Op. cit.* the abbreviation of *Opere Citato*, meaning, "in the work cited" is used following the author's name when other references intervene between different citations of the particular work or when a number of pages have intervened since the work was cited in full. The present trend is to prefer the system of cross-reference by numbers, of a numbered bibliography and avoid numerous foot-notes. If the name of the author is to be used in the running matter the new convention is to drop the initials.

The sequence of a brief quotation requires only an inclusive reference in the footnote. Too many verbatim quotations spoil documentation. It is important that notes which are direct quotations should begin and end with quotation marks. i. e. the quote should be placed after the full stop. Where omissions are made, three spaced dots ... for omitted words or phrases. and four dots ....where sentences are omitted should be placed. Never use more than four dots.

While documenting a technical or research report we may well use a style that is simple, direct and effective without literary embellishment and any loss of scientific rigour. All the efforts of a research scholar considered for documentation of reference will result in producing an excellent research report as a by-product.

Appendices

Appendices are useful to place cumbersome materials breaking the continuity of the main text. They are at the end of the report or at the end of the chapter. They may contain technical or non-technical discussions or particular technique, elaboration of concepts, terms, definitions and so on. Mathematical derivations and formulas, raw or supporting data, lengthy tables, lengthy quotations, forms of questionnaires, schedules, pro-formo and data-sheets, bibliography, glossary are also included in the appendices.

CHAPTER 5

DIFFERENT TYPES OF RESEARCH

B. C. Muthayya

Research can be classified according to the methods used. Another way of classifying research depends on the purposes for which it is used. Both the kinds are discussed below.

I. Types of Research based on the Methods

1. Historical Research

History is defined as integrated narrative or description of past events or facts written in the spirit of critical inquiry to find the whole truth and report it to posterity. It is as broad as life itself and embraces the entire field of human past. As Nevins describes: "Seated at the roaming loom of time, for six thousand years, man has woven a seamless garment. But that garment is invisible and intangible, save where the dyes of written history fall upon it and forever preserve it as a possession of generation to come."

Research, in the perspective of the previous efforts taken on the particular topic, conveys the depth of knowledge and continuity of efforts which have helped to come to the present state of knowledge on the subject. History of research is, therefore, significant to methodology. In this context, historical research is useful to science to the extent its enquiry is critical and objective. Scientific historians study people and their problems and not periods.

Historical research enables communities to grasp their relationship with the past and to plan more intelligently for the future. It gives people a sense of continuity and a conciousness of unity in their efforts and achievements

2. Descriptive Investigations and Diagnostic Studies

Descriptive and diagnostic studies have in common, objectivity and emphasis on the specific characteristics of given situations.

They are not limited to any one method of research. Information can be collected by interviews, questionnaires, systematic direct observations, analysis of community records and participant observations. Therefore, the procedures in this type of studies must be planned carefully.

The literature of descriptive studies refer to expressions such as trend, survey and status, to suggest the gathering of facts or evidence relating to the current situations with regard to the persons, groups, events and studies. The expression 'normative' is sometimes applied to descriptive investigations, because the purpose is to determine the normal or typical conditions or practice, for example when the results of S. S. L. C. examinations from the different schools in a State are compared. The purposes of descriptive investigations are:

1. To secure evidence concerning the existing situation or current conditions;
2. To identify standards or norms with which to compare present conditions in order to plan the next step;

and 3. To determine how to take the next step.

While a descriptive study is oriented towards finding out what is necessary, a diagnostic study is directed towards discovering what is happening and why it is happening and what can be done about it.

3. Ex-post facto research

In this kind of research, the independent variable or variables have already occurred and the researcher starts with observation of a dependent variable or variables. He then studies the independent variables in retrospect for their possible relations to and effects on the dependent variable or variables. The most important difference between experimental research and ex-post facto research is control. In the former the investigator has a manipulative control on the independent variable whereas in the latter this control is not possible; more than this, randomisation is not possible. The ex-post facto researcher must take things as they are and try to disentangle them. In an ideal social scientific research, the possibility of using random samples of subjects and randomly assigning them to groups and treatment to groups would always be possible. However, these possibilities do not exist in the real situation. The ex-post facto research could be of a large scale or a small scale. This type of research has three weaknesses: (1) the inability to manipulate the independent variables, (2) lack of power to randomise and (3) the risk of improper interpretation. In other words, compared to experimental research, other things being equal, ex-post facto research lacks control. This lack is a basis for the third weakness: the risk of improper interpretation. Therefore, committing unequivocally to experimentation or to ex-post facto research may be poor policy. Ex-post facto research may not have particular hypothesis as a predicated relationship may be quite spurious. Therefore, ex-post facto research that is conducted without hypothesis, without predictions, research in which data are just collected and then interpreted is even more dangerous in its power to mislead.

Despite its weakness, much ex-post facto research must be done in almost all social sciences, as many of the problems coming under its ambit may not lend themselves to experimental enquiry. It can even be said that ex-post facto research is more important than experimental research which of course is not a methodological observation. Unless there are exploratory studies in areas which are new, further scientific investigation would not be possible. The only care that one should exercise in ex-post facto research is that the results and the interpretation of the data must be handled with great care and caution.

4. Laboratory Experiments

Social scientific research can be divided into four major categories. Laboratory experiments, field experiments, field studies and survey research. This break-down stems from two sources: the distinction between experimental and non-experimental research and that between the laboratory and field research.

The laboratory experiment is a research study in which the variance of all or nearly all of the possible influential independent variables not pertaining to immediate problem of investigation is kept at a minimum. This is done by isolating the research in a physical situation, apart from the routine of ordinary living and keeping the independent variables under rigorously specified, operationalised and controlled conditions. The laboratory experimenter can, and often does, isolate the research situation from the life around the laboratory by eliminating the many extraneous influences that may affect the dependent variable.

The greatest weakness of the laboratory experiment is probably the lack of strength of independent variables. Since laboratory situations are after all situations that are created for special purposes it can be said that the effects of experimental manipulations are usually weak. Another weakness is the artificiality of the experimental research situation. Actually, it is difficult to know if artificiality is a weakness or simply a neutral characteristic of laboratory experimental situations. The temptation to interpret the results of laboratory experiments incorrectly is great. Although laboratory experiments have internal validity, they often suffer from lack of external validity.

However, laboratory experiments have three related purposes: (1) they attempt to discover relations under 'pure' and uncontaminated conditions; (2) the testing of predictions derived from theory primarily and other research, secondarily; (3) to refine theories and hypotheses, to formulate hypotheses related to other experimentally or non-experimentally tested hypotheses and perhaps, most important to help build theoretical statements. The aim of laboratory experiments, then, is to test hypotheses derived from theory, to study the precise inter-relations of variables and their operation and to control variance under research conditions that are uncontaminated by operation of extraneous variables.

5. Field Experiment

A field experiment is a research study in a realistic situation in which one or more independent variables are manipulated by the experimenter under as carefully controlled conditions as the situation will permit. While the laboratory experiment has a maximum of control, most field studies must operate with less control-a factor that is often a severe handicap to the experimenter. Laboratory experiment and field experiment differ mainly in the setting and the purposes.

The setting for a field experiment is some real existing social situation in which the phenomena to be studied are commonly found. It is not an 'artificial' situation created in a Research Laboratory. The real distinction here seems to be between studying real and studying artificial social phenomena. One meaning of 'artificial' as applied to the behaviour of people in the laboratory seems to be that their behaviour is determined by their role of being a subject, they would not act the same way if they were not in this role. In so far as social behaviour is determined by their role of being a subject, they would not act the same way if they were not in this role. In so far as social behaviour is role-determined, it is clear that findings obtained with one role cannot be generalised to apply to other roles without additional research. In addition the behaviour of subjects in a laboratory experiment is highly restricted by the rules and procedures instituted in order to control conditions. The laws which hold for such restricted situations may not apply without changes to the more complex settings of real life. Usually a field experiment is not subject to such artificiality and thus avoids this problem of generalising to real-life situations.

The broad purposes of field experiment vary from the development of Social-Psychological theory to the immediate solution of some practical social problems. Sometimes both purposes are present, as in the experimental forms of action research which have the dual purpose of bringing about social change and at the same time contributing to basic social science.

Practically-oriented research is the most common type of field experiment. For example, studies evaluating the relative effectiveness of two types of political propaganda or of two teaching methods or of several advertising appeals attempt to get fairly immediate answers to practical problems of politics, education, or advertising without attempting to apply any general theory.

That type of field experiment whose purpose is to test the applicability to real-life situations of the known scientific laws or hypotheses specially developed in controlled laboratory settings, is highly valued in social sciences.

The distinctions between 'artificial' laboratory experiment and the 'real' field experiments are matters of degree; one field experiment will vary greatly from another in the complexity of the social setting, the controls introduced by the experimenter, and the roles played by the subjects.

The weaknesses of the field experiment for the most part are of a practical nature. The control of the experimental field situation however, is rarely as tight as the control of the laboratory experimental situation. The investigator in a field study, though he has a power of manipulation, is always faced with the unpleasent possibility, that is independent variables are contaminated by uncontrolled environmental variables. Another practical difficulty is the problem of randomisation. An important obstacle to good design in field experiment, an obstacle that seems to be ordinarily overlooked is the attitude of researcher; an attitude which is guided more by negativism than optimism. One other weakness inherent in the field experiment situation is the lack of precision. The measures of dependent variables are sometimes, unfortunately, not sensitive enough to pick up the messages of independent variable. In other words the dependent variable measures are often so crude that they cannot pick up all the variance that has been generated by the independent variable.

The field experiment, however, has three unique virtues: 1) the variables in a field experiment, usually have a stronger effect than those of laboratory experiments. The more realistic the research situation, the stronger the variables. 2) Their appropriateness for studying complex social influences, processes and changes in life-like settings. The dynamics and interactions of small groups have been fruitfully studied in field experiments. 3) Field experiments are well suited, both to the testing of the theory and to the solution of practical problems.

6) Field Studies

The essential factor which distinguishes the field experiment from the field study, is the design of the research. The field experiment involves the actual manipulation of conditions by the experimenter in order to determine casual relations, whereas in the field study the researcher uses the selection of subjects and the measurement of existing conditions in the field setting as a method of determining correlations. Field studies are ex-post facto scientific inquiries aimed at discovering the relations and interactions among sociological, psychological and educational variables in real social structures. In scientific studies, large or small, where they systematically pursue relations and test hypotheses, that are ex-post facto, that are made in actual life situations, will be considered field studies.

The investigator in a field study looks at the social or institutional situation and then studies the relations among the attitudes, values, perceptions, and behaviours of individuals and groups in the situation. He ordinarily manipulates no independent variables.

Katz has divided field studies into two broad types - exploratory and hypothesis testing. The exploratory type seeks what is rather than predict relations to be found. They have three purposes: (1) to discover significant variables in the field situation; (2) to discover relations among variables; (3) to lay a ground work for later, more systematic and rigorous testing of hypothesis. It is well to recognise that there are activities preliminary to hypothesis testing in scientific research. In order to achieve the desirable aim of hypothesis testing, preliminary methodological and measurement investigation must often be done. The second sub-type of exploratory field studies, research aimed at discovering or uncovering the relations, is indispensable to scientific advancement in the social sciences.

The field studies are strong in realism, significance, strength of variables, theory orientation and heuristic quality. The realism of field studies is obvious. They are highly heuristic. Any researcher knows that one of the research difficulties of the field studies is to keep himself contained within the limits of his problem. Hypotheses frequently fling themselves at one. The field is rich in discovery potentiality. After starting to gather data, he might stumble upon many interesting notions that can deflect the course of investigation.

Despite these strengths, the field study is a scientific weak cousin of laboratory experiments. Its most serious weakness of course is its ex-post facto character. Another methodological weakness is lack of precision in the measurement of field variables. Other weaknesses of field studies are practical problems: feasibility, cost, sampling and time. The field researcher therefore, needs to be a salesman, administrator and entrepreneur as well as investigator.

7) Survey Research

Survey research is that branch of social scientific investigation that studies large and small populations, by selecting and studying samples chosen from the populations, to discover the relevant incidence, distribution and interrelation of sociological and psychological variables. Surveys covered by this definition are often called sample surveys, probably because survey research developed as a separate research activity, along with the development and improvement of sampling procedures. The definition also links population and samples. The survey researcher is interested in the current assessment of the characteristics of whole populations of the people. Sample surveys attempt to determine the incidence, distribution and interrelations among sociological and psychological variables. The social scientific nature of survey research is revealed by the nature of its variables which can be classified as sociological facts and opinions and attitudes. Sociological facts are attributes of individuals that spring from their membership in social groups. Psychological variables include opinions, attitudes and behaviour. The survey researcher is not only interested in the sociological variables but also primarily interested in what people think and what they do.

Surveys can be conveniently classified by the following methods of obtaining information: Personal interview, mailed questionnaire, panel and controlled observations--to mention a few.

Survey research has contributed much to the methodology of the social science. Its most important contributions have been to rigorous sampling procedures, to the overall design and implementation of the design of studies to the unambiguous and specification of the research problem and to the analysis of the data. Survey researchers use a flow chart which starts with the objectives of the survey, lists each step to be taken in the survey and ends with the final report.

Survey research has the advantage of wide scope. A great deal of information can be obtained from a large population. While surveys tend to be more expensive than laboratory and field experiments and field studies for the amount and quality of information they yield, they are economical. Survey research information is accurate within the sampling error ranges. However, there are a few inevitable disadvantages of survey research: (1) Survey information ordinarily do not penetrate very deep below; (2) It is demanding of time and money; (3) Any research that uses sampling is naturally subject to sampling error; (4) potential rather than actual weakness of this method is that the survey interview can temporarily leave the respondent out of his own social context which may make the results of survey invalid; (5) Survey research, therefore, requires a good deal of research knowledge and sophistication. The competent survey investigator must know sampling, question and schedule construction, interviewing, the analysis of data and other technical aspects of the survey.

Relation between Field Study and Survey

The difference is roughly between the greater scope of the survey and the greater depth of the field study. More precisely, two essential distinctions can be made. In the first place, the survey always attempts to be representative of some known universe and thus attempts, both in the number of cases included and in the manner of their selection, to be adequately and faithfully representative of a larger population. This emphasis on sampling may or may not be found in a field study, which is more concerned with a thorough account of the processes under investigation than with their typicality in a larger universe. In a survey we always ask about the relative incidence, or distribution, of social variables or personality characteristics in the larger group with which we are concerned.

A second and more important difference is that in the field investigation we attempt to study a single community or a single group in terms of its social structure — i. e. the interrelations of the parts of the structure and of the social interaction taking place. The survey, to the extent that it deals with such inter-relations and interaction, does so through a study of the final outcome. The on-going social and psychological processes are inferred in the survey from their statistical end-effects. In the field study, however, attempts are made to observe and measure the on-going processes more directly. Specifically, this means that the field study either attempts observations of social interaction or investigates thoroughly the reciprocal perceptions and attitudes of people playing interdependent roles. Thus a field study will provide both a more detailed and a more natural picture of the social interrelations of the group than does the survey.

II. Types of Research according to the purposes

1) Pure or Fundamental Research

Fundamental research is conducted for the purpose of developing scientific theories or the basic principles of a discipline rather than for the purpose of solving some immediate problem.

Basic research, of course, lays the essential foundations for applied research. Technology advances even more rapidly because there has been a corresponding advance in the development of general theories and principles from basic research (Modern Dictionary of Sociology)

"The fundamental researcher operates from a frame of reference which perceives the experimental field as a temporary one. He is detached, objective, generally not concerned about the results or their applications and therefore not influenced or threatened by conflicting attitudes. In pure research, the investigator follows his imagination. His results will not be measured in terms of material or natural gains. Honour is the reward he usually receives".

According to Goode and Hatt, the fundamental research helps the applied research in the following ways: (1) By developing general principles; theory offers solutions to many practical problems; (2) 'Pure' research helps to find the central factors in practical problems; (3) Research as an answer to problems may become a standard procedure for the administrator; and (4) Theoretical research develops many alternative solutions, with the result that alternative costs may be weighed and ultimately reduced.

2) **Applied Research**

Applied research is directed to the formulation or discovery of scientific principles that can be used to solve some practical problems (of business, government, labour unions, etc.). (Modern Dictionary of Sociology)

"In applied or practical research, the problem is localised within practice and the results are expected to be capable of application in the improvement of the practice or solution of a problem, producing material gains. Thus fundamental research can show the possibility for something to happen, but it requires the assistance of applied research or technology to achieve action. Fundamental research can produce knowledge, while applied research wealth".

Like fundamental research, applied research also contributes to the development of the former in the following manner: (1) Applied research can contribute new facts; (2) Applied research can put theory to test; (3) Applied research may aid in conceptual clarification; and (4) Applied research may integrate previously existing theory.

3) Action Research

Action research is a type of applied social research differing from other varieties in the action process. Some social scientists have differentiated action research from the larger field of applied research by the existence of a client with a problem to be solved. Action research, therefore, aims to contribute both to the practical concerns of people in an immediate problematic situations and to the goals of social science by joint collaboration within a mutually acceptable ethical framework. It not only aims to discover facts, but helps in altering certain conditions, experienced by the community as unsatisfactory.

It is a special type of research which is carried out by launching projects in the field for finding out workable solutions to the problems. In applied research, the theory is tested and applied to the given set of conditions whereas in action research the testing of application is not only in accordance with a certain set of situations as carried out under applied research, but it is modified according to the local prevailing conditions. Another important aspect of action research is that it adapts itself to the changes that take place in the particular community.

It makes full use of the available material of fundamental and applied researches and utilises the results in finding out their correct application under field conditions after making such modifications as may be wanted by the local situations. Action research provides the medium through which the hypotheses and assumptions can be tested and necessary modifications made in them. Generally there is not much of a difference between action research and concurrent evaluation of a project.

The following are some of the different phases in the action research. In the first instance, there is a base line survey where it is essential that all possible information relevant to the subject matter should be collected to get an idea of the existing situation. This may also cover collecting information from other sources already published and also survey the actual local situations. The second phase involves launching the action research project and then the third phase involves the periodical assessment of the action research project. The fourth one is making changes and modifications in the working of the project. And, lastly comes the final evaluation of the project. The method used for action research would again depend upon what type of feed-back information is required. Depending upon the type of information required, the method must be selected which usually consists of the personal interview methods, the survey method and attitude measurement and so on. However, in action research there are three problems involved: (1) the ethical value of the issues is involved in action research, (2) it does not attend to the social scientist's interest in the research, but only that of the client, (3) it locates initiatives too exclusively with the client.

In action research, collaboration with an action agency may sometimes be necessary, or desirable. However, the degree or extent of their participation is a matter for decision which might lead to difficulties in arriving at the agreed formula of action. Despite this, it has two advantages: (1) Participation usually increases the agency's interest in the research and in its possible usefulness. (2) It helps to ensure that the research is really relevant to problem as they appear in the daily operations of the organisation and of others like it.

The formulation of research for immediate use requires knowledge of the nature of decisions that are likely to be made by persons concerned in practical way with the problem under investigation. This knowledge is best acquired in close collaboration with such persons and agencies in the early stages of an inquiry.

The division of labour is appropriate throughout the research, no matter how close the collaboration. The social scientist is an expert on research design, sampling, construction of measuring instruments. But the practitioner knows the specific situation. He can be of inestimable help in pointing out possibilities for 'natural' experiments. The agency personnel can inform the investigator whether data needed for the study are available in records already compiled by them or they may be able to suggest ways of collection of data. At times action personnel, viewing the situation from their point of view, may overestimate or underestimate the difficulties; therefore, the investigator should try to become sufficiently familiar with the situation to make his own estimate of the feasibility of his proposed procedure.

There are some practical problems in action research. (1) Collaboration does not always run smoothly nor are the recipients of research findings always eager to accept and act on them even though they may have requested the investigation in the first place. (2) In other situations, the relevant people may recognise a problem and believe that research can contribute to its solution but some of them may feel that the specific experimental manipulations or other research procedures are in conflict with the goals of the organization or with its functioning. (3) Lack of understanding of the relevance of the research to solution of the problem at hand is another source of reluctance to cooperate in a study or to apply its findings. (4) The reluctance to change accustomed ways of doing things.

4) Evaluation Research

In recent times there have been occasions for the social scientists to be called upon to evaluate programmes that have been implemented or actions that have been taken in order to get an objective and realistic feed-back of the impact of any such programme. Evaluation is a relatively new technical term introduced to designate more comprehensive concept of measurement. The emphasis in measurement is upon the single aspects. The emphasis in evaluation is upon the broad changes and major objectives of a programme. This includes not only subject matter achievement, but also attitudes, interests, ideals, ways of thinking, work habits, personal and special adaptability.

Evaluation in its basic sense, means, some sort of measurement of the end-product and impact of an effort in the light of the stated goals for which the programme was undertaken. The economic benefit resulting from a programme is perhaps one of the easiest to evaluate, because the common people's minds are accustomed to think in terms of cost and price, and financial gains and losses. However, there are so many projects where economic gains are not tangible or directly visible. There may be many intangible gains, the evaluation of which calls for special techniques and special terms of reference. There are three types of evaluation possible: (1) *Concurrent evaluation.* It is a continuous process and somewhat partakes the nature of an inspection and social audit, so that the facts called from the field are primarily used for a feed-back to those who are working on the project and to the policy maker. In other words, concurrent evaluation has some functions which stimulate a sort of guidance and counselling of those who are concerned actively with the programme from the top to the lowest level. It is a generalised answer to a question "How well are we doing". (2) *Phasic or periodic evaluation.* It takes place after a distinct phase or stage of the project has been completed. If sub-goals have been spelled-out for a project, evaluation of these after a group of those sub-goals have been achieved, will constitute phasic evaluation. (3) *Terminal evaluation.* This is done after the completion of the programme or project. In evaluation, it is therefore,necessary that one should be very clear of the objectives of the programme or goals that were aimed before the implementation of the programme, the various sub-goals if there are any and the population to whom this programme is specially intended. While evaluating the programme, one can get the actual changes in terms of economic benefits or improvement in production or material gains or it may be in terms of changes in the attitudes and feelings towards the programme in terms of reactions of the respondents. The type of data that has to be collected should be related to the actual objectives of the programme. One might use survey techniques or personal interview method or field experimental method with certain limitations.

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CHAPTER 6

HISTORICAL METHOD

T. S. Rajarathnam

History is a record of past events and movements. It is a complete, comprehensive, accurate and meaningful record of man's achievements in the past. The study of the past is important as the present is shaped by the past and the present and the past will probably influence the future. A. N. Whitehead points out that "each emerging is perceived as containing within itself all its past and seeds of its future". For example the existent and the future of the social institutions like the caste system would be better understood if their genesis and development are studied.

" Historians, philosophers, social psychiatrists, literary men as well as social scientists, use the historical approach as an aid in visualizing society as a dynamic organism, and its structures and functions as steadily growing and undergoing change and transformation. Social scientists in particular are concerned with social change, since all groups, social institutions, and personalities undergo changes to a lesser or greater degree, and as a consequence, the social roles and forms of organization they assume are also subject to a process of change and transformation ".[1]

Historical research is the application of the Scientific method of enquiry to historical problems. Historical research involves identification and limitation of the problem; formulation of the hypothesis; collection, organisation, verification, validation and analysis of data; testing the hypothesis; and writing of the historical account. All of these steps lead to a new understanding of the past and its relevance to the present and the future.

Identification of an appropriate problem is a crucial step in historical research. It is not that all problems lend themselves for historical analysis. Whether a problem is one of tracing or describing the past or whether it relates to the recent past to draw out its significance for the present and future, whether the problem is worthy of investigation in itself, whether it is feasible in terms of researcher's ability, time, cost, availability of data etc. should be the guiding factors in identifiying and delimiting the problem for historical research.

The next step is formulation of hypothesis. This is very important as it provides guidance for collection and analysis of data It requires social insight and historical orientation. Events, movements, opinions and institutions are products of the environment at a particular point of time. Without understanding the environment and time, one cannot understand the proper background of the historical data and formulate meaningful and scientific hypothesis.

Sources for historical data may be classified as primary and secondary. Primary sources may be further divided into those remains or relics associated with a person, group or period, fossils, skeletons, tools, weapons, food, utensils, clothing, buildings, furniture, pictures, paintings, coins and art objects and those that are deliberately intended for use in transmitting information which include oral or written testimony or the records kept and written by actual participants in or witness of an event and other documents such as constitutions, charters, laws, court decisions, official minutes or records, depositions, declarations, proclamations, certificates, lists, bills, receipts, newspapers and magazine accounts, advertisements, maps, books, pamphlets, catalogue pictures, inscriptions, recorded transcriptions, research reports and so on.

Secondary sources are the reports given by persons who were not on the scene of the events. They report simply what the persons who witnessed the event said or wrote. Text-books and encyclopaedias are examples. In using secondary sources one should be guarded against the usual errors that result when information is passed on from one person to another and the personal bias and prejudices.

As a next step, reliability and adequacy of the historical data should be ascertained. Historical data may be considered adequate for social research: "(1) when they are presented as complexes of social forces (2) when social phenomena meaningfully depict intricate social processes and (3) when sets of interrelationships—psychological, economical, educational, political, and religious—contribute to a unified whole, a configuration or complex pattern"[2].

External criticism and Internal criticism would prove the trust-worthiness and accuracy of the historical data. External criticism establishes the authenticity or genuineness of data. For example, the age or authorship of a document may be established by testing hand-writing, script, type, spelling, language usage, documentation etc.

Internal criticism evaluates the accuracy or worth of the historical data. When once the authenticity of data is established, it is essential to evaluate them for accuracy. Does it reveal a true picture? Was the author competent, honest or unbiased and objective and well acquainted with the facts? Questioning like these, one must make sure that the data are authentic and accurate.

After gathering the required data subjected to internal and external criticism, the researcher should piece them together into a meaningful pattern of evidence and then apply to it the testing of the hypothesis. Testing of hypothesis requires greater imagination and resourcefulness and critical thinking.

Writing of the report of historical research also requires attention. The style should be simple, dignified and objective. Historical researcher is permitted a little more freedom in reporting. Homer Carey Hocket suggests that "the historian is not condemned to a bald, plain, unattractive style", and that "for the sake of relieving the monotony of statement after statement of bare facts, it is permissible, now and then, to indulge in a bit of colour". He concludes, however, by warning that "above all, embellishments must never become a first aim, or be allowed to hide or distort the truth"[3].

Limitations of Historical Method

Only very few historians report the events objectively. Some are impressionistic and others are propagandists or defenders of a people or party. According to Pauline Young, "Limitations arise also because (1) Historians cannot write history life-size, (2) Not all happenings in time and space can be known at the time of writing, (3) Personal biases and private interpretations often enter unconsciously, even when honest attempts are made to select pertinent facts, to arrange them consistently, and to place them in a coherent and true frame of reference. Of necessity the historian must resort to selection. Descriptions of numerous complex happenings, occurring in rapid succession, cannot go on indefinitely until all details are exhausted. Historians find it imperative to omit a mass of detail. In the remaining mass that they do not omit, they often interject their own conclusions"[4].

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CHAPTER 7

DESCRIPTIVE METHOD

P. A. Guruswami

Science, whether physical or social, has four essential functions: description, explanation, prediction and control. It employs various methods for realising these functions. The descriptive method is one such used by scientists, particularly the social scientists It goes without saying from the very name of this method that it performs the function of description in science. The descriptive method is the simplest and is applicable to a number of social problems. It is essentially a fact-finding approach related largely to the present and abstracting generalisations by the cross-sectional study of the current situation. It comprises mainly collection of data; but since mere collection is not research unless there is adequate interpretation in the form of elaboration and of causal connection, the descriptive method to some extent also interprets the data. As has been well observed, the social scientist will not go far unless he, at least tentatively, generalises and unless he has ideas as well as data[1].

Necessarily not all social problems lend themselves for a study by the descriptive method. However, there is a host of problems in the social fields that can be studied through the application of this method. The types of problem covered here include: describing the characteristics of communities, establishing the proportion of people in a specified population who hold certain views or attitudes or who behave in certain ways and discovering or testing whether certain variables are associated. Some specific trend or prediction studies may also fall under this category: whether the popularity of the Prime Minister is declining or not over a period of time? How many people will vote for a certain political party in an election?

Writers are not in agreement on how to classify descriptive studies. Van Dalen has classified them under three broad groups[2].

1. Survey studies : a) School surveys, b) Job analysis, c) Documentary analysis, d) Public opinion surveys and e) Community surveys.

2. Interrelationships studies; a) Case study, b) Causal-comparative studies and c) correlation studies.

3. Developmental studies: a) Growth studies and b) Trend studies.

Descriptive studies are not limited to any one method of data collection. They may employ any or all of the methods like observation. questionnaire, interviewing and scaling techniques used by social scientists. Although descriptive studies may use a wide range of techniques, this does not mean that they are characterised by the flexibility that marks exploratory studies. The procedures to be used in a descriptive study must be carefully planned. Because the aim is to obtain complete and accurate information, the research design must make much more provision for protection against bias than is required in exploratory studies. Because of the amount of work frequently involved in descriptive studies, concern with economy of research effort is extremely important[3].

The following are the major steps in an investigation using the descriptive method.

1. Formulating the objectives of the study;
2. Designing the methods of data collection;
3 Selecting the sample;
4. Collecting and checking the data;

and 5. Analysing the results.

Limitations

There are certain limitations in the descriptive method. One limitation is that the researcher may make description an end in itself. Research is essentially creative and demands the discovery of facts in order to lead to a solution of the problem. Although problems in social sciences are continuous and have a past and a future, the researcher may lose himself in current conditions or at best, look into the past and develop an unprogressive conservatism. Perhaps, if such conservatism related only to the solutions suggested, there may not be much harm since there may be other researchers to come across alternative solutions. But such conservatism might develop in the researcher a restricted outlook even in the gathering the facts themselves, leading to complacency and absorption in the facts that have been gathered. A second limitation lies in going to the other extreme and generally is associated where the statistical technique dominates. The desire to overemphasise central tendencies and to present the facts in terms of averages, correlation co-efficients, means and dispersions may not always be either necessary or welcome. This limitation arises because statistics, which is partly a descriptive tool of analysis, can aid but not always explain causal relations[4].

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CHAPTER 8

THE CASE STUDY METHOD

P. A. Guruswami & T. N. Rajarathnam

Case study deepens our perception and gives us a clearer insight into life......It gets at behaviour directly and not by an indirect and abstract approach.

— Charles Horton Cooley

The scientific social research is based on several methods like survey method, historical studies and experimentation. The case study is one such method used widely by social researchers particularly sociologists, psychologists and educationists. This method is as old as human civilization. Whether it is a question of narrating an incident by a grandmother to a grandchild vividly or the volumes of fables narrating of the past bringing out a moral theme, the case study method - without formally using the term - comes to be followed. By studying Family Budgets, Frederick Le Play (1806-1882) introduced the case study method in Social Sciences in a systematic manner. Spencer's *Descriptive Sociology*, Sumner's *Folkways*, Znaneicki's *The Polish Peasant in Europe and America*, Edward Westermark's *Origin and Evolution of the Human Marriages* are some of the early works built on case study method.

What is 'Case Study?'

This method, also known as Historical - Genetic Method, is exploratory and is used not necessarily for proving or disproving a hypothesis but often for the formulation of a hypothesis. By definition, it is a qualitative, intensive, insight-stimulating and comprehensive approach. The field of study is comparatively limited but has more of depth in it. It aims at studying everything about something, rather than something about everything as in the case of statistical methods. Because of its aid in studying behaviour in specific, precise detail, Burgess termed the Case study method, "the social microscope"[1]. These and other important characteristics of the case study are brought out clearly by the following definition: It is a method of studying social phenomena through the thorough analysis of an individual case.

The case may be a person, a group, an episode, a process, a community, a society or any other unit of social life. All data relevant to the case are gathered and all available data are organised in terms of the case. The case study method gives a unitary character to the data being studied by inter-relating a variety of facts to a single case. It also provides an opportunity for the intensive analysis of many specific details that are often overlooked in other methods. This approach rests on the assumption that the case being studied is typical of cases of a certain type, so that through intensive analysis generalisations may be made which will be applicable to other cases of the same type[2]. The totality of the being, underlying unity, complexity of social phenomena and influence of time are some of the basic assumptions of the case study.

Not all problems are amenable to case study method or for that matter any method of research. Some of the kinds of cases that may be studied by case study method are:

a) Persons or groups moving from one culture to another - who have not left their old nor have they got into the new - such as emigrants or converts - from Hindu to Christian or Hindu to Muslim or vice-versa.

b) Individuals, groups or institutions passing from one stage of development to another. Example: Villagers getting into factories in the towns. Their entire thinking processes undergo change and so their behaviour pattern with the accompanying stress and strain.

c) The non-conformists and their abnormalities; the manner in which they react to social stimuli. Example: Smugglers, hoarders, blackmarketeers and profiteers.

d) Democratic institutions which have failed or succeeded. For example, the factors responsible for the failure of a Village Panchayat. Such an integrated impression and serious study may be necessary, for instance, to throw light on the working of successful credit institutions, to find out, if possible, any outstanding factors responsible for their success, or to analyse in detail the working of some institutions which have failed or stagnated, so as to understand the factors responsible for it.

e) Social, economic and political consequences of programmes of change. The " Green Revolution " is a case in point.

Case Study Technique

As far as the methodology or method of the Case study is concerned, i. e., the logic of scientific investigation, there is not much difference between it and the other methods of research like survey. It also follows the same sequence or steps from the selection of the problem through the presentation of the research findings. However, there are some special methodological issues peculiar to the case study. Mouly writes that "if it is to be accepted as a scientific technique, the case study must follow essentially the same steps and meet essentially the same criteria as do the other research methods. On the other hand, it presents a number of problems which are relatively unique either in kind or in degree"[3]. Any approach of such comprehensiveness necessarily involves the use of data with varying degrees of overtness and statistical accuracy. The technique of gathering and processing data are done generally in three phases: choice of cases, recording of data and their interpretation.

Two essential elements in the *choice of cases* are , first, selection of 'representative units' *as far as possible*. The 'typicalness' of the cases is important, for the individual case is studied not as a definite entity in its own right but as a specimen in a culture series, whose actions are socially relevant. A preliminary statistical study may be useful here. The ability of the researcher to recognise 'representative' cases is important and may facilitate selection.

For instance, in a study of factors affecting the successful working of the panchayats, it is needless to say that a representative group of panchayats must form part of the sample. Secondly, although the case study has an overall outlook, a well defined and carefully selected problem is presumed and a social situation in concrete is being studied. It is not an aimless collection of data. There would, therefore, be a necessary circumscribing of the limits of enquiry both in number of cases and type of data. This is sometimes termed 'identifying the situation' and penetrating discrimination is required to pick out the aspect of study, particularly the operating casual factors.

In collecting and recording data, the essential characteristic of the case study, viz., that it is a way of organising social data so as to preserve the *unitary character of the social object being studied* must not be forgotten. In a more practical form, how can the wholeness of cases be preserved? Goode and Hatt have attempted to outline the answer briefly under four rather complex rubrics[4]: (1) Breadth of data; (2) Levels of data; (3) Formation of indexes and types; and (4) Interaction in a time dimension. The breadth of data refers to the fact of collecting a broad array of data about the unit of the study. Although mere quantity of data is not sufficient, since the collection must be guided by the research problem, there is a greater opportunity to group the pattern of the individuals' life, if a substantial body of data concerning many facets of that life is available. When data from various abstract levels like sociological, economic, political, psycho - dynamic and even biological are collected, the individual being studied can be better understood.

Another technique of preserving the wholeness of the social unit is the development of typologies and indexes, so that the various traits are actually used in characterising the unit. Example: Male or Female, young or old and poor or rich. Finally, to the breadth and additional levels of the data gathered in the case study method must be added the emphasis upon the process and time. This rather dynamic analysis lays emphasis on the temporal dimension of the problem of the investigation. The period of time may be short or long. An individual's life from childhood until the time of a study is an illustration of the interaction in time dimension.

The interpretation of data is an equally challenging and difficult task in the case study. The main danger here is the response of the researcher himself, i.e., he must closely guard himself against the subjective interpretations of the facts relating to the individual being studied. This can be achieved in some measure, at least by following some standardised frame of reference for organising and presenting his data on the problem. It may be mentioned here that Spicer's pattern of writing the case study may be very useful for this purpose[5]. He presents his data under five headings: the problem, the course of events, the relevant facts, the outcome and the analysis. According to him the first prerequisite is that the problem should be stated briefly and candidly. What we want to study should be spelt out more specifically here so that it can facilitate easy and objective analysis of the problem at the later stages. Then may be presented the historical development or sequences of the problem in a chronological order. Thirdly, all necessary details concerning the problem should be listed. Following these three stages, the logical development will be drawing valid conclusions which must be explained and interpreted towards the end of the study.

Limitations and values of case data

At this stage it is important to point out some of the limitations of the case study. The first and the foremost difficulty, the one that is the basis of all others, is the overconfidence that the researcher develops in his mind. The researcher is central in the case study and thus his sense of complacency is an important barrier which in turn develops a false sense of confidence which is highly detrimental to any scientific outlook. The second major drawback is the tendency of over-generalisation on the part of the researcher. This is exactly what is happening in the studies of rural communities by anthropologists and sociologists in India.

After say, a study of one or two villages they venture to arrive at sweeping generalisations about the whole of the countryside. Further the time and money needed for case study is much greater than for the other methods.

Notwithstanding these defects and shortcomings, the case study has several advantages: They are: (1) Case study helps in formulating valid hypothesis. (2) For refining the tools of data collection for other research methods and also for finalising the sample frame, case study is considered very useful. (3) Case study enlarges the range of personal experience of the researcher as the whole range of subject's life is studied unlike the survey where the researcher's knowledge is limited to the particular aspect only.

Thomas and Znaniecki[6] were thoroughly committed to the value of case data for research purposes and believed them to be "the perfect type of sociological material". They were convinced that if social science has to resort to the use of other than human documents and case data, "it is only because of the practical difficulty of obtaining at the moment a sufficient number of records to cover the totality of sociological problems and of the enormous amount of work demanded for an adequate analysis of all personal materials necessary to characterize the life of person or a social group".

To conclude, the case study is and will continue to occupy a pride of place in social science research for many years to come.

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CHAPTER 9

LABORATORY TECHNIQUES

Mrs. Godavari Kamalanathan

Today approach to Science is a judicious combination of experimentation as well as survey. Hence the tools for collecting data involve both the laboratory as well as observational techniques. Laboratory techniques are called for in chemistry, biochemistry, physics, mathematics, geology, geography, zoology, nutrition, foods, food chemistry, textile chemistry, psychology, zoology, and branches of social sciences. Experimental studies call for use of equipment as well as living being from virus through plants to human being. In the real scientific sense there is inter dependence in the methods and the approach is inter disciplinary. Laboratory in the strict sense is the space for conducting intensive experimentation under specific conditions rather than the conditions being conceptual of mere physical dimension. Laboratory techniques are usually formulated based on certain information gathered through the review of literature and surveys, questionnaires, case studies and observations.

Laboratory method is a problem solving approach that attempts to follow most closely some of the cannons of research. Generally, essential factors except a single variable are put under specific condition generally referred to as control condition. The variables are manipulated or changed with a view to determining or measuring the effect of their operation. Experimentation is expected to reveal causal relation and interactions. Hence it calls for consciously directed, purposeful, precise, accurate observation. To be truly useful it has to be intensive, limited to certain aspects, minute in analysis and therefore exacting and time consuming. The element of originality, the need for creative thinking is called for to a great extent. The basic principles may be the same all over the world, for the various disciplines but the applications vary. The facilities are different from country to country, state to state and even region to region in a state.

Alertness to new facts, adaptation to present circumstances, accuracy of observation, application to living conditions should accrue from the laboratory research. In any field of science, laboratory technique will involve inter-disciplinary approach; for example, in experimentation in Nutrition it has several sub-groups-Animal Nutrition, Human Nutrition, Nutritional requirement, Role of Nutrition in the body, Nutrients in Foods, Community Nutrition, Nutritional Deficiency and so on. Of these while analyses of nutrients in foods can be confirmed strictly to laboratory work, almost every other aspect of nutrients will call for co-ordination of several aspects of research methodology. Even in the aspect of nutrient analysis of food, if the analysis is extended to cooked foods, it will be preceded by survey of prevalent methods of cooking, determining acceptable methods of cooking among the various methods, standardization of recipes with reference to time, utensils, medium, ingredients, will all have to be considered. Application of laws of thermodynomics, chemistry of colloids and crystals 1 PH will all come into play.

Laboratory technique will call from originality of application and ingenuity of thinking. Several variables need to be investigated and to be successful, a team of workers will have to work in unison to achieve the goal.

Being a tool for research, laboratory method is used, to impart knowledge, to develop skills, to kindle interest to test theories, to collect information, classify and (if done precisely) draw conclusions. Reproducibility of techniques is a good criteria of a well conducted research. The data collection in laboratory as exercise, if planned scientifically opens up new vistas and may serve as pilot study. For instance, years back in a class exercise in college when foods were analysed, a new thought had come up "why not analyse sprouted grams". It was found to contain vitamin C which is absent or very low in dry grams, and this was taken up for further research, on ascorbic acid in its various forms. In laboratory technique intellectual curiosity is kindled. Improvisation is given scope. 'How and why' become the keynote.

Development of personality

Biographies of great scientists indicate the qualities needed for research work. Of all the various methods, laboratory method calls for discipline of mind in techniques, time, environment and insatiable curiosity. Intelligent, internal drive and hard work, not taking anything for granted, enthusiasm, joy of doing are noted among all great scientists working in the laboratory.

Perseverance and accurate observation, carefulness in drawing conclusion in research work, avoiding generalization are noted among scientists.

Physical Set up and Components

The physical set up and components of Laboratory are the following:

1) Space, 2) apparatus 3) light or darkness 4) ventilation, 5) humidity, 6) temperature, 7) energy source, 8) water, 9) the lay out, 10) efficient management of time and scope for individual work and group work.

Materials

The chemicals, foods, articles or subjects are essential features. The so called accessories are the following: instruments, equipment, utensils, measuring devices, depending on the precision needed in the modern age. Special equipment have been designed for the left handers also.

Teaching aids and communication aid - such as black board, microphone, charts and models are also part of the physical setup of a laboratory.

The Components of Laboratory Procedure

The Choice of the Study on the Investigation

A research worker is a student all his life. In the lives of scientists it is seen that genius is seen at the age of 14 as in case of Newton or at a later age but all of them continue to show the same zeal throughout their life. To keep abreast of the growth of knowledge one must have a regular reading habit. A scientist will glance, skim, deeply study the articles depending on the nature of his interest and the quality of the work studied. A young research worker needs guidance of his teacher or guide to become a discriminating reader. At the same time the research worker should use his discretion in sifting information and pick up what is pertinent. Though to have perfectly original mind, the worker should think much and not be distracted by all the knowledge available, yet the very thinking process needs a bank of accumulated knowledge.

Once the nature of investigation is decided upon, the facts of the investigation are to be thought out with depth. It has been called "intellectual incubation period". The term *problem* is often used in laboratory method. It is not description of the study or rather it is a negative description of the study. The connotation of the term '*problem*' is that it is "difficult of settlement or solution - question or puzzle, a source of perplexity".

The experimentation

Experimentation is an important aspect of laboratory research. It consists of making an event occur under well defined, known conditions where as many extraneous influences as possible are controlled, eliminated or specified. This is what is called controlled conditions. Every step of the experimentation is clearly envisaged and listed. Experimentation will include preliminary arrangement such as pilot testing, selection and storage of materials, equipment or instruments, for testing and experimental subjects. Development and mastery of techniques through practice, organisation of recording of data and framing of statistical analytical models, are essential.

Once the stage is set for experimentation, the actual testing is carried out in a methodical, well organised manner. Where, How and When are the three faces of actual testing.

Where ?

The laboratory will be mainly the area of testing. However, the testing may be extended to different regions if necessary.

When?

The time will depend on the type of testing - usually the most conducive time is chosen. For human studies or on plants or astro sciences the cyclic changes and seasonal variations will play an important role.

How?

For collection of data the mode of measurement is important. A proper perspective is to be maintained. It has to be decided as what approach will be the best. Scales such as Mega, Macro, Semi micro, Micro or Ultra micro (these are all relative terms) needs to be decided upon to get the best data under practical condition.

Microprocedures are followed for very small samples - Minute quantities such as vitamin, harmones, trace elements.

The smaller the units the greater should be the precision of work. In this case volumes and concentration are so adjusted that the order of final measurement remains the same microquantity as the original sample. Procedure which require minimum transfer of material and uses minimum number of reagents will be selected.

Methods by which a test substance is compared with a standard are favoured for micro techniques. Keen careful intelligent observation as the experiment progresses is important whatever may be the type of testing. Meticulous care and power of observation are developed in experimentation. Experimental results are valid for the precise conditions under which the experiments are conducted.

In experimental research results are valid for the precise conditions under which the experiments are conducted.

In experimentation groups comparable in all respects except treatment under investigation are formulated and tested. Various possibilities are tested one by one. Careful observation and immediate correct recording of the data are to be closely attended to.

Chance plays an important role in research. Even in spite of extremely careful conditions, mistakes may creep in. Sometimes out of mistakes have accrued important finding, notable example being the discovery of principle of immunization by Louis Pasteur. After a period vacation when he resumed the work, he found all the culture had become sterile and subculture failed to grow and test birds were not affected. This lead to his inspiration of reinoculating the same fowls with fresh culture and all the treated fowls withstood the inoculum where as untreated ones succumbed. Sir Gowland Hopkins who was considered as father of biochemistry and venerated Nutrition Scientist usually gave his class a certain well known test for proteins. At one particular class the students failed to get the reaction. Hopkins had the acumen to test again and elicited that the reaction was obtained only when acetic acid employed contained an impurity - Gly-oxylic acid. Then he followed this clue further to note the group in the protein with which gly-oxylic acid reacted and this led to the isolation of tryptophane. Though chance is a factor in making famous discoveries these were possible only through creative thinking, by giving attention to even slightest clue. At the experimental stage the research worker should not become obsessed with a single track but must have an open mind and record of data as observed. Opportunities come only through continued observation and recording of data, noting the unusual, interpreting the clue with intelligent followup, productive thinking, further testing and application and enthusiasm.

Methods of analysis of data

Once the data are available as a whole, several suggestions will emanate. Great scientists after intensive thinking were able to clearly perceive the pattern, through what is called intuition. This intuition is a result of logical thinking. Von Helm Holtz, the great physicist of Germany, had found that ideas came to him not when he was fatigued or when at laboratory but often in morning after rest.

While an experiment is formulated, the statistical approach is also taken into consideration. Test checks should be carried out from time to time to see that the data collection is correct.

The conclusions are objectively arrived at, possibilities are suggested and the most probable answer is taken. The study, if really good, will lead to another exciting line of research.

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CHAPTER 10

TOOLS FOR COLLECTING DATA

OBSERVATION

Observation may be defined as the careful and systematic watching of facts as they occur in the course of nature. In every act of observation there are two components - the object, or what is observed, and the subject or the observer. It may be that sometimes one may have to observe one's own immediate experience. That would be subjective observation or Introspection. Many data of psychological interest are gathered by the method of subjective observation. On the other hand in many investigations, the observer is an entity apart from the thing observed. Observation of this type is objective observation or Extrospection. In recording social data, objective observation is more appropriate as compared with subjective.

The general characteristics of observation are: first, it is at once a physical as well as a mental activity. In as much as one has to see or hear something, the use of the sense faculties is involved. In so far as data have to be taken notice of, attention needs to be focussed on them. There are thus two distinct elements in every act of scientific observation.

Secondly, observation is selective. One does not just observe anything and everything, but the range of things which fall within any act of observation is narrowed down. Thus the police inspector, standing at a street corner, looking out for traffic offence such as overspeeding or breaches of 'no horn' regulations may see a thousand and one cars pass by; but he takes notice only of those vehicle - drivers who are driving too fast or are sounding their horns. In the same way the scientific observer may see many stars in sky, but he takes notice only of those which are objects of his scientific study.

Thirdly, observation is purposive, not random. In so far as the research is aimed, that certain specified objectives are sought to be attained by the investigation, observation is in consequence limited to those facts and details which serve the ends sought by the acts of observation. It is not as if one takes notice of anything and everything that comes in one's way and then picks out those items which relate to the enquiry. This sort of observation would be random and haphazard. Often in scientific research one has to be engaged in a search for the facts and details which one is trying to secure. For this reason observation is guided by specific purposes.

Fourthly, the direction given to the observation of the research worker is the direct outcome of certain dominant interests which are served in the course of the investigation. Observation, if it is to be meaningful, must of necessity relate to these interests. Often indeed the interests are wider than the immediate objectives of the investigation.

Fifthly, observation has to be efficient. Mere watching is not enough. It is in fact not sufficient to gain some general or vague impressions based on what has been casually observed. Scientific thinking has to depend on observation which is in some sense exact. In other words, even if observation should result in conclusions which are qualitative in character, it is necessary that these observations should be based on tools of research which have been properly standardized. The difference between casual and scientific observation lies in the fact that the former type of observation occurs without any previous preparation, and it is therefore a matter of chance that the right thing is observed at the right time and in the right place. Scientific observation, on the other hand, is carried out with the help of tools of measurement. Every effort is made to make certain that what has been observed was noticed under standard condition. This is necessary because, if data are to be of any scientific value, they must be comparable. It should not be that what was evident under one set of conditions cannot be compared with what would be evident under another set of conditions.

In practice, this is not a simple requirement to fulfil. Nevertheless, the use of standardized questionnaires, rating scales and similar devices of measurement is intended to minimize the error resulting from the differences which may exist between discrete observation. All things considered, the scientific value of the evidence collected by observation increases when this error is at its minimum level.

From all that has so far been said regarding observation, it will be evident that some kind of control has to be exercised over observation in order to enhance its scientific value and to avoid the errors to which human observation is liable. At the same time it cannot be forgotten that in the social sciences, the techniques of observation have to develop out of simple observation without much rigid control, to the more exact observation in which standardisation and controls are exercised. This has been emphasized by Goode and Hatt in the following way: "Most of the knowledge which people have about the social sciences is derived from simple observation, whether participant or non-participant. The controls in this case refer to the standardization of observation techniques or, in some cases, controls over the variables in an experimental situation. That is, we have learned about social behaviour from the situation which we have witnessed or participated in, and our observations were not checked by other observers, by a set of specific items to be noted down, or by a detailed outline of experimental expectations. Scientific observation develops, however, from the most casual experience with a subject, to the most formalized abstract measurement of variables, to the use of precision instruments. Even when a science has had a considerable growth, the simple forms of looking and listening are not superceded. Not only do they contribute to the basic, varied stock of knowledge about social relations with which we all begin our study, but they are the principal data - gathering techniques for many modern investigations". In these words Goode and Hatt have summed up the attitude which should influence the research worker who undertakes data collection by observation in the social field.

A word needs to be said in this connection regarding the distinction which has been made between participant and non-participant observation. By participant observation is meant any act of observation undertaken in circumstances which include the observer as a part of the things which he is observing. The anthropologist, for example, follows this type of observation when he takes part in tribal activities, which he may be engaged in studying. He gets into the situation and thus gains a more insightful understanding of the situation that he would otherwise be incapable of securing. Participant observation would of course vary from complete membership of the group to part time membership or temporary association. Notable examples of participant observation are to be found in the way American Peace Corps Workers are observing rural and urban conditions in India. They are able to gain greater insights into the actual conditions than what they would gain if they merely stood by and watched what is going on.

Non-participant observation, on the other hand, occurs when the observer keeps clear of any personal involvement in what is being observed. In other words, participant observation entails a psychological identification to some extent between the observer and the thing observed. In non-participant observation, this psychological identification is absent. On the other hand, the observer is aware that he is an entity apart from the object of his observation.

It will be necessary to stress the fact that no rule of thumb can be laid down as to which type of observation is desirable in any particular enquiry. It cannot be forgotten, however, that when an outsider enters a group in order to carry out observations, he may thereby alter the natural behaviour of the group, apart from the stresses and strains he is liable to experience in the course of his efforts to become adapted to the ways of the group. Further, by becoming a participant, he is liable to narrow down the range of his experience. The psychological identification of the participant observer in the life of the group into which he has entered-particularly on the emotional side - is likely to result in a loss of that objectivity which is necessary and desirable in social research. Above all, the participant observer will find that although he may gain a clearer understanding of what he is observing, this has to be done, as a rule, at the cost of control or standardization, which would result in lowering the scientific value of what is being observed. Despite all that has been said against participant observation, the fact remains that non-participant observation, in the strict sense of the term, is - to put it mildly - not an easy matter. One has in some sense to be in the group but not of the group. One has to be immanent and transcendent in relation to the group if the observation is at all to be meaningful. The minimum requirement is that the members of the community or group must accept the presence of the field workers as legitimate. Commenting on this, Goode and Hatt have pointed out that "the investigator then has several useful roles from which to select. He is a stranger and thus less involved emotionally with the social situation. True members may thus feel relatively free to talk over tensions and delicate matters which they would not discuss with their own inmates. The researcher is also a listener. Further he is a pupil, eager to learn, and by that eagerness indicating his belief that the community or group is a significant one. In addition, of course, for most interaction he may shift into his role of participant, so that he does not remain a mere alien." This makes it abundantly clear that in social research, some degree of participation in the life of a group is an inescapable requirement if the data collected by observation are to prove fruitful.

Although there is a great deal which may be said regarding observation, it would be desirable to round off this discussion on observation by examining the distinction that has been made between simple and systematic observation. By simple observation is meant the unsophisticated and relatively free way of looking and listening, with little by way of any predetermined plan to guide observation. The inevitable outcome of simple observation is that the investigator will in course of time be saddled with a mass of factual data which he will need to organize by some kind of coding and indexing operation. It will be necessary also to separate the facts observed from the interpretation of the observation in order to make certain that the relevant data collected by persons who are not actually engaged in field work. It would also be profitable for the field worker to leave the field from time to time, in order that he may have opportunities to think over the problems encountered and the data gathered. Uncontrolled observation usually needs supplementing by schedules of information. As Goode and Hatt have pointed out, "Informal methods may be supplemented by highly structured observation, by detailed questionnaire, and by psychological or sociological tests. Thus, what the sociologist or social anthropologist does in an unsystematic fashion, in order to arrive at any conclusions at all can be carried out by more reliable procedures."

By systematic or controlled observation is meant observation undertaken with due regard for the accuracy and trustworthiness of the evidence collected by applying tools of research. In the opinion of Goode and Hatt, "We can think of systematic observation, then, as being a later stage in the development of a project. As our ideas grow in depth and sharpness, we wish to rely much less upon uncontrolled observation. Since the sociologist is often in the position of the astronomer, or the comparative psychologist, it is rather difficult to control the object under investigation, he must at least put controls on himself. Thus he increases precision, and at the same time he protects his work from later attack. By reporting how he made his observations, under what conditions, when and so on, he makes it possible for other scientists to know the limitations of his data and to repeat the observations." It will thus be evident that systematic observation seeks to place limitations on the bias of the individual observer on account of the controlling influence of such devices as team observation, synchronization, films and recording schedules and inventories, and coding techniques. In a variety of ways, controlled observation helps in giving shape to the evidence gleaned through simple observation.

CHAPTER 11

TOOLS FOR COLLECTING DATA: INTERVIEW

P. Rangaswamy

Interview is one of the chief means of collecting data in social research. It is an effective tool in the hands of the researcher, provided he knows how to use it properly so as to achieve the research objectives. The researcher should be fully aware of its purposes and limitations and well-trained in the skills of securing reliable and valid information through that technique.

Purposes

Interview has been defined as 'a systematic method by which a person enters more or less imaginatively into the inner life of a comparative stranger[1]. It can be successfully employed to collect wide range of information - from merely factual or census data to highly personal and intimate information relating to a person's inner strivings and attitudes, values and beliefs, past experiences and future intentions. It can be a good source of hypotheses as well as a good means of testing hypotheses regarding human motivations and socio-personal interactions. Often times it can be used as a supplementary tool to other techniques to enrich a study of persons and to check upon information gathered through other sources. Sometimes it may be the only device available to collect certain kinds of data. It allows the interviewer to go behind mere outward behaviour and study its underlying motives. Interview makes possible a face-to-face association and a process of interstimulation between the interviewer and the interviewee and this helps in securing data not obtainable by methods that do not involve an inter-personal relationship.

Limitations

The limitations of interview are that it is costly and therefore a waste when other less expensive sources of the same information are available; it is not a reliable technique where respondents may not give the correct information, either because they may not possess it or they may consciously or unconsciously hide or distort it. Interviewees often suffer from faulty perceptions, faulty judgements, faulty memory and inability to articulate. Ralph Berdie who has made an extensive study of the psychological elements in interviewing, found that, because memory and retention are highly selective processes, interviewees under proper circumstances generally gave accurate accounts of their most recent, most intense or most frequent experiences. Painful or embarrassing experiences are often forgotten or consciously avoided.

It has also been established by studies that interviewers often approach their respondents with prepared set of expectations as to how the latter will answer certain questions or they develop these expectations in the course of the interview on the basis of early or incomplete responses. This interview bias and *a priori* thinking may distort and invalidate the results of the whole interview.

Some of the above defects can be overcome by proper design of the interview schedule, systematic training of the interviewers and supplementing interviews with other tools such as projective techniques, sociometry, etc.

Types of interviews

Interviews may be broadly classified as structural interviews and non-structured interviews. Structured interviews are those in which a detailed preplanned schedule is used and nonstructured interviews are those with no predetermined questions but which proceed on the basis of only an interview guide.

Non-structured interviews again can be divided into non-directive interviews, focussed interviews, depth interviews, etc. In non-directive interview, the interviewer's function is just to encourage the respondent to talk freely about a given topic under a minimum of direct questioning or guidance. He should create a completely permissive atmosphere in which the subject feels free to express himself fully without fear of disapproval or dispute and without advice from the interviewer. He should encourage free expression by such comments as: 'You feel that ....', 'Tell me more', 'Why?', Isn't that interesting?' or 'Go ahead'.

In focussed interview, the interviewer is required to focus attention on a given experience and its social and psychological effects. It takes place with persons known to have been involved in a particular concrete situation; they have seen a film, heard a radio programme or participated in an observed social situation. The situation has been analysed prior to the interview and an interview guide has been prepared which outlines the major areas of enquiry and the hypotheses to be tested. The interview is focussed on the subjective experiences - the attitudes and emotional responses of the subjects regarding the particular situation under study.

The depth interview is intensive and searching in character. It is used principally for studies requiring full and detailed expression of social attitudes, emotions or convictions. In modified from, it is used to some extent in marketing research studies designed to obtain underlying reasons for preferences for certain products.

Thus non-structured interviews are more flexible than the structured interviews and so require more skill on the part of the interviewer. They are specially applicable to situations where a detailed structuring of questions before-hand is not possible. The interviewer has to frame and ask questions during the interview on the basis of the interview guide. Consequently the answers are not comparable as in the case of structured interviews.

Conducting the Interview

The quality of interviewing first depends upon proper study design, and design of the schedule. Even the most skilled interviewers will not be able to collect valid and useful data if the schedule of questions is inadequate to the objectives of the study or has been put together clumsily. On the other hand, even the best interview schedule does not ensure proper data collection unless the task of interviewing is performed effectively. Although interviewing requires certain personality characteristics which enable a person to establish quickly an easy rapport with others, it is a skill which can be improved considerably by training and experience.

Steps in the Interview

Planning and Preparation

Careful planning and preparation are necessary both in the case of structured and non-structured interviews. In the case of the former, a detailed schedule has to be prepared to collect data pertinent to the objectives of the study. All the generally accepted principles of schedule design have to be strictly followed so that data collection can proceed smoothly and in a standardized fashion. The interviewers have to be well-trained in administering the schedules according to common instructions. In the case of non-structured interviews, an interview guide has to be prepared outlining subjects of study. This guide cannot be too rigidly followed. The framing and ordering of the questions has to be done by the interviewer during the interview, according to the unique circumstances of the interview situations.

In both the types of interviews, the interviewer has to think of possible responses of the interviewees and should plan ways of dealing with inadequate responses, silences, distortions, avoidance etc.

The interviewer should carry an introduction letter from the sponsoring agency. He should fix a suitable time and place for the interview according to the convenience of the interviewees. When studying a community or cultural group, it is advisable to interview the leaders first, to enlist their co-operation and have them recommend the interviewer to others in the group. The same applies to study of organizations and institutions. The persons in-charge should be approached first and their co-operation secured before any attempt is made to interview members or workers. Back-door approaches and encroachments should be avoided.

Starting the Interview

The first approach to the interviewee should be made carefully so as to win his confidence and co-operation. He may be greeted with a smile, a namaste and 'how do you do'? His name should be ascertained so as to make sure that he is the desired respondent. Then the interviewer should disclose his identity and explain the purpose of the interview in terms that the respondent can understand: for example "I am Arumugam from Sri Ramakrishna Mission Vidyalaya. We are making a study of the ways people spend their incomes and I would like to ask you a few questions". Official cards or letters may be shown where necessary.

The basic key to successful interviewing is to establish rapport with the respondent so as to create a friendly atmosphere and put the respondent at ease. "A state of rapport exists between the interviewer and respondent when the latter has accepted the research goals of the interviewer and actively seeks to help him in obtaining the necessary information"[2].

Barriers to initial communication must be overcome with patience and understanding. Sometimes there may be suspicion on the part of the respondent that the interviewer is a government agent or a salesman and that the information may be used against him. Such suspicions should be cleared by establishing one's own identity and the identity of the sponsoring agency, by explaining clearly the purpose of the interview and the scientific nature of the study. Questions and doubts if any, regarding the above should be answered. The interviewer can also describe the method by which the respondent was selected and state the anonymous or confidential nature of the interview. The interviewer should establish by his manner and questions that he has no ulterior motives but only seeks information for scientific purposes.

Some respondents may be afraid that they will have to answer difficult questions. They may be diffident about their own competence to answer questions regarding the subject under study. Such kind of anxiety has to be allayed by reassuring the person:

"This is just a survey, you know. There are no right or wrong answers and this is not a test or quiz. We are simply trying to find out how people feel".

The interview should be carried on in an informal conversational style. Even where there is a structured schedule of questions, they have to be asked conversationally rather than read stiffly. The interview of course is not simply a conversation. It is conversation with a purpose. In order to be successful, it must have all the warmth and friendliness of a conversation, and at the same time the clarity and guidelines of scientific searching. Consequently, the interviewer cannot lose himself in being friendly. He must introduce himself as though beginning a conversation but from the beginning, the additional element of respect, of professional competence should be maintained. The interviewer's manner should be friendly and courteous throught out and should reveal a genuinely scientific attitude. He should be neither too grim nor too effusive; neither too talkative nor too timid. The idea should be to put the respondent at ease so that he will talk freely and fully.

Asking the Questions

Unless the interview is of the non-structured type, interviewers must be impressed with the importance of asking each question exactly as it is worded. Each question has been carfully pretested to express the precise meaning desired, in as simple a manner as possible. Interviewers must understand that even a slight rewording of the question may change its meaning and alter the response.[3]

Any explanation of questions other than those specifically authorized in the instructions should be carefully avoided. Such an explanation may change the frame of reference and bias the response. If each interviewer is permitted to vary the questions as he likes, there will be no way of comparing answers. If a particular question is not understood, the interviewer can repeat it slowly with proper emphasis offering only such explanation as given in the instructions. If understanding is still lacking the fact may be noted on the schedule[4].

For similar reasons, questions should be asked in the same order as they appear on the schedule. Each question sets up a frame of reference for succeeding questions and if the order is changed, responses may not be the same.

The interviewer must ask every question given on the schedule, unless there are instructions to skip it. He should not take answers for granted or infer them from earlier responses.

The whole interview should be carried on in an easy, natural and relaxed manner. There should be nothing forced or artificial about it. It should be remembered that the interview is a social interaction, a contact of two personalities. In order to be successful, it should be emotionally satisfying to both. The interviewee is interested in telling about himself, his feelings, ideas, opinions and experiences and the interviewer should develop the art of quiet and sympathetic listenting. Many interviewees desire sympathetic listeners rather than aggressive interrogators. The interviewer should take all answers naturally, never showing disapproval or surprise. He should not reveal his own opinions. Even when he is asked for his views, he can laugh off the request with such remarks as: "Well, I haven't thought about it," or "your opinions are more important than mine."

The interviewer's job is fundamentally that of a reporter, not of a debater. He should never argue nor dispute. He may not try to educate the respondent or impose his own opinions on him. His main focus should be on the respondent and obtaining his views on the subject under study. He can show genuine concern and interest in the ideas expressed by the respondent, at the same time maintaining an impartial and objective attitude. He should be patient listener as well as a creative and intelligent questionner. He should keep the direction of the interview discouraging mildly irrelevent conversation.

Eliciting Complete Response

Obtaining a specific, clear and complete response to a question is not always a simple matter. People may answer 'Don't know' to a question, in order to avoid thinking. They may launch off an irrelevant discussion; sometimes they may contradict themselves. The interviewer should be alert to all such situations and know how to deal with them individually. "Alterness to incomplete or non-specific answers is perhaps the critical test of a good interviewer[5]. He should understand the objective of each question, the precise thing it is trying to measure. Both the written instructions and oral training given to the interviewers should emphasize the purpose of the question and should give examples of inadequate replies which were encountered during the pretest. By the time he is actually out interviewing, the interviewer should have formed the automatic habit of asking himself after each reply : "Does that completely answer the question I just asked?"[6] When the first reply is inadequate, a simple repetition of the question with proper emphasis will usually suffice to get a complete answer. This is particularly effective. When the respondent's answer is vague or too general, or incomplete, then the interviewer has to probe: "That is interesting. Could you explain that a little more?" Sometimes, in order to clarify or make more specific certain information, the interviewer may say "Now let me see if I have got your point" and then summarize what the respondent has said and ask : "Is that what you mean?" Such kind of probes should always be non-directive, never leading.

The interviewer should never suggest a possible reply. Probing of course, plays a greater role in non-structured interviews made with the help of an interview guide.

The 'Don't know' replies pose another problem. Such replies may be due to a genuine lack of knowledge or due to a host of other causes such as fear to speak out the mind, reluctance to focus on the issue, uncrystallized opinion, lack of comprehension of the question, etc. The interviewer should be able to locate the cause, and by suitable probes ascertain the responses. In one case for example, he might say: "Perhaps I didn't make that clear. Let me read out the question again". In another case, he might say, "Well, lot of people have never thought about it before, but I just want your ideas on it, just the way it seems to you". The interviewer's ability consists in stimulating and obtaining full responses wherever possible and not in passively accepting the initial reactions of the respondent.

Recording the Interview

There are two chief means of recording the responses during the interview. If the responses are precoded, the interviewer need only check a box, circle a code or otherwise indicate which code closely corresponds to the respondent's answer. If the question has not been precoded but is open-ended, the interviewer has to record the response verbatim.

On precoded questions, errors and omissions in recording are a frequent source of interviewer error. The interviewer, by oversight or divided attention, may neglect to indicate the reply to a question, overlook some particular question, check the wrong code or the code for another question and so on. The better the interviewer the fewer such mistakes he will make but even the best interviewers may some times commit faults. The only certain way to avoid this is to make an automatic habit of checking each interview, after its completion, to make sure that all the responses have been filled in accurately and completely. He can correct errors, if any and complete inadequate replies. If his handwriting is illegible in some place or if he has recorded verbatim replies only sketchily, he can remedy the defects then and there. If he waits until later in the day or until he returns home at night, he may forget many things and nothing much can be done about it. This kind of incomplete and erroneous schedules will be a source of much trouble during the editing stage.

For open-ended questions, it is very important to report the responses verbatim in the respondent's own words, aside from irrelevancies and repetitions. Undue summarization, or paraphrasing, improper classification or biased selection of portions of the reply are not warranted. The interviewer has to quote the respondent like a faithful news-reporter. There is no need even for polishing up any slang, cursing or bad grammar as it may distort the meaning.

For speedy recording, the following procedures may be adopted. First, the interviewer should be prepared to write at soon as he has asked the question and to write while the respondens talks, not waiting until the entire reply is completed. Second, the interviewer should use common abbreviations. Third, he should not bother to erase but should cross out instead.

Interviewer Bias

In spite of the best precautions, some amount of interviewer bias is bound to creep in because interviewers are not machines but human beings with different perceptions, judgements and personalities. They may have strong expectations and stereotypes regarding the respondents and their replies and these may make their reports not completely comparable or valid. Some of the biases can be overcome by standardizing the interview - by standard wording, standard answers, by proper interviewer selection and training. But some biases are bound to remain. It is for the study director to become aware of such biases and to discount their effects on the interpretation of the data.

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CHAPTER 12

TOOLS FOR COLLECTING DATA SCHEDULES AND QUESTIONNAIRES

T. P. S. Chaudhari

A schedule refers to a set of statements and/or questions to be answered by the respondent in a face to face interview, and filled in by the interviewer, or by the respondent in writing. A schedule is sometimes distinguished from a questionnaire which refers to a device for securing answers to questions by using a form, which is usually filled in by the respondent himself. For some studies, only an interview guide may be used. It is a list of points or topics which the interviewer seeks to cover during the interview. In using an interview guide, considerable flexibility may be required as to the manner, order and language used by the interviewer in asking questions. All the three, that is, Schedule, Questionnaire and Interview Guide contain a set of related items: that is, points or questions relating to a central problem. If the point is so formulated as to usually leave some limited alternative ways of answering it, it is known as a scheduled or structured item.

Some questions are automatically structured because of the precision of the only categories which can answer them. For example, "How old were you on your last birth-day?" Questions relating to marital status, can be best dealt in a structured form such as:

What is your marital status at present?" - Single
Married
Divorced
Separated
Widowed.

If an open-ended question like "what is your marital status?" is used, the interviewer should be prepared to face a variety of responses like, "fine", "so-so", "as good as could be expected", or "ask my husband". Unstructured (open-ended) questions should be preferred where responses to the item cannot be anticipated in detail.

The purpose of the Questionnaire

Although this classification cannot be made in a watertight fashion. in a broad enough sense, we might be dealing with questions of a variety of kinds, namely,

a) Those aimed mainly at ascertaining facts;
b) Questions aimed mainly at ascertaining beliefs about what the facts are;
c) Those aimed at ascertaining feelings;
d) Questions aimed mainly at discovering standards of action;
e) Exploration of present or past behaviour;
f) Questions aimed mainly at conscious reasons for beliefs, feelings, policies or behaviour.

We will discuss some of the types briefly. It should be obvious that the structuring and phrasing of questions will need to logically harmonise with their purpose.

Ascertainment of fact

Questions relating to fact have to be put to those who are in possession of the fact. The "reported fact" must be checked for its credibility. This check must follow the usual line of evidence. How did the respondent obtain knowledge of the fact? Through direct observation? Through inference? Through hearsay? What could be the motives of the respondent in reporting the fact? How accurate is the respondent's memory of the fact likely to be? Any one of these factors is likely to affect the response; e.g. a housewife's report of her husband's income. Where the fact relates to an event, a situation or a community, it is safe to check accuracy through comparison of responses from several sources.

Belief about what facts are

Such is the purpose in asking a respondent to indicate whether the following statement is true or false:

"NO MUSLIM student has ever made his mark in the field of mathematics". The respondent's answer is not used to establish what is objectively true but rather to provide a picture of his beliefs.

There is an obvious difference between inquiries dealing with facts and those relating to belief in facts. The former precedes the latter. If we want to learn about the facts of delinquency, we ask people who know (police, social-workers, probation-courts, etc.). If we want to know about peoples' belief in the extent of delinquency, it will be advisable to include a general sample of the population instead of relying merely on experts. At the same time the questions in this case will explore beliefs instead of pressing for objective evidence.

We may also consider questions of distortions in perceptions and beliefs as well as gaps in knowledge as clues to a person's desires or fears in this context. Also information about characteristics and interrelationships or structure of beliefs (whether private or accessible to public, specificity, clarity and strength of the belief) could be sought.

Ascertainment of feelings

Emotional reactions will sometimes reveal beliefs that a subject is unable to verbalise. These deal with aspects like fear, distrust, disgust, contempt, hate, envy, sympathy, admiration, etc., e.g., "The idea of a career woman is repulsive to me". "I have no sympathy for politicians, irrespective of their affiliation".

Feelings and motives call for freedom in response to be given to the respondent since such reactions are too complex to be compressed in a few words. It must be remembered that the words used to identify emotional reactions may carry different import for investigator and his respondent! These reactions are often best concretised by linking them to the respondent's past experiences.

Standards of action

Questions relating to appropriate behaviour in a given social situation may involve exploration into climate of prevailing opinion on the issue as a basis for predicting respondent's probable behaviour in such situations. Questions under this category ought to be searching enough to enquire not only into what the respondent feels the right thing but also into realistic policies to serve to guide the respondent's action in specific situations.

Q 1. Suppose you were the class monitor and you saw a fellow student cheating in the examination. Make an X-mark against what you would do?

1. Take away his answer book, ask him to leave the hall and report the case.
2. Pretend not to have noticed.
3. Give him an oral warning.
4. Warn him first and then, if he persists act as 1.

Q 2. Indicate which of the above actions you would be most likely to take, next most likely etc, under the following situations:

a) If you did not personally know the student
b) If the student happened to be your friend.
c) If the authorities but not the student friends were likely to hear about the action.
d) If your student friends but not the authorities were likely to hear about the action.

The phraseology of the questions is important, as different responses are likely to be obtained, as the shades of phrasing differ, leading to different interpretations.

i. What do you think *is* the right thing to do or say?
ii. What do you think *you yourself* really would have done in the situation?
iii. What do you think *most people* would do or say in a situation like this?

Questions inquiring into present or past behaviour

These constitute a special type of questions relating to the ascertainment of fact, since the present or past behaviour of a subject is a type of fact, and knowledge in this field is helpful in predicting future behaviour. "Specific" rather than 'general' type questions are preferable. If it is a study of consumer behaviour, you had better ask "which brand (s) of coffee do you have in the house at the moment? May I see it? Do you usually buy this brand?" instead of asking "Which brand of coffee do you usually use?" Specify a concrete instance and then ask whether that instance is typical or atypical. This provides the subject with a recall cue, and, in a sense. binds him to reality.

Conscious reasons for beliefs. feelings, policies or behaviour

Although questions under this heading are of the major order, the answers may seldom be simple. There may be any number of factors involved. For example, why do you select a particular brand of squash? A full answer would require exploration into subject's knowledge on different brands, of cost considerations, etc., etc.

In addition to these reasons for a given belief, or a action, it may be relevant to inquire into reasons against alternative beliefs, actions etc.

Construction of questionnaires

Relating the items to the problem under investigation

Concepts and definitions are important in all research - analytical as well as empirical, but more so, in the latter. Studies made through the survey approach, operationalise some concepts and use schedules and questionnaires. For example, take the concept of political information relevant for the study on voting behaviour. The level of political information may be found out by assessing the knowledge of the voters about: (a) the candidates standing for election (their parties and symbols); (b) the manifestoes of their parties; (c) the problems and issues (economic, political, social) facing the country; (d) the region and (e) the local constituency. In order to be scientific, the methodology must single out the indicators for each concept, list appropriate questions for each, decide the basis for judging the responses to the questions and give scores to the different type of responses. While it is generally agreed that index on level of political information should be prepared, adequate spade work is not done to determine in advance (or through pretest) the types of responses which will be obtained for a question, the basis for differential scoring on those responses and finally, the basis of differential weighting to different questions going under the same concept. All these should precede designing the schedule and questionnaire.

Social phenomena are complex and their observations call for a large array of questions. However, the more the questions that are asked and the longer the interview with the respondent, the more fatigued the respondent will become and the bias that accompanies such fatigue.

One way of keeping the questionnaire and the interview within reasonable limits is to base these on detailed broad experience (gathered earlier) with the subject of the inquiry. This naturally imposes the obligation on the researcher to learn as much of his subject matter as possible before undertaking the actual field work.

The important point to be remembered is that every question ideally relates to the hypotheses; one that does not is irrelevant. At the same time failure to include a crucial question may vitiate the entire research. Formulating the questionnaire is a matter of the same order as decisions on the "important questions which have to be answered" for throwing light on the hypotheses.

Developing the questionnaire is like focussing a camera where, in a sense, the lens moves from the "inside" "outward". Perhaps to start with, the researcher has the faintest of notions concerning the subject, then he consults the library and colleagues. In this manner he outlines logically the tentative implications of his problem. Starting from personal observations and experience, he draws upon observations and experiences of others and thus broadly maps the subject-matter areas to be covered and also comes to a rough formulation of some of his questions. To start with, he has a pack of several questions and he tries progressively to uncover omissions, biases and ambiguities. Only gradually and in repeated phases, the questions get refined and more precise. Each time that he tries to refine, (a) the list of possible questions grows, and (b) the number of areas of interest expands. Thought has to be given how to select between these several areas of interest so that ultimately he has a fewer number of areas to observe with reasonable accuracy and comprehension. Ambiguities, biases, poor phraseology must be reduced and improved; and closer logical relationship developed between (i) the questionnaire and the problem, and between (ii) the different parts of the questionnaire. In any case, before the questionnaire is finalised, a number of unstructured exploratory interviews will be necessary and a number of informal and formal pretests will have to be conducted. All these efforts will lead progressively to the refinement essential for the study.

While 'personal interview' is accepted as the general method for collecting information in survey research, one may explore the possibility of using improved devices like 'sentence completion test' for eliciting the reaction of respondents in certain situations or using 'six or seven step ladder' figure to get from the respondent self-placement in a scale. In a study conducted on status images by the Gokhale Institute of Politics and Economics, Poona, a 'seven-step status ladder' is used for finer discrimination - the top step representing the 'highest' status and the bottom step the 'lower' status. Respondents were required to indicate their position on this seven-step status ladder. They were also asked to indicate their position in the status hierarchy on a time scale viz., their status at present, five years ago, five years hence. The ladder served the purpose of a seven point rating scale with score 'one' indicating the lowest status and score 'seven' the highest.

The Schedule as an organic entity

The ordering of items or blocks of items in the schedule should be so carefully planned that the informant (respondent),

(a) gets gradually drawn into the spirit of the dialogue through an awakening of his interest,

(b) is conveniently moved from items which are relatively simple to answer to those which are progressively more complex.

(c) is not too early, nor suddenly, faced with a request for a "personal" type of information.

(d) is never asked to give an answer which could be embarassing without being provided with adequate opportunity to explain.

and (e) is not made to jump back and forth from one frame of reference to another.

In order to interest the respondent to be drawn into the study, the introductory questions should be attention-catching without being controversial. Both the interviewer and his questions should help to build rapport with the respondent. The interviewer must avoid respondent fatigue or controversial response. Questions which may tend to bring these about must not be put first nor must they be put too late, because by then the undesirable result will have already set in. As for creating embarrassment, suppose the respondent is asked: "Are you a registered voter?" and he answers 'Yes'. If he is next asked: "Did you vote in the last election?", the question "In case you did not, we would appreciate if you could state the circumstances preventing you from voting" must also be added. By adding this last question, the interviewer saves the intelligent and responsible citizen from feeling guilty, if he had to answer "no" to the earlier question. By putting in the last question, he has also avoided "tension" which might affect the quality of the subsequent response.

Pilot study and pretests

However smoothly organised the earlier drafts of your questionnaire may appear, they will have to be given a careful empirical checking. In matters where extant literature is scanty and doubtful, the procedure calls for a pilot study and for a final version of your questionnaire, one or two pretests are essential. The empirical checks must cover all points: the logic of the items, the structure of the schedule, the phraseology etc. Considerable successive refinements and modifications will have to be made in the light of experience thus gained. Experience in building rapport and getting recalls can be built up in this fashion.

The following hints obtained from pre-tests will help to recognise poor questions:

1. *Lack of order in answers,* which may be due to questions which tap different sentiments and experiences in respondents and difficult words and questions which try to obtain too much information at once.
2. *All or none responses* – obviously due to the questions eliciting stereotyped response.
3. *Too many 'don't know' 'don't understand' answers* - either due to improperly drawn questions or poor sampling design.
4. *A large number of " qualifications " in answers of respondents* - often due to inadequate pilot studies and premature specification of possible alternative answers.
5. *High proportions of refusals to answer* (or to be interviewed at all).
6. *Substantial variation in answers when the order of questions has been changed.*

The schedule and questionnaire need particular care while questions calling for reasons are asked. Often respondents give more than one reason for a specific question. In such situations, the questionnaire should inevitably provide for the ranking of the reasons. Unless this is done the entire information may become useless for ranking analysis subsequently. Similarly, while structuring the questionnaire, wherever possible, space should be provided for writing verbatim the answers even though columns may exist for giving the codes. This will facilitate detection of coding mistakes committed by the investigators. This is important in socio-economic research where often decision about right codes is not easy and requires judgment. This is true particularly for those questions, where there is scope for differences in judgments about the interpretation of verbatim replies.

The Mail Questionnaire

The distribution of a questionnaire to an appropriate sample of correspondents so as to ensure an adequate range of responses representing a wide area is liable to confront the research worker with many practical difficulties, foremost among which is the difficulty of contacting the respondents in person and collecting the responses from them. When, however, the questionnaire has to be distributed to persons who are literate, the work of distribution and collection can be undertaken with comparatively greater ease and facility by mailing them. Where this is possible the main job of the research worker is first to prepare a mailing list, and despatch the questionnaire under cover of a circular letter, requesting the respondents to complete the questionnaire and return it before a specified date, enclosing a reply paid envelope, so that the respondent is not put to any expenditure but has merely to record his responses to the questions.

There can be no doubt that the distribution of the questionnaire by mailing makes the range of responses considerably wider and more truly representative Furthermore, since the mailed questionnaire does not put the respondent to any pressure for an immediate response, there are chances that the respondent will feel free to consider each point carefully and record his answer, provided he is not altogether indifferent to the matter of the enquiry. The difficulty which usually arises is in the case of persons who are rushed with work and cannot therefore find sufficient time to sit down and record their responses. Valuable though their responses may be, they are not likely to respond to the mailed questionnaire merely because they are hard pressed for time.

It is important to realize that the returns to a mailed questionnaire which are liable to vary between 10% and 50% of the number of questionnaires despatched, depend on several factors. First, the sponsorship of the questionnaire gives it an obvious prestige value. Secondly, the attractiveness of the layout of the questionnaire increases the chances of a response. Thirdly, as a rule, the longer the questionnaire the less inclined would the respondent be to record his responses. Fourthly, the covering letter has to be drafted in an appealing manner, since it is the main introduction to the questionnaire. Fifthly, the easier it is to fill the quetionnaire, the greater the chance of a satisfactory response. Sixthly, a reply paid envelope will facilitate return, since it puts the respondent to no expenditure. Seventhly, the chances of a return depends to no small extent on the kind of persons to whom the questionnaire is addressed. It is not, of course, always possible to know this before-hand. Nevertheless, it is useful to remember that a mailed questionnaire is likely to be responded to by persons who will take it seriously, not treat it as a joke. As Polansky has observed professional groups constitute ideal populations for questionnaire administration.

The mailed questionnaire ought not to be regarded as a simple and easy method of data collection, convenient though it may be. A great deal of further effort may be necessary in order to maximise the quantum of the return. "Putting his questionnaire into the mail", as Polansky remarks, "does not mean the researcher is finished with an active role in data collection. If the nature of the study permits open identification of respondents one can keep track of who has and who has not returned the questionnaire. A cumulative curve can be drawn, indicating the point at which returns have slowed down to such a trickle that, it is safe to assume that, those as yet unreturned will not be returned without further delay. At this point a follow-up mailing can be undertaken which will insure the return of a fair proportion of those still outstanding. As a final measure of course, there is always the possibility of telephoning where possible - a request for compliance".

Mechanical Problems

The get-up, printing, paper and bulk of the questionnaire contribute significantly to the quality of the response. Unattractive questionnaires evoke indifference particularly in mailed questionnaire. Bulky, haphazardly cyclostyled schedules seldom get consideration at the hands of most respondents. The paper and print must be attractive; brevity is essential; the schedule must be logically constructed; how much blank space should be allowed against each question, calls for judgment on the part of the researcher.

If the study is of a periodic or recurring nature the questions must be designed with a view to bring about uniformity and comparability in the results.

In drafting the questionnaire one will have to bear in mind what manipulation and processing the schedules will receive after their return from the field on completion. Are the schedules to be precoded (code symbols printed on the form) or is the coding to be a separate operation? Will a transcription sheet or code card be used or will the codes be placed on the original schedule? Will the tabulation be made directly from the schedules or will the data be put on code or punch cards which will be sorted and counted? Logical and mechanical matching between the processing and tabulation system and the collection of field information in the questionnaire have to be well planned and provided for. In fact a good researcher will actually tabulate the "data" from the pretest in order to see what weaknesses are present.

And finally, there is the mechanics of keeping the records of the study through the questionnaire. This means more than the working out a "flow-chart" or "control sheet" for checking each questionnaire as it goes through the steps of —

i) transmission to the interviewer or the respondent
ii) waiting for completion or return
iii) receipt after completion
iv) checking the form
v) filing of the form and additional ancillary reference coding
vi) coding
vii) checking the coding (spot-checks or entries)
viii) tabulation
ix) tabular presentation
x) checking of tabular computation.

CHAPTER 13

SCALING TECHNIQUES : ATTITUDE SCALES

B. C. Muthayya

Measurement concerns the assignment of numbers to objects to represent amounts or degrees of a property possessed by all of the objects. An important characteristic of measurement is its power to enable us to decide within limits which of the inexhaustible number of sets of numbers that might be assigned to the set of the objects is appropriate. The result of measurement is a scale which comprises the set of numerals given to the objects by using a certain rule of assignment. Objects may be measured according to many different rules, each of which leads to a scale with special properties. The scaling techniques have come into being because of a need felt by the social sciences to quantify the data which is otherwise qualitative in nature. The quantification of the data facilitates the establishment of scientific laws.

Stevens, S. S. mentions four types of scales, namely, the nominal, the ordinal, the interval and the ratio scales.

A nominal scale is one that consists of two or more named categories into which objects or individuals or responses are classified.

The basic requirement for a nominal scale is that anyone be able to distinguish two or more categories relevant to the attribute being considered and specify criteria for placing individuals, in one or the other category.

For example, the classification of individuals according to caste groups constitutes a nominal scale. Use of nominal scales is characteristic of exploratory research where the emphasis is on uncovering a relationship between two characteristics rather than on specifying with some degree of precision, the mathematical form of the relationship, or where the focus of the study is on the pattern of relationship among several characteristics of the person.

An ordinal scale defines the relative position of objects or individuals with respect to a characteristic with no implication as to the distance between positions. The basic requirement for an ordinal scale is that one be able to determine for each individual on the object measured, whether that individual has more of the attribute in question than another individual or the same amount or less. In other words, one must be able to determine the order of positions. The numbers assigned in the ordinal scale do not provide a definite indication of the distance between any two points. In ordinal scale, therefore, the scales are limited to statements of greater, equal or less.

In an interval scale, not only are the positions of objects or persons arranged in terms of greater, equal or less but also the units or intervals of measurement are equal. In other words, the distance between positions labelled one and two on the scale is equal to the distance between positions, two and three. In researches in social sciences, it has not been possible to devise procedures for many of the attributes that would give with reasonable certainty the equality of the intervals. Attempts however, have been made particularly in connection with the measurement of attitudes.

The *ratio scales*, in addition to having the characteristics of an interval scale contains an absolute zero. The empirical operations necessary to establish a ratio scale include methods for determining not only equivalence - non-equivalence, rank order and equality of intervals but the equality of ratios. This type of scale often called fundamental measurement is most commonly found in physics. In social sciences, attempts have been made to construct such scales in the field of psycho-physical attributes.

There is some variation with regard to the way the different types of scales are classified. For example, W. S. Torgerson distinguishes four types of scales namely ordinal, ordinal with natural origin, interval and interval with natural origin In the *ordinal scale*, the numbers are assigned to the various instances of the property so that the order of the numbers corresponds to the order of the magnitude of the instances The *ordinal scale with natural origin* has the additional restriction that the number "Zero" is assigned to the zero amount of the property. The *interval scale* in addition to the order of the numbers corresponding to the order of the magnitude to the various amounts of the property, the size of the difference between pairs of numbers has meaning and corresponds to the distance between the corresponding pairs of amounts of property. In the *interval scale having a natural origin*, there is the additional restriction that the numbers assigned to the instances correspond to the distances of these instances from the natural origin of the property. In this scale, the ratios of the numbers assigned have meaning. Torgerson calls this type of scale a ratio scale. Torgerson's classification differs from Stevens, first in that, he distinguishes between ordinal scales with and without natural origins, and second, Stevens includes the nominal scale whereas Torgerson does not. According to Torgerson, in a nominal scale, the process involves the classification of objects where numbers are used to name the objects or name the class of objects and hence feels that the numerals used are only to identify the objects which could be done by other sets of distinguishable marks. He further mentions that in measurement, the number assigned refers to the relative amount or degree of a property possessed by the object and not to the object itself whereas in the different nominal scales, the numbers refer to the objects or classes of objects.

Coombs, C. H. has proposed another classification of scales which includes all the four types of scales of Stevens and another scale which he calls as partially ordered scale. This scale falls between the nominal and the ordinal scale in which the objects are considered first and secondly, the distances between the objects are examined. The objects may be simply classified, may be partially or may be completely ordered. The distances between objects may also be classified, ordered or partially ordered. This results in ordered-nominal scale, nominal - partially ordered scale, and partially ordered - ordered scale.

It should be noted that any particular scale may be the mixture of different kinds of measurement. A common occurence in social and behavioural sciences is for the order to be determined fundamentally (in terms of the magnitude of the characteristics) and intervals to be defined by fiat (in terms of operational meaning of the characteristics). The usual speed test score would be an example of the situation. All the scales lead to a considerable number of procedures which have been devised to enable researchers in social and behavioural sciences, to determine scale values of a series of objects, events or individuals with respect to some attributes. The procedures differ from one another in several different aspects, namely, the properties of the scale, the discriminability amongst the stimuli, nature of the response, field of specialization, latent or manifest data and experimental procedures like the rating methods, method of paired comparison, method of rank order etc.

In most measurement situations in social and behavioural sciences, the raw data consists of a number of responses to each of the number of stimuli or stimulus combinations. There are three approaches to the measurement problem: The *subject-centered approach* where the systematic variation in the reactions of the subjects to the stimuli is attributed to individual differences in the subjects, the *stimulus-centered* or *judgement approach* where the systematic variations in the reactions of the subject to the stimuli is attributed to differences in the stimuli with respect to a designated attribute and lastly, *the response approach* where the variability of reactions to stimuli is ascribed to both variations in the subjects and in the stimuli. These three approaches can be illustrated mainly by examples from the area of attitude measurement. The method of judgement through the use of equal appearing intervals of Thurstone for the construction of attitude scale is one of stimulus-centered approach where the task set for the subjects (judges) is such as to minimise any variation due to their own position with respect to the attitude. The Likert technique provides an example of subject-centered approach where the task for the subjects is such as to allow individual differences with respect to the attitude continuum to be expressed. The *response* approach is that followed by Guttman technique of scale analysis. In this, an attempt is made to order both subjects and stimuli with respect to the attitude continuum. Both subjects and stimuli can thus be assigned scale values.

The subject-centered approach has not yet led. to any great extent, to the development of scaling models. The applications in general are examples of measurement of the variables as operationally defined. By far, the major part of the field of mental testing is based on measurement of this kind. Most aptitude, achievement, and intelligence tests, where the individual's score is a simple or adjusted sum of the number of items answered correctly, are essentially examples of measurement by definition. It is interesting to note that in those areas where the primary interest is in scaling subjects, the change from measurement by definition to measurement by a fundamental process has ordinarily involved a shift from the subject-centered approach to the response approach.

Attitude Scales

The analysis made so far gives an idea of the different type of scales and their feasibility for social science research. Most of these attempts of scaling have contributed to the development of scales for the measurement of attitudes towards social issues. This attempt was to devise procedures whereby the individuals could be placed on an attitude-continuum. The attitude scales differ in the method of construction, method of response, and the basis for interpreting scores. Since the assessment of the attitute is a primary concern among social scientists, the remaining part of this chapter devotes itself to a discussion of the attitude measurement in terms of the differernt types of attitude scales as developed by L.L. Thurstone, R. Likert and L. Guttman.

The attitude measurement consists in assessing an individual's response to a set of social objects or situations. This is done by observing a sample behaviour from an attitude universe. Each behavioural element in the attitude universe is the response to a particular situation or object. The particular situation or object that evokes the response together with the specified set of response categories is called an item. An item is a manifest variable. A number assigned to an individual's item response is an item score. A collection of items is called a questionnaire. The questionnaire is free from some of the connotations of the other terms like test, inventory or scale. A questionnaire may contain items from different attitude universe although usually a single universe is represented. A number derived from item response which represents a position on the latent variable is called a scale score or simply the score. The scores form the attitude scale. The scale implies a system for obtaining a score from individual's item responses. The term scale is also occasionally used to refer to the scoring system.

Scaling always implies the existence of a continuum of some kind. Its nature must be inferred from the character of the items selected to make up the scale. The first step, therefore, in scaling procedure regardless of the technique employed is a thorough knowledge of the subject matter. It is also necessary to assume that every scale is composed of items which form only a sample of the possible universe of the items. Therefore, the scale construction requires a high degree of consciousness of the logical problems surrounding the twin assumptions - the existence of the continuum, and the representation of the responding continuum achieved by the particular scale. The question of representatives is checked by tests of validity and the existence of a continuum can be empirically verified through various attitude scaling techniques. The reliability of the scale is also very important as it is a pre-requisite before the scale is administered to a larger population for any purpose.

A unidimensional scale measures a single variable. In general, the property of *unidimensionality* means that people with the same score have about the same attitude. Operationally, unidimensionality and homogeneity have essentially the same meaning. In general, if the items on a scale are highly interdependent, then the items are homogeneous and the scale is unidimensional. A homogeneous scale is, in general, a reliable scale. If a scale is, reliable and homogeneous, it measures some variable. The problem of validity is to discover what it measures. The first problem in validation is to delimit and define this attitude universe. It is helpful to distinguish atleast three kinds of attitude universes namely *elicited verbal attitudes* in terms of the respondents' opinion to a statement, *the spontaneous verbal attitudes* like the opinions expressed by individuals in normal conversations, and lastly the *action attitude* like the verbal and non-verbal behaviour expressed in a particular situation. Although most of our attitude scales measure *elicited verbal attitude* other scales are equally possible. This description will facilitate the assessment of the validity of the scale or the attitude universe. There are various known methods for assessing validity of attitude scales which are not discussed here.

Four major scaling techniques are briefly discussed namely the judgement methods, the method of summated ratings, scalogram analysis and rating scales.

Judgement Methods

The judgement methods of attitude measurement are all variants of a technique developed by L. L. Thurstone and E. J. Chave. The technique requires dichotomus, nonmonotone items having operating characteristics with single maxima. There are two major aspects of the judgement methods. First, the items must be scaled, i.e., each item must be given a scale value that represents its degree of favourableness towards the issue. Secondly, the respondents must be scored on the basis of their responses to the items.

There are several methods of determining the scale value of items. If only a few items are to be scaled, the *methad of paired comparisons* is appropriate. Here each one of the several judges, (preferably 25 or more), is presented with every possible pair of items and is asked which of the paired items is more favourable to the issue in question. For each pair of items, the proportion of times, one item was judged to be more favourable than the other is obtained. Therefore, if we have 'n' statements and each statement is compared with every other statement, then the total number of pairs will be given by the formula:

$$nC_2 = \frac{n(n-1)}{2}$$

Several methods may be used as shortcuts in the situation including the method of rank order. The method of rank order or order of merit method is seldom used. In this method, each judge places the items in rank order of favourableness towards the issue in question. The scale value of an item is the weighted or unweighted average of the ranks given to the item by a group of judges. Alternatively, a paired comparison analysis can be used following the procedure developed by Thurstone.

The law of comparative judgement assumes that for a given stimulus, there is associated a most frequently aroused or modal discriminal process on a psychological continuum. A discriminal process is a theoretical concept and represents the experience or reaction of an individual when confronted with a stimulus and asked to make a judgement of some attribute. Thurstone also makes an assumption that the distribution of all discriminal process aroused by stimulus is normal about the modal discriminal process. The mean or median discriminal process associated with a stimulus is taken as a scale value of the stimulus and the standard deviation of the distribution of discriminal process is referred to as discriminal dispersion. The modal discriminal process and the discriminal dispersion for any given stimulus will, therefore, depend upon the particular attribute that is being judged. In the case of comparison between any two statements, A & B for which comparative judgements are to be obtained by a number of judges, where 50% of the judges say that A is more favourable than B and another 50% in the reverse direction, then the proportion of favourable judgement for each of the statements would be ·50 which is the modal discriminal function. If we find more than ·50 of the judges say that statement A is more favourable than B, then the modal discriminal process will be higher for A in relation to B. On the basis of the comparative judgements obtained, it is possible to arrive at the frequency corresponding to the number of items, a particular statement is judged more favourable than the other. Based on the preferred frequency, it is possible to obtain the proportion of a particular statement being judged more favourably than the other. These proportions thus obtained can be expressed as unit normal deviate by means of the table of normal deviates. By adding up the unit deviations, and dividing by the number of statements in each row and adding a constant, the scale values are obtained for each one of the statements.

For large number of items, the methods of rank order or the paired comparison becomes unwieldly.

The method of equal appearing intervals is the most widely used of the judgement methods. It is much simpler in application than the method of paired comparisons since it requires only one judgement per item. The procedures for developing the scale is as follows :-

The investigator gathers several hundred items conceived to be related to the attitude being investigated; that is, the item must elicit response that is psychologically related to the attitude being measured. It also requires that the scale differentiates among people who are at different points along the dimensions being measured. Secondly, a large number of judges, which could range from 50 to 300, working independently sort the items into fixed number of categories (usually 7, 9 or 11) that are arranged in the order of favourableness. For example, the judge places statements which he considers most favourable in the first pile, the second most favourable in the next pile, and the statement which he considers most unfavourable in the 7th or 9th or 11th as the case may be. The 4th, 5th and the 6th positions as the case may be, depending upon the number of categories used, serves as a neutral position at which there is neither favourableness nor unfavourableness. The judge is usually asked to sort the items in such a way that the intervals between categories are subjectively equal. However, there is no way of determining whether in fact the intervals are subjectively equal which, by and large, remains an assumption of the experimenter. Now the scale value of a statement is computed as the median position to which it is assigned by the group of judges. Statements that have too broad a scatter as revealed by Q value are discarded as ambiguous or irrelevant. A final selection is made taking items that are spread out evenly along the scale from one extreme position to another. It is often possible to construct duplicate forms of the scale from items not used for the original form. Usually it is preferred that the final scale should contain around 20 items. The subjects in filling up the scale are either asked to check statements in the scale with which they agree or to check the 2 or 3 items that are closest to their attitude position. The median of the scale values of the items the individual checks is interpreted as indicating his position on a scale of favourable-unfavourable attitude towards the object.

In preparing statements for a scale of this type the following precautions should be observed :- The statement should be as brief as possible so as not to fatigue the subjects. It should be such that it can be endorsed or rejected according to one's opinion. Every statement should be such that acceptance or rejection of the statement does indicate something. Double barrelled statements should be avoided. One must insure at least a fair majority of the statements really belong to the attitude variable that is to be measured. There are some objections to this scale: First, that the amount of work involved in constructing it is not only cumbersome but also time consuming. However, in view of the recent developments in time saving techniques, the amount of time and labour involved in constructing a scale by this method is not substantially different from other scales. Second it has been mentioned that the scale values of the statements are not independent of the attitude of the judges doing the sorting. There are several studies which revealed that the scale values assigned do not depend on the attitude of the judges. However, it has been found that judges of superior and low intelligence differed due to the inter-action of attitude and intelligence bringing about some effect on the scale position of the items. Third, it has also been pointed out that the individual score is the mean or median of the scale values of the several item checked by the respondent. This results in essentially different attitudinal patterns being expressed in the same score. For example if items, let us say, one and two having scale values of 8·6 and 8·4 are checked, the median value will be 8·5. But in the case of an individual who checks items, 1, 2, 3 and 4 with scale values of 8·6, 8·4, 10·3 and 3·8 the median value again will work out to 8·5. This suggests that basically both the individuals have a similar attitude in the favourable-unfavourable attitude dimension but the median score is constituted of different attitude patterns by virtue of the different types of items marked by the individual. Although this score has some of these defects, it has been found to be more useful in attitude assessment as it constitutes a reasonably satisfactory ordinal scale and provides a basis for saying whether one individual is more favourable or less favourable than the other.

The *method of successive intervals* was designed by Thurstone to overcome some of the difficulties inherent in the method of equal appearing intervals. Here also the procedure to obtain the scale values is the same as that for equal appearing interval scale, except that the latter do not require the judges to discriminate between statements placed within the same category. If a judge encounters a statement that he regards as extremely unfavourable early in the judging process, he will undoubtedly place that statement in the extreme category. Subsequently, if he encounters another statement that is more extreme than the first, then he may not have a category beyond the one previously used and hence he sorts the second statement in the same category as first. He is not forced to discriminate between the two statements as would be the case in paired comparison. The method of successive intervals takes care of the possible inequalities in the widths of the intervals on the psychological continuum of a scale. This method requires, like the method of equal appearing intervals, a single judgement from each subject for each statement to be scaled. As mentioned, the procedure followed to obtain judgement and arrive at the cumulative frequencies are all similar to the method of equal appearing intervals. The scaling problem in this method is to determine estimates of the widths of the intervals making up the psychological continuum from the cumulative proportion distributions for a given set of statements. After obtaining the cumulative proportions for each of the statements, they are converted into the unit normal deviate by using the table of unit normal distribution. After obtaining the unit normal deviates, the differences between the successive entries (between 2 and 1, 3 and 2, 4 and 3, 5 and 4, 6 and 5 etc.) are obtained which indicates the estimates of the various interval widths. It is assumed that the best estimates in the widths of the various successive intervals are the arithmetic means of the entries in each of response categories for all the subjects. These means are the estimates of the widths of the various intervals and are obtained in order to achieve the psychological continuum. Once the knowledge of psychological continuum is achieved, it is a simple matter to find the scale values of the various statements. The scale values of the statements may be taken as the medians of the corresponding cumulative proportions of this continuum. The medians may be calculated by using the relevant formula. This will give the scale value for each one of the statements. However, this procedure described does not permit us to obtain an estimate of the width of either of the two extreme intervals. This is because no estimate can be obtained for the lower limit of the first interval or the upper limit of the last interval as the widths of this two intervals are indeterminate. For further information of the procedure, the reader is advised to refer to Edwards, A.

Method of Summated Ratings

The summated scale consists of a series of items to which the subject is asked to react. The type of summated scale most frequently used in the study of social attitudes follows the pattern devised by R. Likert and is referred to as Likert type of scale. In this scale, the respondent indicates his several degrees of agreement or disagreement with each item that constitutes the scale instead of indicating his agreement for only a few items. Each response is given a numerical score indicating his degree of agreement or disagreement based on a three point or five point response. The sum of the numerical scores assigned to all the separate items gives his total score which is interpreted as representing his position on the scale of favourable and unfavourable attitude towards the object. Thus one would expect an individual with a favourable attitude to respond favourably to many items, an ambivalent individual to respond favourably to some and unfavourably to others and an individual with an unfavourable attitude to respond unfavourably to many items.

The procedure for constructing the Likert type of scale is as follows : The investigator assembles a large number of items considered relevant to the attitude being investigated, either clearly favourable or clearly unfavourable. These items are administered to a group of subjects representative of those with whom the questionnaire is to be used. The subjects indicate their response to each item by checking one of the categories of agreement or disagreement. The response to the various items are scored in such a way that a response which is indicative of a most favourable attitude is given the highest score. It makes no difference whether five is high and one is low in a five point response category or vice-versa. The important factor is that the responses should be scored consistantly in terms of the attitudinal direction they indicate. Each individual total score is computed by adding his item scores. The responses are analysed to determine which of the items discriminate most clearly between the high scores and low scores on the total scale. The items which do not discriminate as measured by the discrimination power of the item between low and high scores in the scale, or items that do not show a substantial correlation with the total score are eliminated to ensure that the scale as a whole is internally consistent. That is, every item is related to the same general attitude.

Sometimes it is also necessary to find out the interrelationship among each of the items in the scale to assess the extent of homogeneity of the items that constitute the scale.

This scale has certain advantages over the Thurstone scale. It permits the use of items that are not manifestly related to the attitude being studied. This scale is generally considered simpler to construct and likely to be more reliable than a Thurstone scale of the same number of items. The range of the responses permitted to an item given in this scale provides a more precise information about the individual's opinion on the issue referred by a given item.

However, some of the disadvantages of the Likert type of scale are: It does not claim to be more than an ordinal scale, i. e. it makes possible the ranking of individuals in terms of the favourableness of their attitude toward a given object but it does not provide a basis for saying how much more favourable one is than the other nor for measuring the amount of change after some experience. Another disadvantage of the Likert type of scale is that the total score of an individual has little clear meaning since many patterns of response to the various items can produce the same score. This is also true in the Thurstone type of scale but the extent of its occurrence is much more in this scale. Despite the lack of theoretical rationale for scalability, the scores on the Likert type of questionnaire provides the basis for classification of people based on the characteristics measured. The selection of the items, the format of the items etc. are similar to that already mentioned while discussing the Thurstone's scale.

Cumulative Scale or Scalogram Analysis

In a cumulative scale the items are related to one another in such a way that ideally an individual who replies favourably to item 2 also replies favourably to item 1, one who replies favourably to item 3 also replies favourably to items, one and two and so on. Sometimes the items as they appear in the scale are arranged in the order of favourableness; sometimes they are randomly arranged. Ordinarily no attempt is made to determine whether the intervals between items are equal. Thus, in practice, cumulative scales are ordinal scales.

The general procedure for determining whether or not the responses of subjects to items form the scale is known as scalogram analysis. It is based on a analysis of the response patterns of the subjects to a set of items where a response pattern denotes the set of responses to items given by a subject. In practice, scalogram analysis can perhaps be most accurately described as a procedure for evaluating sets of statements or existing scales to determine whether or not they meet the requirements of a particular kind of scale as described by L Guttman. For items of this "Cumulative" type of scales as mentioned earlier, acceptance of one item implies that the person possesses enough of the attribute to accept all items of a lesser magnitude. When responses to a set of attitude statements meet this requirement that set of statements is said to constitute a unidimensional scale. Therefore, the first task in analysing cumulative scales is to ascertain the degree to which the initial set of items represents a single dimension which is inferred from the degree to which subjects respond with the admissible answer patterns (scale types). It is assumed that any non-scale pattern reflects one or more response errors. The number of response errors counted is the minimum number of changes required to convert a non-scale response pattern into a scale type. The total number of response errors (e) made by a sample of subjects is divided by the total number of all responses they make (nk, where n is the number of subjects and k is the number of items). This ratio is substracted from unity to yield the co-efficient of reproducibility, R : ($R=1-e/nk$). The value of R may be used as a measure of the degree to which the set of items is scalable, that is, it represents a unidimensional attribute. An arbitrary value of 0·90 is sometimes taken as the minimum acceptable co-efficient of reproducibility. Generally the reproducibility or scalability of a set of items can be increased by eliminating certain items which account for a disproportionate number of errors.

The procedure involved in constructing a *scalogram is briefly as follows :* First it involves the selection of a small number of statements from a large number of possible statements representing a universe of a content, which, by and large, should have the most homogeneous content. For each statement, weights of 0 and 1 are assigned for two response categories of agree and disagree. Usually Guttman's techniques can be best illustrated for two response categories though there are methods to apply this technique for more than two response categories. These weights are so assigned that one is always given to the response category that indicates more of whatever it is that is being measured in terms of favourable attitude getting 1 and unfavourable attitude getting 0. These statements are given to a sample of hundreds of persons. They are asked to respond to these statements in terms of agreement and disagreement. A score is obtained for each individual by summing the weights assigned to the response categories he has selected. The total score of each subject is arranged in rank order from high to low. From this point, there are several procedures to evaluate the scalability of the set of items. There are techniques like the Cornell technique and techniques suggested by Goodenough W.H. etc. In the Cornell technique, the important task would be that from a person's rank position based on the total score, it must be possible for us to reproduce his response to each of the items in a simple fashion. That means if an individual has indicated his agreement for four items, his total score should be 4, implying that he has agreed with each of the items. If an individual's total score is three, then it implies that he has agreed with three items and if he disagreed with all the items, his total score would be 0. Thus it would be possible to reproduce the responses of individuals to the various statements based on the total score alone. Since perfect reproducibility based on the knowledge of the total scores is not to be expected in practice, it becomes a matter of some importance to measure the degree of reproducibility present for any given set of responses to attitude statements. This is accomplished by setting cutting-points for the response categories of each statement. A cutting-points marks that place in the rank order of the subjects where the most common response shifts from one category to another. Guttman suggests two rules in locating cutting-points:

1. The cutting-point should be so located as to minimise the error.
2. No category should have more error in it than non-error.

On the basis of a cutting-point, the errors in each category of response are located for each of the statements and they are summed up. The total number of errors is expressed as a proportion of the total number of responses and this value is substracted from unity. This gives the co-efficient of reproducibility. In another method, as suggested by Goodenough, the score matrix is prepared with rows corresponding to the subjects and columns to statements. The responses of the subjects to the various statements are recorded in the row of matrix in terms of 0 and 1 weights. The response patterns are recorded having subjects with the higher score assigned to the first row and the next row will correspond to the subject with the next higher score and so on. The scores for each one of the rows and across the columns which gives the frequencies with which the 1 response has been made to each of the various statements. The sums for each column of the matrix is divided by the total number of subjects to obtain the proportion of the subjects giving the 1 response to each of the statements, and the proportion giving 0 response is found out by deducting the obtained proportion from the unity. A bar-chart is prepared for each statement where part of the chart indicates the proportion of subjects giving the 1 response to a statement and the lower part represents the proportion giving 0 response. The point of division is indicated by the solid lines and each point of division is extended to charts of other statements in terms of dotted lines. For example, in a four statement scale, the possible range of score is 0 to 4. The bar-charts are used to find out the predicted patterns of response to the statements corresponding to each total score. The errors can be located in the observed patterns of response based on the predicted pattern of response for each of the subjects. These response errors are summed up and recorded, and the co-efficient of reproducibility as mentioned earlier is found out.

Another simple method to find out the co-efficient of reproducibility is based on the total frequency of the responses for each statement. The predictive pattern of response for each of the statements for a set of say, four statements with a total score of 4 or 0 can be easily assumed. The predictive patterns of response for the remaining total scores of 3, 2 and 1 for a set of four statements can be worked out as follows: The distribution of total frequencies for each of the statements is examined and the lowest frequency is given 0 and the remaining statements, 1 each which gives the predictive response for a total score of 3. Similarly, among the remaining total frequencies, the lowest is given 0, and the next two, 1 each which gives the predictive response for a total score of 2. Thus, the predictive response pattern is found for a total score of 1 also using the same procedure. On the basis of this, the predictive pattern of response for each total score is obtained and the response errors are calculated for each subject to arrive at the co-efficient of reproducibility.

Though cumulative scales like summative scales are composed of monotone items, the additional property of item magnitude is taken into account by the scoring procedure. Clearly this procedure is cumbersome, arbitrary and difficult to specify analytically. There are other reasons besides analytical complexity for rejecting cumulative scaling procedure. Which items are retained or discarded depends more on variations in item popularities than on degree of inter-correlation or functional equivalence. The ideal model of scalogram analysis assumes unidimensional items, which probably do not exist. The kind of items retained are typically those which are widely spread in popularity. Generally, cumulative scales are not recommended for attitude measurement.

Rating Scales

There are a number of rating scales differing in the fineness of the distinctions they permit and the procedures involved in assigning persons or objects to positions. One common feature to all types of rating scales is that the rater places the person or object being rated at some point along a continuum or in one of an ordered series of categories. Some of the ratings scales are, graphic rating scale, itemized rating scales, comparative rating scales and self-rating scales.

In *Graphic rating scale*, the rater indicates his rating by simply placing a check at the appropriate point on a line that runs from one extreme of the attribute to the other. The scale points with brief descriptions may be indicated along the line, their function is to serve as a guide to the rater in localizing his rating. This scale is relatively easy to use though certain precautions like avoiding the use of end statements that are extreme, and making the descriptive statements as close as possible to the numerical scale. In itemized type of scale like the graphic scale, the rater selects one of the limited number of categories (usually five or seven categories) that are ordered in terms of their scale position. The scale also provides a central neutral point with equal number of categories on either side. This scale consists of a series of items describing a particular act or attribute of the object or person to be rated and the rater selects one which best describes the act or the attribute of an object or person. One can obtain reliable ratings if the categories are properly defined. In *comparative rating scale*, unlike the other two scales, the rater gives relative ratings. The positions on the rating scale are expressly defined in terms of a given population or social group or in terms of people of known characteristics. For example, the rater may be asked to indicate whether the ratee's sociability more closely resembles to that of person A, B or C all of whom are known to the rater. Another comparative rating scale is the *rank - order scale*. Here the rater ranks each one of the individuals in relation to one another on the characteristic being measured. Ranking is used in this way only when the rater is confronted with a limited number of ratees. There is another technique known as *forced choice technique* where pairs of items are chosen which have equal popularity but different discriminating power. Two such pairs are combined in a tetrad. The rater is required to say which item in the tetrad is most like the individual and which is, least like the individual. The major difficulty in this technique is that the four items in the tetrad may not be comparable. However, this is an attempt to overcome the 'halo effect'. It is well-known that some sets of specific items are not much better than an overall rating scale since all items can be rated on the basis of a general impression of the individual.

In most of the investigations for want of raters who are familiar with the ratees and also where information on some non-observable behaviour is required, *self-rating technique* is used where the individual himself gives ratings on the attribute measured. It has its advantages and limitations like those of self-reporting techniques.

Sometimes, the individual may be unaware of the presence of a attribute being measured in himself or where aware, may be unwilling to reveal its presence and also one's conception of moderate or extreme position in the measured attribute varies from one another making the rating difficult. However, this method has proved useful in the measurement of social attitudes as the individual rater is in a better position to report his beliefs, feelings etc.

There are certain disadvantages in the use of rating scales. There is room for systematic errors in one's rating through the influence of personal bias of the rater or raters which is commonly referred to as 'halo effect'. In this, if more than one characteristic of a person is to be rated, raters frequently carry over a generalized impression of the person from one rating to another. Another frequent type of constant error is the 'generosity error' where the rater develops a tendency to overestimate the desirable qualities of the ratee whom he likes. There is another type of error known as contrast error where there is a tendency on the part of the rater to see others as opposite to himself on a trait.

One of the ways of reducing constant error is to train the raters carefully and make them aware of the possibility of such biases in rating. The generosity error may be reduced by using relatively neutral descriptive terms for the scale positions rather than evaluative ones. Halo effect may be reduced, or eliminated altogether by having various ratings of a given person made independently by different raters or by the same rater at different times without awareness that he is rating the same person. Some random errors may also affect ratings because of different frames of reference of the raters in describing individuals in terms of the characteristics in question. Reliability of the rating scale can be increased by not only careful training of raters but also by giving attention to the construction of the rating scale. Some of the factors that must be taken into account in constructing a scale are: (1) The descriminative ability of the judges or the raters including the extent to which they are trained and experienced, (2) The kind of characteristics to be judged, (3) The conditions under which the ratings are to be made whether it is based on extensive or limited data. The reliability of ratings is usually enhanced considerably by having several raters making independent ratings, comparing their ratings and discussing discrepencies and making second independent ratings that are then pooled or averaged to give a final score. Validity of the rating scale can also be assumed to be present if the attributes being measured were relatively 'objective' so that their meaning would be uniformly understood by the raters using the scales, and the ratings were themselves obtained under optimal conditions, including carefully constructed scales, trained judges, and specified common frames of reference.

At attempt is made in this paper to briefly sketch some of the major scaling methods for attitude measurement where are in use. Each one of the methods has its own advantages - refineness of the procedure, scoring and analytical nature but each of them has its own disadvantages in terms of time consumed. feasibility for certain measurements and complexity involved through cumbersome scaling procedure. The use of any particular technique very much depends on the nature of research and the type of data that individual researcher would seek to examine. As pointed out, in the beginning it is a question of whether the interest is in the response or in the individual, which by and large decides the approach to be followed and the scaling methods to be used. This paper only gives an outline in a descriptive way but those interested in further information and the techniques of the scale are advised to look into other references suggested.

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CHAPTER 14

APTITUDE TESTS

B. C. Muthayya

Sometimes people mistake aptitudes for abilities but psychologists as such are clear in their views about what constitutes an aptitude and what, an ability. This confusion in the minds of many may be due to the inter-changeable use of some tests in assessing both aptitude and ability. Aptitude implies that the individual has a capacity *to learn* whereas ability implies that he has a capacity *to do*. An aptitude is a combination of characteristics indicative of an individual's capacity to acquire (with training) some specific knowledge, skill or set of organized responses such as the ability to speak a language, to become a musician, or to do mechanical work etc. An aptitude test, therefore, is one designed to measure a person's potential ability in an activity of a specialized kind and within a restricted range. Aptitute tests must be differentiated from ability in an activity and achievement tests which are designed to measure an individual's quantity and quality of learning after a specified period of instruction. *Skill*, implies ability to perform a given act with ease and precision, whereas proficiency includes not only skills in certain types of motor and manual activities but also generally indicates the extent of one's competence. Aptitude indicates the capacity to acquire proficiency under appropriate conditions. The principles underlying aptitude test are the same as those employed with tests of intelligence in respect to sample of performance, population samples and standardization of techniques. There are various types of aptitude tests which can be grouped into mental abilities, mechanical and related abilities, psycho-motor abilities, visual skills and some specialised aptitudes like clerical aptitude, reading speed and comprehension, vocabulary and perceptual speed. Among the mental abilities which is used synonymously with the term intelligence, there are tests to measure both the verbal and non-verbal types of intelligence. Regarding the mechanical ability tests, there are tests like mechanical comprehension, spatial relation tests, mechanical assembly tests, mechanical adaptability tests, paper form board etc. The psycho-motor tests are those which measure muscular abilities or combinations of sensory and muscular abilities. It covers the range of abilities that includes what is commonly called dexterity, manipulative ability, motor ability, eye-hand co-ordination as well as other aspects of muscular performance. Some other tests which are included under this category are Finger or Tweezer dexterity tests, Peg-board, Minnesota rate of manipulation, reaction time, tapping and aiming tests etc. The vision test measures the visual skills in terms of visual acuity and discrimination of differences in distance, colour and postural characteristics of eyes at appropriate distances. These tests are particularly used in indentifying people for jobs involving visual skills like vehicle-operator, inspection and close work, machine operator, etc. The special aptitude tests like the reading speed and comprehension, vocabulary and perceptual speed tests are used for educational purposes of identifying potential learners. There are also aptitude tests for professions like music, art, medicine, law, science and engineering.

This in brief, gives an idea of the nature of the aptitude and the tests available for its assessment. However, no attempt has been made here to explain the procedure for the development of aptitude test as it is thought to be beyond the scope of this paper.

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CHAPTER 15

CONSTRUCTION OF ACHIEVEMENT OF TESTS

H. Visvesvaran

Introduction

Achievement tests are designed to measure an individual's proficiency in a particular area, to predict how well he will perform on the job with little or no additional training other than a brief orientation period.[1] In modern times the term 'evaluation' is used in a wider connotation than the term 'test' or 'examination'. Evaluation includes what the examination seeks to achieve. It seeks also to measure the all-round progress of students, and against the objectives of education. Evaluation looks backward towards the objectives and also looks forward because it attempts to diagnose the causes of failure to attain objectives, and to find out methods and means by which success and better results can be achieved.

Types of Tests

In most of the examinations to-day, two types of tests are used. One is the 'essay' type and the other is the 'objective' type of tests.

The Essay Type of Examination

'Essay' questions would include a variety, ranging from a single three-hour question such as "Discuss Chaucer's Poetry", to questions which can be answered completely and correctly in a few paragraphs. "The most significant features of the essay question are the freedom of response allowed to the examinee and the fact that not only can no single answer be listed as correct and complete, but even an expert cannot usually classify a response as categorically right or wrong[2]."

Essay type questions are now regarded with increasing dissatisfaction in informed circles since their unreliability has been demonstrated by many researches, including, to mention just two, those of Starch and Elliott in 1913 and of Hartog and Rhodes in 1935.[3]

Examples have been produced of the same answer paper being given widely varying marks by different examiners, the most startling example being that of a Geometry paper which received marks varying from 28% to 92% from different examiners.[4] It has been shown that students may answer papers for the same subject in an examination set and marked by the same examiner and passing in one, fail in the other.[5] This demonstrates the variability both of the examinee's performance and of the examiner's paper setting and marking. It has been shown that an examiner may give the same paper different marks on different occasions, that if he reads an answer of moderate standard after reading a very good one he may fail the former, while if he reads it after a poor answer he will give it a good mark, and all this believing that he is being careful and fair. However impartial an examiner may try to be, he is almost certain to be biassed according as the views of the examinee coincide or clash with his own. It is well-known also that individual examiners differ in the qualities for which they look in assessing answer, some paying great attention to the amount of correct detailed factual information, others looking rather for originality of thought and a grasp of the essentials.

The essay type of examination has other limitations. In the time given only a very inadequate sampling of the pupil's knowledge can be tested. There cannot be questions on every topic of of the course. An attempt is made sometimes to overcome this by asking a large number of short questions which are to be answered in a sentence or two or even in a few words. While a larger area of knowledge can be covered by this method, unless the questions are skilfully planned they will tend to appear trivial.

Essay type questions are useful to test the candidate's ability to summarise, collect and organise data in the form of an argument or defence of a position, to develop a new application, to compare alternative views, or to evaluate a proposition. However one of the weaknesses of the essay type examination is difficulty in isolating and assessing different skills.

Suggestions for Improving the Marking of Essay Questions

Cochman and Weidemann outline a procedure for evaluating essay questions.[6] This is shown by the fact that the majority of the consistency coefficients of two series of scorings made five weeks apart were between ·80 and ·90 for teachers with ten minutes of training.

1. A sampling of the answer papers may be read to obtain a general idea of the grade of the answer that may be expected.

2. One essay question is scored through all the papers before another question is considered. There are two outstanding advantages in scoring one question through an entire set of papers. The first is that the comparison of answers appears to make the grades more exact and just. The second is that having to keep only one list of points in mind saves time and promotes accuracy.

3. Before scoring the material in the text, the questions and also the lecture notes on the subject are read by the examiner.

4. A list of main points which should be discussed in every answer is made. Each of these points must be weighed and assigned a certain value if the scoring is to approach accuracy. This value assigned to the main points needed for a reasonably adequate answer is designated as the minimum score. If a pupil elaborates and discusses points not required yet pertinent to the question, his answer is given an additional value called the extra score. This extra score may vary for different pupils, but may not exceed a certain fixed maximum.

5. After the points have been weighed the actual scoring begins. The answer is read through once and then read over again for checking details of facts. As the answer is read a mental note of the points omitted and the value of each point is made so that when the end of the question is reached the minimum grade is figured out. If there is any additional or extra percentage to be given it is added to the minimum score.

However in the attempt to overcome the unreliability and subjectivity of the essay type of examination, as well as lack of discrimination of skills, new methods of testing, adopting the so-called 'new type tests' came into existence.

New Type Tests

There are several forms and types of new type tests. Some of the common types are the simple Recall and open completion types, the True-False type, the Multiple Choice type and so on. The essential features of New Type Tests are that no long written answers are required and that therefore a wide area of knowledge can be tested in detail. The examinee responds by supplying single words, by underlining suitable words from a number given, by ticking the correct answer from a number of statements.

It tests one category at a time (or a very small number of categories). The answer is capable of being placed on a two-point scale, such as 'right' or 'wrong'; 'appropriate' or 'inappropriate', X or Y. etc. The mark is independent of the examiner, so that the same mark would be given by any examiner.

In the large scale use of new type tests, problems of administration are often crucial. Conditions in some areas of the world make it essential to hold the ratio of examiners to pupils at its lowest possible level. In this respect, objective tests have many advantages. The major effort by the examiner goes into the meticulous preparation of the test itself; the marking and paperwork are far less time-consuming than with conventional tests, since the range of acceptable answers for each item has been deliberately restricted to a very small number, preferably to one. Indeed, in some circumstances objective tests can even be marked by mechanical or electromechanical methods. In this way, exceedingly large numbers of test answers can be marked in a relatively short time, by relatively few skilled examiners, with little or no difficulty of standardization between examiners. There is no doubt that this kind of test administration will be used increasingly in the future.

Steps Involved in New Type Test Construction

There are five major steps involved in the construction of an educational achievement test.

1. Planning the test
2. Writing the test exercises
3. Trying out the test in the preliminary form and assembling the finished test after try out
4. Administering and scoring the test
5. Establishing Test Norms.

"Good tests just do not happen. Nor are they the results of a few moments of a high inspiration or exaltation. On the contrary the process is calm, deliberate and time-consuming"[7].

Test constructions in the past have been too exclusively concerned with measuring the attainment of the traditional or prevailing immediate objectives of instruction in school subjects[8]. Very often they have accepted these objectives unquestioningly as an adequate and authoritative basis for tests construction.

Planning the Objective Test

Planning is an essential activity in all stages of a test construction project. It involves the preparation of an outline specifying the content or operations to be covered by the test, careful attention to item difficulty, to directions to the examiner, to arrangements for tryout, to problems of test reproduction, to provision for expert review, to the procurement of personnel and so forth.

Most test construction projects are undertaken with only a somewhat indefinite conception of their purpose in the minds of the test constructors. The basic step therefore is to prepare a general statement of the test purpose. Such a statement would include an analysis and clarification of the general objectives so that the purposes of the test can be stated in specific concrete terms. Such a general definition of objectives should specify, what is to be tested, and what uses are to be made of the test scores.

Expert Opinion

In the construction of educational achievement tests, the advice and assistance of authorities should be sought with respect to the topics of the test outline and the emphasis on each. The panel of expert consultants should command wide respect. It should also constitute an adequate representation of professional thought in the field. The most profitable way to use consultants is usually to submit to them a tentative outline. perhaps one based on analysis of the objectives of instruction.

Determining Test Length

The number of items that should be included in the final form of a test is, from an idealistic standpoint, determined by the purpose of the test or the uses to which it is to be put and by the statistical characteristics of the items. If the items of the test are very homogeneous in nature, the optimum number is lower than for highly heterogeneous item content or form.

Number of Items Needed for Pilot Study

The number of items which should be constructed for tryout is always considerably larger than the number needed for the finished test. The planning of the number of items to be constructed should take cognizance of the anticipated item morality. The loss will vary with the experience and competence of the item writer. Fewer surplus items are commonly needed on grammatical usage. With some types of items two or three times as many items as will eventually be needed should be constructed; in other cases the mortality may be only 10 to 20 per cent.

Planning the Types of Items

The planning depends on the following factors :

1. relation to scoring facilities
2. relation to administrative facilities
3. achieving appropriate item difficulty.

Review of Items

As a general rule test items should be reviewed by the panel of consultants, before tryout on any sizable number of subjects, from three points of view; the accuracy and appropriateness of their subject matter content, their technical merits apart from content, and their editorial quality. Effort spent in intensive review of these three types will obviate the need to try out unusable items and will improve the general quality of the items tried out.

Alternate Forms of a Test

Tests which are so similar that they can be used inter-changeably and yet are not identical are variously considered to be equivalent, comparable, alternate or parallel forms of the same test. In a large scale testing programme interchangeable tests may be needed for two purposes :

1. To compare the results of a tests administered to different groups of individuals at different times.
2. To compare the results of a test given to the same individuals more than once.

Comparable forms of a test are needed for the first purpose in order to minimize the effects of leakage. A person may apply for the same examination more than once. If he is given the identical test twice it is highly probable that for most types of tests his score on the second administration would be higher than his score on the first. Thus he would be given an unfair advantage over competitors taking the test for the first time. Comparable forms of the test are therefore needed in order to minimize practice effects.

Construction of Alternate Forms of a Test

The test planner must determine what definition of comparability he is going to adopt. He would ordinarily want to give attention to whether the two forms test the same functions and whether they yield score distributions of the same type and with the same central tendency and dispersion.

Test intended to be comparable should be based on the same outline of content. If the outline is so detailed that it indicates the content and behaviour to be tested by each item and perhaps even the difficulty of the item, then two tests constructed on the basis of the outline will contain pairs of items that are more or less interchangeable insofar as the judgement of the item constructor is concerned.

Construction of comparable forms by attempting to construct pairs of items of identical difficulty and testing identical abilities raises the question of just how similar the items within each pair should be. The members of the pair should not be so related that knowledge of the answer to one would immediately tell a person the answer to the other, but they should be so similar that in general a person able to answer one is likely to be able to answer the other.

A Statistical Criterion for Parallel Tests

Tests are parallel if "it makes no difference which one is used".[9] Clearly such a definition requires that the means and standard deviations of a given group of subjects be equal regardless of which test is used.

Parallel tests are tests that have equal means, equal variances, and equal intercorrelations. For any given set of experimental data, where the parallel forms of a test are given to a single group, there will be, even under the best conditions, some small sampling differences. To be certain that the tests may be regarded as parallel, it is necessary to have some statistical criterion that will show whether or not the means may be regarded as samples from a population in which the means are identical, the variances may be regarded as samples from a population in which variances are identical, and the intercorrelations may be regarded as samples from a population in which the correlations are identical. Such a test has been provided by Dr. S.S. Wilks (1946). Since two parallel forms have only one intercorrelation, it is possible in this case to check only for equality of means and of variances. In addition to equal means, variances, and reliabilities, parallel tests should have approximately equal validities for any given criterion.

Characteristics of Good Test Items

1. The principal prerequisite of any test item is validity. In other words the item must be such that it can be anticipated that those who give acceptable answer are on the average more competent on the job than those who choose one of the distractors.
2. An item should be as reliable as possible. It should be based on abilities that fluctuate relatively little from day to day; in other words it should have as much inherent stability as possible.
3. Each item should be constructed with the necessity of scoring objectively in mind.
4. There should be face validity for each item.
5. Practicality of administering and scoring the items must also be considered.

Suggestions for Item Writing

An item may be defined as a scoring unit. Item writing is a creative work.

The examiner should express the item as clearly as possible choosing words having precise meaning. Items become unsatisfactory because of complex or awkward word arrangements. All qualifications needed to provide a reasonable basis for response selection should be included, of course avoiding the inclusion of non-functional words in the item. The item writer should avoid unessential specificity in the stem or the responses or irrelevant inaccuracies in any part of the item while carefully adapting the level of difficulty of the item to the group and purpose for which it is intended. There should be neither irrelevant clues to the correct response nor the use of stereotyped phraseology in the stem or correct responses. Irrelevant sources of difficulty should not be introduced.

The Forms of Test Items

The form of an objective test item is determined by the arrangement of words, phrases, sentences or symbols composing it, by the directions to the examinee for response to it and by the provision made for recording the response. A wide variety of item forms have been suggested and used.

The forms given below are the short-answer, which represents the supply type, and the true-false, multiple-choice and matching which represent the selection type. The item writer needs to be thoroughly familiar with each of these forms.

1. *The true-false variety*

This variety consists of a declarative statement that is marked true or false.

e. g. Ice melts at 0°C. True False

2. *The right-wrong variety*

The variety consists of a sentence, equation or other expression that is to be marked right or wrong depending on whether it is correctly or incorrectly written.

e. g. He asked him what was wrong with the patient. (Sentence Structure) Right Wrong

3. *The yes-no variety*

This variety consists of a direct question that is to be answered yes or no.

e. g. Do green plants give out oxygen during photosynthesis ? Yes No

4. *The correction variety*

In this variety the examinee is directed to make every false statement true by suggesting a substitute for the underlined word. This variety combines selection of responses with the supplying of responses to some items.

e. g. The use of steam revolutionized transportation in the 17th century.

5. *The Multiple-choice Form*

This form consists of the item *stem* (an introductory question or incomplete statements) and two or more *responses*, (the suggested answers to the questions, or completions of the statement). The correct response is called the answer and the incorrect responses, the distractors. There are several varieties.

i) *The best-answer variety*

This variety of the multiple-choice form consists of a stem followed by two or more suggested responses that are correct or appropriate in varying degrees. The examinee is directed to select the best (most nearly correct) response.

e. g. The immediate problem for the Central Government to-day is

a) The Food Problem

b) National Integration

c) The integrity of Andhra Pradesh

d) Removal of Poverty

e) The Five-Year-Plans

ii) *The correct-answer variety*

This variety consists of an item stem followed by several responses, one (or more) of which is absolutely correct while the others are incorrect.

e. g. Who discovered the circulation of blood in the human body ?

a) Harvey b) Pasteur c) C. V. Raman
d) Lister e) Newton

iii) *The multiple-response variety*

When the item writer is dealing with questions to which a number of clearly correct answers exist, it is sometimes desirable to include two or more correct answers in the choices offered. When this is done, and the examinee is instructed to mark all correct responses, the item variety is designated as the "multiple-response" form.

e. g. What are the conditions necessary for the germination of seeds ?

a) agreeable temperature b) good seed c) air d) soil e) carbondioxide.

iv) *The incomplete-statement variety*

Quite frequently the introductory portion of a multiple-choice item consists of a portion of statement rather than a direct question :

e.g. Sunlight is necessary for:.........

a) photosynthesis b) germination c) breathing
d) bearing fruits e) withering of plants.

6. *The matching form*

The matching form of objective test exercise consists of a list of premises, a list of responses, and directions for matching one of the responses to each of the premises. Names, dates, terms, phrases, statements, portions of a diagram and many other things are used as premises. A similar variety of things may be used as responses.

e.g.	———1.	a digestive organ	(a) lungs
	———2.	a respiratory organ	(b) stomach
	———3.	an excretory organ	(c) skin
			(d) mouth
			(e) eye

The Experimental Try out of Test Materials

"After the test has been prepared according to plan, it is impossible in advance to know exactly how good the test is. To locate all poor items, the tryout should be considered a necessary step in constructing the test in its final form".[10]

When a set of test items has been written, criticised by subject matter experts and revised on the basis of their criticisms it must ordinarily be tried out experimentally on a sample of examinees. The following are the usual objectives of tryout or pilot study.

1. To identify weak or defective items and to reveal needed improvements.
2. To determine the difficulty of each individual item in order that a selection of items may be made that will show a distribution of item difficulties appropriate to the purpose of the finished test.
3. To find out the discriminating power of each individual item.
4. To provide data needed to determine how many items should constitute the finished test.
5. To provide data needed to determine appropriate time limits for the finished tests.
6. To know how best to organise the items in subjects.
7. To decide the proper format.

Pre-Try Out

Before the items are tried out they should be assembled into tryout units. By a pre-tryout is meant the preliminary administration of the tentative tryout units to small samples of examinees to discover gross deficiencies, but no intention of analysing pre-tryout data for individual items.

Planning the Tryout

Sampling

Practical considerations of course play a major part in obtaining samples. Schools and classes within schools constitute natural administrative units. Depending on the time available sample may be chosen on a random basis to represent various strata such as sex, locality, management of schools and so on.

Representative Samples

Measurements are almost always made on samples rather than on total population, but general statements are often made about the total population from which the same were taken.

A representative sample is one which duplicates or reproduces the characteristics of the total pupulation that are likely to influence results based on the sample.

There are two common ways of seeking representative samples:

1. *Random sampling*

To make the sample probably representative the cases taken for study may be selected at random. This means a selection of cases in such a way that each individual case has an equal and independent chance of being selected.

2. *Purposive sampling*

When individuals are selected according to some purposive principle, the sampling is known as purposive sampling.

Item Analysis

Basically, item analysis is concerned with the problem of selecting items for a test so that the resulting test will have certain specified characteristics. For example, we may construct a test that is easy or one that is difficult. In either case it is desirable to develop a test that will correlate as high as possible with certain specified criteria and will have a satisfactory reliability.

"Through item analysis, it is possible to shorten a test while at the same time increase its validity and reliability"[11].

Indices of Item Difficulty

Many ways of expressing the difficulty level of an item have been in vogue and the most popular is the percent of the tryout group that marks an item correctly.

Item Variance and Difficulty

"The internal consistency of the individual items in the test is determined by their ability to discriminate between the pupils who rank high and those who rank low on the test as a whole"[12].

The proportion (p) passing an item is an index of item difficulty. If 90% of a standard group pass an item, it is easy: if only 10% pass, the item is hard. When p = the percentage passing an item and q = the percentage failing, it can be shown that the S. D. of the item (its variability) is $\sqrt{pq}$ and its variance (σ^2) is pq. When p = ·50 and q = ·50 the item variance is ·25. This is the maximum variance which an item can have; hence an item with a difficulty index of ·50 brings out more individual differences than a harder or easier item. Other things being equal, items of moderate difficulty (30–40–50–60–70%) are to be preferred to those which are much easier or much harder.

Correction for Chance Success

"In tests that require the examinee to choose one of the two or more answers which are presented to him there is an opportunity for success without knowledge"[13].

The point of any correction for chance success is to subtract from the percent marking an item correctly the percent attributable merely to chance or non-chance factors having zero relationship to the function measured. The conventional correction for chance success leads to the following formula for computing the percent of successes on a given test item that is read by every examinee.

$$R_p - \frac{W_p}{k-1}$$

Where R_p = the percent who answer correctly
W_p = the percent who answer incorrectly
k = the number of choices in the item.

In view of the lack of analytic precision in the conventional correction for chance success some test constructors disagree with the use of this formula in computing item analysis data.

Item Discriminating Power

For many years test constructors have recognised the need for determining the value of each test item, for making the test in which it is included, rank examinees accurately with respect to a defined criterion variable. If the test constructor knew the relative value of each item he could select only the best for inclusion in the final form of the test. Usually the total score on a test is used as the criterion variable for evaluating each individual item in the test. The item-test correlation coefficients are computed. To make computations easy in 1935 Flanagan published an abbreviated table of product moment correlation coefficients and in 1936 made available 'A Table of the values of the product-moment coefficient of correlation in a normal bivariate population corresponding to given proportions of success'.

Selecting Items for the Final Test

Based on the analysis of the results of the Pilot Study items are selected for the final form. A great deal of care and skill is exercised to make sure that the items included in the final test actually measure what the test constructor wants the test to measure.

If the items in a Pilot Study have been well constructed and are well apportioned among the skills and abilities to be measured, the total score may be regarded as a valid measure of the intended subject-matter field. In other words the test will be regarded as a valid measure by experts qualified to make such judgements. Given a pilot study of this kind, selection of items for the final from may be accomplished as follows:

1. A difficulty index should be computed for each item.
2. A discrimination index should be computed for each item.

Since the total test score is used as the criterion biserial 'r' may be computed or read from the tables to indicate item - criterion relationship.

3. The number of items desired at each level of difficulty may be borne in mind.

   Bearing these points in mind the final selection is made.

"The process of constructing a test is ideally a co-operative enterprise, involving on the one hand, the judgement of subject matter specialists as to the field and content of each item, and on the other hand, the judgement of a test analyst as to the form and technical merits of each item[14].

Lindquist suggests that, in general achievements tests, the time allowance should be so adjusted that "at least 75 percent of the pupils will have time at least to consider all items in each section"[15].

Administering the Test

After preparing the final test it is administered to a representative sample of the population. The sample is chosen to represent the entire population bearing in mind the limitations of time. The tests are scored objectively and the test norms are struck.

Reliability of a Test

This refers to the extent to which the results of the test are verifiable (1) after the lapse of time or (2) regardless of the particular items. An ideal measuring instrument would yield the same results every time it is used and the same results regardless of the particular form of the test involved. Such an instrument would be perfectly reliable. "One of the first requirements of a test is its internal consistency or reliability"[16]. "It refers to the consistency of scores obtained by the same individuals on different occasions or with different sets of equivalent items"[17].

Methods of Determining Reliability

There are four procedures in common use for computing the reliability coefficient of a test. They are:

1. Test-retest
2. Alternate or parallel forms
3. Split-half technique
4. The Kuder - Richardson formulas.

All of these methods furnish estimates of the reproducibility of test scores; sometimes one method and sometimes another will provide the better measure.

i) The test-retest correlation

This is obtained by correlating scores on one administration of a test with scores on a second administration of the same test. There are however important limitations to this procedure. If the time between the testings is too short, the subjects will remember many of the answers they gave on the first trial and mark the same answers on the second trial. This factor tends to make the correlation between the two sets of scores higher than the true reliability coefficient. This method is subject to the criticism that it is difficult to maintain comparable testing conditions for the two testings. It is not possible to sustain motivation throughout the second administration. These difficulties are so serious that the test-retest method is rarely used.

ii) Correlation between alternate forms

The correlation between two supposedly equivalent forms of a test (i.e. two tests that are sufficiently similar to be used interchangeably but that are not identical) is sometimes suggested as a possible estimate of reliability. This procedure has two advantages over the test-retest method: both forms ordinarily can be administered on the same occasion, and memory and practice are less disturbing. The major difficulty with this technique lies in the assumption that the two forms are comparable.

iii) The Split-half method

This involves dividing the test into halves. It may be used when a single form of a test has been administered only once. The two halves of the test are most frequently composed of the odd-numbered items and the even-numbered items. The score on just the odd-numbered items and the score on just the even-numbered items are obtained. The correlation between the scores on the two parts can be regarded as an estimate of the reliability of a test half as long as the original test. The reliability of the entire test is calculated using the Spearman-Brown prophecy formula.

$$\text{The formula is:} \quad r_1 = \frac{2\,r_{12}}{1+r_{12}}$$

where r_1 stands for the reliability coefficient of the total test and r_{12} is the correlation between the scores on the halves of the test.

This method makes the assumption that all of the items are measures of a single factor, such as the ability to perform routine numerical operations or the ability to visualize spatial relations. The split-half method has been criticized for the reason that the resulting estimate of reliability varies depending upon the particular way in which the test is split into halves or upon the accidental position of particular items in the original test.

iv) The Kuder-Richardson formulas

The Kuder-Richardson solutions to the reliability problem were designed to overcome the disadvantages of the test-retest, alternate forms and split-half methods. The Kuder-Richardson method requires only a single administration of one form of a test. It yields a unique value as the estimate of reliability. It is not complicated by practice and memory factors. The most useful of the Kuder-Richardson formulas is presented below:

The data required are the difficulties or percentages correct of the items (p), the correlations between the items and the total test score (r_{tt}) and the standard deviation of the test (σ_t). The assumption is made that the test measures only one factor.
The formula is :

$$r_t = \frac{\sigma_t^2 - \Sigma pq}{2\sigma_t^2} + \sqrt{\frac{\Sigma r_{tt}^2 \, pq}{\sigma_t^2} + \left\{\frac{\sigma_t^2 - \Sigma pq}{2\sigma_t^2}\right\}^2}$$

where r_t is the reliability coefficient, and $q = 1 - p$

This formula is applied if an item - analysis study has been made that provides the item-test correlation coefficient and the difficulty value for each item. The appropriate type of item-test correlation coefficient to use in this formula is the point biserial.

Tests Norms

Single test scores have almost no meaning and thus are of limited value. A score of 60 on a test may be high or low, depending upon its position with respect to the rest of the scores in the distribution. A score becomes significant or interpretable only when compared with other scores.

A type of measure that assists in the interpretation of test scores is called a norm. Norms are measures of a specified function based on a specified sample that provide standards against which particular test scores can be interpreted.

The Arithmetic mean is a type of norm. Suppose the Arithmetic mean of the test scores of a sample is 75 and the score of an individual student is 60 then his performance is much below the average performance of the sample.

The following are some of the norms usually computed after achievement tests are administered to a sample of subjects.

1) The Arithmetic Mean, 2) The Median, 3) The Mode, 4) The Percentiles.

The Arithmetic Mean

It is the sum of a set of measurements divided by the number of measurements in the set.[18]

The Median

The median is a point on a scale such that half the observations fall above it and half below it.[19]

The Mode

The mode is strictly defined as the point on the scale of measurement with maximum frequency in a distribution. In a distribution of grouped data, the crude mode is the mid point of that class interval having the greatest frequency. The mode is estimated from the Mean and the Median using the formula noted below.

$$\text{Mode} = 3\ \text{Mdn} - 2\ \text{Mean}$$

Percentile

A centile point or percentile is a value on the scoring scale below which are any given percentage of the case. For example, the 90th percentile is the point below which are 90 per cent of the scores, and the 24th percentile is the point below which are 24 per cent of the scores.

The method of calculating percentile is essentially the same as that employed in finding the median. The formula is

$$P_p = l + \frac{(p \cdot N - F)}{(f_p)} \times i$$

Where

- p = percentage of the distribution wanted, e.g. 10%, 33% etc.
- l = exact lower limit of the class interval upon which P_p lies
- $p \cdot N$ = part of N to be counted off in order to reach P_p.
- F = Sum of all scores upon intervals below l.
- f_p = number of scores within the interval upon which P_p falls
- i = length of the class interval.

The percentile method has been developed to express ranks in terms of common units. Percentile norms may be computed using the formula given above or determined from the smooth Ogive.

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CHAPTER 16

THE DESIGN AND EXECUTION OF RESEARCH

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I. Introduction

The formulation of a research design is an essential step in the process of research because it helps the researcher to chalk out his plan of action as efficiently as possible consistent with the conditions available. It is a plan which could be used as a guide throughout the research process, always helping the researcher to keep track of what is going on. Especially when a large scale research is planned, the research design will be helpful in organising the various facets of the research work. In short, a research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure.

Obviously a clear idea of the purpose of the research is necessary for the formulation of the research design. Since the purpose of the research itself may take different forms, it follows that the research designs also vary. In education, roughly four broad types of research designs have been identified as follows.

1. Formulative or Exploratory research designs
2. Descriptive studies
3. Designs involving testing of specific hypotheses
4. Experimental Designs.

This four fold classification is more for convenient organisation than for sharp categorization. The lines of demarcation between these categories are not sharp. Though each of the four research designs has its own special features, there are a few points common to all these designs. A good research design should convey to the reader a clear picture of what the study is about and how the objective is proposed to be achieved.

II. Aspects of Research Design

The following are some of the aspects which should be elaborated in a research design.

1. The title

This statement of the title brings the reader immediately into contact with the topic.

2. The objectives of the study

This elaborates and brings to the forefront, what exactly the researcher wants to achieve. Sometimes it is quite possible that there are a few major objectives and under each major objectives, a few more specific objectives limited in scope are also given.

3. Variables involved

Every study obviously involves consideration of some one or more variables. The identification of the relevant variables is one of the major tasks of the research worker. There are three kinds of variables.

a) Fixed mode variables (eg) Sex : men/women
Locality: urban/rural

b) Integer mode variables - Variables whose measurement always varies over integer values (eg) Strength of a class

c) Real mode variable - Variables whose measurement can take any value. (eg) Height of a child.

This is just to point out that a good design should help the researcher not only in the identification of the relevant variables, but also help him in understanding how they are likely to behave.

It is also customary to point out which variables are treated as dependent variables and which as independent variables.

4. Tools to be used

Having listed the variables to be included, the next part of the design tells the reader how those variables are going to be tackled and measured. Some variables may perhaps have to be kept constant, though not reflected. This leads to the 'control' aspects. The variations of some of the variables may be effected though specific treatments, leading to experimental designs. In another study, perhaps, we may like to allow variables uncontrolled and watch how exactly they behave. Thus we see that, it is here differences in tools and procedures come into play, leading to different types of research designs.

5. Procedure

This section of the research design makes things more concrete. It tells the reader how exactly the researcher intends to proceed. The exact sequence of operations are presented here.

6. Tabulation, analysis and treatment of data

This section will be more anticipatory in nature, but still has a place in the research design. This is a preparation for what exactly should be done after the collection of data is over.

If the data is quite voluminous, it should be anticipated and procedures for tabulating and processing should be stipulated. Presentation of mock tables is one convenient technique that may be helpful.

This section may also contain some hints on the type of statistical techniques that are likely to be applied to analyse the data.

7. Sample

This specifies from where the data for the study is to be obtained. The selection of the sample is a fairly tricky job and the value of the findings are to be judged in relation to the sample selection procedure adopted. This also helps us in estimating the cost and time necessary for the completion of the research project.

8. Limitations

No study can be without limitations, especially in Education where many variables operate simultaneously. A good research design should make the limitations explicit. It may be that certain variables are not taken into account because of certain factors, or may be that they are controlled and kept at a constant level, or may be that the study itself is confined to some specific category of students. Limitations are of different types and it would be a good practice to specify the limitations in the research design, so that the communication of results is more effective and precise.

9. Other features

It may not be out of place to work out, though not very accurately, the time and cost of the study. A time schedule, with clear indication of what aspect of the research work is to be done at what time, by whom and how, will be a highly useful guide-line to the research worker.

In this section we may also include notes on such things as training of field workers, hazards involved in data collection and other such aspects.

When the research worker has prepared his note on the above aspects and arranged them properly, we may say that he has a research design. This design is like a compass always helpful for the research worker guiding him in the right direction.

III. Research Design in Social Sciences

The following steps involved in the formulation of a research design are discussed here.

1. Selecting a topic for research

The range of potential topics for research in social sciences is as broad as the range of social behaviour itself. The general topics of study may be suggested by some practical concern or by some scientific or intellectual interest or one may want to find out the facts of a particular programme, the consequence of certain courses of action, or researches to predict the future course of events in order to plan appropriate action. Scientific or intellectual interest may also suggest an equally wide range of topics for research or one may be interested in the phenomenon that has been already studied to some extent or if he happens to be working in a field in which there is a highly developed theoretical system, he may want to test specific predictions based on the theory. Therefore, the scope for selecting a topic for research depends very much on the nature of interest of the investigator or the interests of the sponsoring agency of any research project. The next step in formulating a research design is to specify the research problem. It is not always possible for a researcher to formulate his problem simply, clearly and completely. It may take the investigator quite some time, thought and research before he can clearly say what questions he has been seeking answers to. As long as scientific enquiry is geared to the solution of the problems, it becomes a pre-requisite to make the problem concrete and explicit as a first step in the formulation of research. Although the selection of a research topic may be determined by other than scientific considerations, the formulation of the topic into a research problem is the first step in a scientific enquiry and as such should be influenced primarily by the requirements of the scientific procedure. However, there is no fool proof rule which will guide the investigator in formulating significant questions about a given research area.

A problem is an interrogative sentence or statement that asks what relation exists between two or more variables. The answer to this question is what is being sought in the research. There are three criteria of good problems and problem statements: (1) the problem should be stated clearly and unambiguously in question form, (2) the problem should express a relation between two or more variables, (3) the problem and the problem statement should be such as to imply possibility of empirical testing. This criterion is often difficult to satisfy in certain types of researches.

There are certain conditions that are conducive to the formulation of significant problems. Among these conditions are systematic immersion in the subject matter through first hand observation, the study of existing literature and discussion with persons who have accumulated much research experience in the field of study. So, the first step in the formulation is the discovery of a problem in need of a solution. It is also necessary to select a topic that would yield a task of manageable size. The task must be reduced to one that can be handled in a single study or divided into a number of sub-questions that can be dealt with in separate studies.

2. *Formulating Hypothesis*

A hypothesis is a conjectural statement of the relation between two or more variables. Hypotheses are always in declarative sentence form and they relate, either generally or specifically, variables to variables. It is a proposition, condition or principle which is assumed perhaps, without a belief, in order to draw out its logical consequences and by this method to test its agreement with facts which are known and may be determined. There are two criteria for good hypothesis statements: (1) hypotheses are statements about the relation between the variables, (2) hypotheses carry clear implications for testing the stated relations. A statement that lacks either or both these characteristics is no hypothesis in the scientific sense of the word. The function of hypothesis is to direct our research for the order among facts. The suggestions formulated in the hypothesis may be solutions to the problem. Whether they are, is a task of enquiry.

Hypothesis may be developed from various sources. A hypothesis may be based simply on a hunch; it may rest on the findings of other studies and the expectations that a similar relationship between two or more variables will hold in the present study; or it may stem from a body of theory that by process of logical deduction leads to the prediction that if certain conditions are present, certain results will follow.

A null hypothesis is a succinct way to express the testing of obtained data against chance expectation. The null hypothesis is the chance expectation. The standard error is a means of testing the null hypothesis. Indeed it expresses the null hypothesis since it is a measure of expected chance fluctuations around a mean zero. We can express these ideas in variance terms. How much does the obtained result vary? Does it vary significantly? Vary from what? Vary significantly from chance? The null hypothesis and the statistical tests will give us the answers to these questions.

Regardless of the sources of the hypothesis, it performs two important functions: 1. it serves as a guide to the kind of data that must be collected in order to answer the research question, 2. the way in which they can be organized most efficiently in the analysis. It goes without saying that formulation and verification of hypothesis is a goal of scientific enquiry. Yet, there is no short cut to this goal. In many areas of social relation or social research significant hypotheses do not exist. Much exploratory research, therefore, must be done before hypothesis can be formulated. Such exploratory work is an inevitable step in scientific progress.

A problem cannot be solved if it cannot be reduced to hypothesis as a problem is a question not directly testable. Therefore, hypotheses are important and indispensable tools of scientific research. The reasons for this belief are:

1. They are working instruments and can be deduced from theory or from other hypotheses.
2. They can be tested and shown to be problems true or false.
3. They are powerful tools for the advancement of knowledge because they enable man to get outside himself.

The problems and hypothesis direct investigation, help to deduce specific empirical manifestations implied by them. It advances scientific knowledge by helping the investigator to confirm or disconfirm theory and hypotheses incorporate the theory or part of it, in testable or near-testable form. There are a few errors in the nature of problems and hypothesis: 1. scientific problems are not moral and ethical questions, 2. value statements that indicate cultural or personal judgements or preferences should be avoided, 3. Another common defect of problem statements often occurs in doctoral thesis: listing the methodological points or problems as sub-problems. These have two characteristics that make them easy to detect 1. they are not substantive problems that they spring from the basic problem, 2. they clearly relate to techniques or methods of sampling, measuring or analysing.

3. *Defining concepts and variables :*

Any investigator, in order to organise his data, so that he may perceive relations among them, must make use of concepts. A concept is a word that expresses an extraction formed by generalizations from particulars. In other words, it is a shorthand representation of a variety of facts. A construct is a concept. It has added meaning however, of having been deliberately and consciously invented or adopted for a special scientific purpose.

A *variable* is a symbol to which numerals or values are assigned. Scientists somewhat loosely call the constructs or properties they study as variables. A *constitutive definition* is a definition that defines a construct with other constructs. For instance, we can define 'weight' by saying that it is heaviness of objects. An *operational definition* is a definition that assigns meaning to construct or a variable by specifying the activities or operations necessary to measure the construct or variable. The operational definitions are of two kinds : One is measured and the other is experimental. A measured operational definition is one that describes how a variable will be measured. An experimental operational definition spells out the details of the investigator's manipulation of a variable. Whenever a research is undertaken, it is therefore, necessary to understand the concepts or constructs involved in any research problem, the variables to be studied, and adopt the constitutional and operational definitions as required.

a. *Types of variables :* There are independent and dependent variables, active and assigned variables and intervening variables An *independent variable* is a presumed cause of the *dependent variable*, the presumed effect. In other words, the independent variable is the antecedent; the dependent variable is the consequent. In experiments, the independent variable of course is a variable predicted to, whereas the independent variable is predicted from. The dependent variable is the condition we are trying to explain.

b. *Active and assigned variables*:- This is another classification of the variables. The manipulated variables will be called *active variables* whereas the measured variables are called *assigned variables.*

c. *Intervening variables* :- Intervening variables are terms invented to account for internal and directly unobservable psychological processes that in turn account for behaviour.

A researcher must have a good understanding of these variables in his research design. It is always necessary to identify the dependent and independent variables, as it will help him to evolve his research plan accordingly.

4. *Sampling*

The next step in any research design is to select the sample for one's study. It involves two aspects: 1. selection of the respondents, 2. number of respondents. Sampling is taking any portion of a population or universe as a representative of population or universe. The emphasis here is taking a portion of a population and considering it as representative. There are different sampling methods. These are :

a. *Simple random sample*

This is the basic probability sampling design. A simple random sample is selected by a process (using random numbers, or by drawing lots) that not only gives each element in the population an equal chance of being included in the sample but also makes the selection of every possible combination of the desired number of cases equally likely.

b. *Stratified random sample*

The population is first divided into two or more strata. The strata may be based on a single criterion or a combination of two or more criteria. A sample random sample is taken from each stratum and the subsamples are then joined to form the final sample.

c. *Cluster sampling*

In this, one arrives at the ultimate set of elements to be included in the sample by first sampling in terms of larger groupings ("clusters"). The clusters are selected by simple or stratified random sampling methods; and if not all the elements in these clusters are to be included in the sample, the ultimate selection from within the clusters is also carried out on a simple or stratified random sampling basis.

d. *Proportionate stratified sampling*

This involves proportionate random selection of elements to represent different parts of the population proportionately.

e. *Accidental samples*

Here one simply reaches out and takes the cases that fall to hand, continuing the process until the sample reaches a designated size.

f. *Quota samples*

This guarantees the inclusion in the sample of diverse elements of the population and makes certain that these diverse elements are taken account of in the proportions as they occur in the population. The basic goal of this sampling is the selection of a sample that is replica of the population to which one wants to generalize.

g. *Purposive samples*

A common strategy of purposive sampling is to pick cases that are judged to be typical of the population in which one is interested assuming that error of judgement in the selection will tend to counterbalance each other.

The investigator must choose one of the methods depending upon the scope of his research. The method of selection of the sample very much depends upon the nature of the observations to be made and the extent of the generalisation of the findings.

The investigator also has to decide on the *sample size.* A rough and ready rule taught to beginning students in research is: 'Use as large samples as possible'. Whenever a mean, a percentage or anything else is computed from a sample, a population value is being estimated. The question therefore, is how much error is there likely to be in statistics calculated from samples of different sizes. Where the error is less, the size can be taken as adequate.

5. *The use of available source material*

The investigator must make an assessment of the available information in terms of documents, census records and such other published data from which he must be able to draw as much information as could be relevant for his study. This will also orient the investigator to the problem and might help in defining the problem adequately and formulation of hypothesis where feasible.

6. *Data collection*

Here, the investigator has to decide what methods to use in order to study his problem whether it is a questionnaire, an interview schedule, a case study or observation method or a combination of any of these. The tools that have to be used depends upon the nature of the problem, the nature of the sample and the time at the disposal of the investigator, apart from the cost of the investigation. In case it is a problem that could be studied by using experimental method, the investigator has to work out the conditions under which the experimentation will be carried out.

7. *Data analysis*

This depends upon the nature of the data collected. In case the data is in terms of scores, quantification using statistical methods is called for. In case it is qualitative data, then one has to follow the procedure of coding through which raw data are transformed into symbols, usually numerals that may be tabulated and counted. The transformation is not however, automatic; it involves judgement on the part of the coder.

8. *Tabulation*

Tabulation is a part of the technical process in the statistical analysis of the data The essential operation in tabulation is accounting to determine the number of cases that fall into various categories.

9. *Interpretation and Generalization*

Interpretation generally implies explanation of the obtained result based on either one's sound commonsense or theoretical propositions. It could also be in the form of speculations. Therefore, the interpretation of results is often no more than a commonsense reading of simple tables and explanation of simple descriptive measures. Whatever may be the nature of data, the task of interpretation falls squarely on the soulders of the researcher himself. The researcher in interpreting his results inevitably-and rightly-influenced by all that has gone before, by his acquaintance with the raw material behind the figures and by his own judgement. Some research workers take the view that it is their job merely to present their results in logical and convenient form leaving to the readers to draw their own conclusions. The researcher who cautiously confines his conclusions to those strictly justified by the data may be saved from criticism but he is not making his own full potential contribution. There is surely room in every research report, for the research worker's own ideas and speculations, even if he cannot offer evidences to substantiate them. In the course of his work, he must inevitably develop theories and hunches, and so long as he makes clear that they are not more than this, it is a pity to omit publishing them with the results. However, the author who values his reputation for objectivity will take pains to warn the reader frequently and repetitiously, whenever any unsubstantiated conclusion is being represented and will choose his words with the greatest care.

As *generalization* of the results is concerned, there is never any justification for claiming more generality for the results than is their due. Often the population coverage actually achieved differs from that initially intended: the sampling frame may have turned out to be incomplete or substantial population segments may have been lost through no response. Whatever be the reason, the resultant loss in coverage as far as it is known to the researcher must be acknowledged and conclusions generalised only to the population actually covered. Similarly, when a survey has for reasons of convenience or lack of resources been confined to a limited area, the researcher must resist the temptation of generalising the findings to the entire population or the area even if the covered area is fairly typical on various relevant factors. The localisation of a research project is often highly desirable but the researcher must be prepared to accept the consequent limitation in his final conclusion.

IV. Designing of Experiments

Experiments are most often designed to discover and evaluate differences between effects rather than the effects themselves (e.g.) differences between yields produced by fertilizers or differences between gains produced by feeds that are wanted. One of the simplest of such experiments is designed to contrast the effects of two treatments. Pairs of similar individuals are selected, one of the treatments being applied to each. The individuals in the pairs may be field plots or pigs or colonies of bees. If there were only a single pair it would be impossible to say whether the difference in behaviour is to be attributed to the two treatments imposed or to the natural variability of the individuals or partly to each. Hence, there must be two or more pairs or replications, one member of every pair being chosen at random to receive the first treatment, the other member the second. The differences between the measurements of the two pairs contribute the sample data upon which inferences are to be based. If there were no individual variation the differences would presumably be all alike. But always there is variation.

For certain problems in nutrition of rats it seems adequate to sample a highly in-bred colony whose range in 28-day weight, for example, is half that resulting from random mating. Standard errors for means of 'n' such animals would be half those in the randomly mated population; consequently, confidence intervals would be decreased by the same fraction while sample values of 'it' would be doubted (Snedecor, 1964).

The designing of experiments is to compare the effects of various treatments on some type of experimental units, (Armitage, 1970). The treatment to be applied to any particular unit is to be decided by the investigator. Some examples are given here:

a. A comparison of the effects of feeding animals with different doses of a particular food. The units here will be animals.

b. A prophylactic trail to compare the effectiveness for children of different vaccines against measles. Each child will receive one of the vaccines and may be regarded as the experimental unit.

c. A comparison in one patient suffering recurrent attacks of a chronic disease of different methods of alleviating discomfort. The successive occasions on which attacks occur are now the units for which the choice of treatment is to be made.

d. A study of the relative merits of different programmes of community health education. Each programme would be applied in a different area, and these areas would form the experimental units.

In all such examples a crucial question is how the treatments are to be allotted to the available units. One would clearly wish to avoid any serious disparity between the characteristics of units receiving different treatments In example (b) for instance it would be dangerous to give one vaccine to all the children in one school and another vaccine to all the chilnren in a second school, for the exposure of the two groups of children to measles contacts might be quite different. It would then be difficult to decide whether a difference in the incidence of measles was due to different protective powers of the vaccines or to the different degrees of exposure to infection.

It would be possible to arrange that the groups of experimental units to which different treatments were to be applied were made alike in various relevant respects. For example in (a) groups of animals with approximately the same mean weight could be formed, in (b) children from different schools and of different age groups could be represented equally in each treatment group. But however careful the investigator is to balance factors which seem important he can never be sure that the treatment groups do not differ markedly in some factor which is also important but which has been ignored in the allocation.

The allocation according to Fisher (as quoted by Armitage, 1971) should incorporate an element of randomization. In its simplest form this means that the choice of treatment for each unit should be made by an independent act of randomization such as the toss of a coin or the use of random number tables. This would lead to some uncertainty in the number of units finally allotted to each treatment and if these are fixed in advance, the groups may be formed by choosing random samples of the appropriate sizes from the total pool of experimental units.

In the clinical trials the total number of patients is often not known in advance since many patients may become unavailable for inclusion in the trial sometime after it has started. The simplest method is then to allocate treatment by an independent random choice for each patient. Restricted randomization is a method by which the numbers allocated to different treatments are kept close together. Some times a form of systematic allocation is used where the units are arranged in a certain order and then allotted systematically to the treatment groups.

A second important principle of experimental design is that of replication, the use of more than one experimental unit for each treatment. Various purposes are served by replication. First, an appropriate amount of replication ensures that the comparisons between treatments are sufficiently precise, the sampling variation can be estimated only, if there is an adequate degree of replication.

Thirdly, it is useful in enabling observations to be spread over a wide variety of experimental conditions.

A third basic principle concerns the reduction in random variability between experimental units. The experimental units should be as homogenous as possible in their response to treatment. In a clinical trial, it may be that a precise comparison could be effected by restricting the age, sex, clinical condition and other features of the patients but these restriction may make it too difficult to generalize from the results. A useful solution is to subdivide the units into relatively homogenous sub groups called blocks. The precision of the overall comparisons between treatments is then determined by the random variability within blocks rather than that between different blocks. This is called randomized block design (Armitage, 1971).

In a factorial design in which confounding with blocks takes place, two types of random variation are important, the variation between experimental units within a block and that between blocks. This principle was first exploited in agricultural experiments where the designs are called split-plot designs. In some field experiments it is convenient to divide the field into main plots and to compare the levels of one factor say the addition of different soil organisms by allocating them at random to the main plots. At the same time each main plot is divided into a number of 'sub-plots' and the levels of some other factor-say different fertilizers are allocated at random to the sub-plots within a main plot, exactly as in a randomized block experiment. In general, the experimental units are not referred to as 'plots' and the design is therefore more appropriately called a split-unit design, (Armitage, 1970).

The clinical nutritional or laboratory investigator planning an experiment is confronted with two problems of a statistical nature. First, he must organize the logical structure of the experiment in a manner which will provide adequate information about the phenomena to be investigated. By the term "adequate" is meant answers to a host of frequently complicated and almost always interrelated questions that can be asked about an experiment. As a few simple and obvious examples, the experimentor must ensure that the results will be free from biases or, if this is impossible, that the biases are known or are measured as part of the experimental procedure. Again, eventhough the results are obtained in a manner free of bias they may not be sufficiently precise for the purposes of the study. Inability to secure sufficient precision at the planning stage, will force the experimenter to enlarge the resources to be devoted to the experiment or, alternatively, to reduce its scope.

The problem of structuring an experiment requires a balancing of the scope, aims and proposed precision of the experiment with the resources at the disposal of the investigator. This is the general area held to belong to the domain of experimental design, as we shall see, the design of the experiment will condition in a rather marked way the quality of the inferences which can be made from the data after they have been collected.

The second statistical problem facing the investigator is the choice of the particular statistical method to be used in the analysis and evaluation of the results. There is, it might be pointed out, no choice regarding any one method unless the data are to be filed away without examination. Assuming this is not the intention, the only question concerns the particular method is used.

Pairing is often indicated clearly in the experimental material. Crop yields in successive seasons tend to be so different that no one would think of comparing the results of one treatment last year with those of a second treatment this year. Both treatments must be applied every season with a consequent pairing of the yields. Much the same can be said of different localities in the same year.

On the other hand, pairing is not practicable in a variety of experiments. Among Breneman's chicks there was no basis for matching individuals, hence, they were randomly assigned to the treatments. When yearling steers are shipped in from the range of fattening, so little is known of their history that estimating outcome seems to be doubtful. Again, if circumstances dictate different numbers of individuals for the two treatments; pairing is clearly impossible (Snedecor, 1964).

Research design also involves planning for the budget, duration of study, personal, and their careful training, equipment, chemicals, stationery, transport, over head charges etc.

V. Desirable Characteristics of a Good Design

The following may be considered to be some of the desirable characteristics of a good design.

1. Clarity

Since the purpose of the research design is communication, it should be clearly worked. All ambiguity should be avoided. Defining technical terms, especially when its meaning is slightly new, will be a good feature in this direction. For example, we may use such comprehensive terms as 'teacher competence' which is in the later section of the research may be equated to 'teacher qualification'. All such things should be made clear so that the research design communicates exactly what the researcher has in mind.

2. Flexibility

A research design is a guide to the researcher and it should be always open for the researcher to revise, edit or modify the research design. Flexibility in choosing the right procedure for data collection, flexibility in the approach to the problem, flexibility in the presentation are all desirable, but not with the objectives of the study. These objectives once fixed should not be changed though it may not be out of place to improve the wording or make them more specific.

3. Precision and accuracy

These two characteristics are concerned with the way the measurements are made No measuremeat is ever cent per cent precise and accurate. Hence a good researcher has to be conscious of the errors involved in the measurement. How much error can be tolerated depends upon the type of the research design.

With exploratory studies, probably a broader margin of error may be tolerated. With experimental designs we may insist on more accuracy and precision.

Thus the research design should help to develop an insight into the study of errors and make the research worker conscious about the fact how it is likely to affect the results at the end.

VI. Conclusion

Perhaps the best way to conclude this presentation may be to quote what Setltez and Jahoda have to say in this connection. They summarise as follows:

The function of research design is to provide for the collection of relevant evidence with minimal expenditure of effort, time and money. These considerations are important in any study what ever its purpose. But how they can best be achieved depends to a considerable extent on the research purpose. When the purpose of the study is exploration, a flexible research design which provides opportunities for considering many different aspects of a problem is appropriate. When the purpose of the study is accurate description of a situation or of an association between variables, accuracy becomes a major consideration, a design is needed that minimizes bias and maximizes the reliability of the evidence selected. When the study involves testing of hypothesis or making casual inferences the design has to be more specific and accurate in its details.

A good research design is an instrument which directs and guides the research worker in the right direction. It is an effective tool of communication between persons interested in the research project.

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CHAPTER 17

ORGANISATION, TREATMENT OF DATA AND INTERPRETATION OF RESULTS

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1. Organisation of data

Statistical methods render two invaluable services. The first is that of enabling us to organise, classify and summarise data so that they can be more readily comprehended and interpreted. The second service is that of enabling us to draw conclusions, to a statable degree of exactness, about the probable nature of objects and events, upon less than complete evidence.

The very determination of the types of data to be secured, the methods to be adopted in securing them and the selection of the sources from which the researcher could extract the required information, all these necessitate intellectual organisation. A mass of varied data emerges from various sources like questionnaires, schedules, interview reports, observations, experiments, etc. Data of simple nature can easily be organised. But data from questionnaires or schedules, because of their complex nature, require proper processing. The data may contain certain errors in recording and transcription. The informants may deliberately or unconsciously supply information, which makes the data unreliable. The sources, nature and magnitude of such errors and irregularities must be detected and corrective steps are to be taken. This process is known as editing.

After editing the collected information, it is necessary to classify them. Eventhough, there are no set rules for organising and classifying mass of data, the investigator usually subjects them to some classificatory system - that is a logical arrangement of data into groupings which have common elements and mutual relationships. He should decide which data serve essentially for general background and which are suitable for expository and explanatory purposes. In actual practice some of the following basis for classification of data are generally used.

1. Geographical Classification - classification according to location village, city, ward, etc.
2. Chronological Classification - classification according to time weekly, monthly, yearly, etc.
3. Qualitative Classification - classification according to the qualities of attributes possessed by the individuals under study sex, material status, literacy, employment, religion, poverty, etc.
4. Quantitative Classification - classification according to measurements - heights, weights, age, scores, etc.

The types of classification with qualitative data are (1) dichotomy, (2) serial and (3) variables. A classification which employs dichotomy calls essentially for a judgment of the presence or absence of the quality or attribute possessed by the individuals. Examples of such a scheme are listing of reasons, counting opinions on a particular issue, etc. Instead of categorising the attributes into one of the two classes, one may wish to indicate high, medium or low intensity of the presence of the attribute under study. Here no assumptions are made concerning the location of an absolute zero point. This is known as serial scale. The common 5 category scale of degree of satisfaction - viz. highly satisfied, satisfied, neutral, dissatisfied, highly dissatisfied - is an example of serial order. If a system of categorization not only enables a serial order, but also designates equal intervals and absolute zero point, then it meets the full requirements of variables. Variables can be classified into classes of specified limits. The usual way of grouping numerical measurements is to group them into frequency distribution, showing the number of cases falling in each class.

2. Coding of Data

Sometimes the data may be quite verbose or qualitative in details. The use of codes is one of the ways of presenting data in a concise form. Especially when the data is proposed to be processed on a computer or other data processing system, this step is a must.

An example of coding will make this point clear. In a study, four different tests were administered in each of the twenty schools selected for study. In each schools students belong to standards IX, X, and XI were included. The sample also included boys and girls. Each test had 50 multiple choice questions with five choices for each question. When such data have to be processed, it would be convenient to code as follows:

1.	Test identification code	1 to 4	(4 tests)
2.	Student identification	000 to 999	(1000 students)
3.	School identification	00 to 20	(20 schools)
4.	Class identification	09, 10, 11	(3 classes)
5.	Sex of the student	Boy-1 Girl-2	(B/G)
6.	Response to fifty questions	A-1 B-2 C-3 D-4 E-5	

Using this kind of coding, we can easily get frequency distributions either school wise or class wise or sex wise or test wise and so on. Thus coding facilitates the work of tabulation very much.

This task of coding requires that the researcher should have a good estimate or guess about the nature of variation in the variable. This again will become clear considering following example. In a study of late coming to the school, the various reasons had to be coded. Here the researcher should anticipate the maximum number of reasons that may come up. If it is definitely less than 10, a single digit code is enough. If it is definitely less than 100 but greater than 10, a two digit code is necessary.

3. Tabulation of Classified Data

Tabulation and classification are not two distinct processes. In fact, they go together - classification being the first step in tabulation.

It is difficult to lay down all specific procedures for tabulating data, because, much depends on the nature of the data and the requirements of the study. However, before the table of information is released, it should be reviewed for form, content, validity, and clerical accuracy. It is rather difficult to make a thorough satisfactory check on all these matters, at the time of preparation of the table. Therefore, if possible, the investigator should have his work verified by some experienced persons.

The following questions may be kept in mind, while verifying whether the table is satisfactory :

1. Does the title of the table clearly state the items in the table ?
2. Are all entries pertinent ?
3. Is there unity of subject matter ?
4. Does the arrangement of the table contents focus attention to those items which are to be compared ?
5. Are the data arranged to emphasize important points?
6. Does the table include adequate figures, such as, totals, averages, percentages, etc. for interpretation ?
7. Whether the table is too crowded so as to be separated into smaller ones ?

4. **Preparation of Tables**

The easiest method of organising mass of data is to prepare meaningful tables. Each table should present one key idea or quality, sub-divided into sections to illustrate difference between groups based upon certain other variables. It will be a good practice to number all the tables serially and also give a proper (short) title to each table; this will facilitate identification at the latter stage of report editing.

Soon after the table is prepared, it would be good to write the interpretation or comments also along with the table. Some space for this purpose should be provided under each table.

If graphical representation is intended, this may also be prepared and attached to the table. Each graph should invariably have a title (for identification), should be neatly drawn with the scales clearly indicated.

5. Descriptive Statistics

In any statistical analysis, a clear and practical differentiation should be made between descriptive statistics and statistical inferences. Descriptive statistics, as the name indicates, emphasizes description of the data with the help of measures of central tendency, measures of dispersion, rates, ratios, etc. It is simple and from a scientific point of view less refined than inductive statistics, but is very important and indispensable for many research problem. In giving an adequate description of the mass of collected data, one or another or several of the following operations may be used.

a) *Measures of Central Tendency*

One of the most important objects of statistical analysis is to get one single value that describes the characteristics of the entire mass of unweildy data. We use the word 'average' very commonly in our day-to-day conversation. We talk of average student, average height, average weight, etc. In statistics the term average is defined as that value of the variable which is considered as the most typical or representative value of a group. An average is called a measure of Central Tendency because, individual values usually cluster around it. Measures of Central Tendency, by condensing the mass of data in one single value, enable us to get a bird's-eye-view of the entire data.

We have different measures of Central Tendency. The most popular among them are:

1. The Arithmetic Mean (Usually known as the Mean)
2. The Median and
3. The Mode

Arithmetic Mean is the most popular and widely used measure. The computation of the mean inplies equality of intervals or an integral scale. If the investigator is not using an integral scale, then the use of the mean leads to misrepresentation. If, for example, one gathers information about the consumption of a particular food item, by developing a 4 position scale (viz. consumes every day, consumes occasionally, consumes very seldom, completely avoids that food) and computes the mean of the scores so obtained, the average has no meaning, because, there is no reason to believe the scale positions are equally distant. In such a case, the median seems to be more appropriate to represent the group of values.

Median is defined as that value of the variable below which (and above which) there are 50% of values of the variable. It is the middle most value, when the values are arranged in the order of magnitude. It is the most appropriate measure of average in dealing with qualitative data, where ranks or scores are used. In certain distributions where the mean is distorted by extreme values, the median is especially useful. But median is a positional value. Its value does not depend on each and every observation in the group.

In the same example quoted above, instead of using a positional scale, if the researcher makes use of a list of alternatives and asks the respondents to check the items they consume every day, the data collected would be in nominal scale. The appropriate measure in this case would be the mode. Mode is defined as that value which is more frequent. It is again used to describe qualitative phenomenon. It should be remembered that mode is at its best, as a measure of average, when there is a clear-cut situation, a situation in which there is clearly one value or one class that is out-standing in the frequency of its occurrence.

b) *Measures of Variability*

While describing the data, the researcher may be interested to report whether all the elements of his study are much alike with respect to the variable under consideration or whether there is greater variability among them. He has to report the amount of variability because, the reliability of the representative value of the group depends largely on the variability of the individual observations.

Of all measures of variability, standard deviation stands superior because of its mathematical properties. It is the most important and widely used measure of studying dispersion. The greater the amount of variability, the greater the standard deviation. for, greater will be the magnitude of the deviations of the individual values from the mean. A small standard deviation means a high degree of uniformity of observations as well as homogeneity of a series of values. Thus, if there are two or more comparable series with identical or nearly identical means, it is the distribution with smaller standard deviation that has the most representative mean. Standard deviation, therefore, is extremely useful in deciding or judging the reliability of the mean.

c) *Nature of Distribution*

If the values of the variable are plotted on a graph paper, the resulting diagram or graph will tell us, the nature of the distribution of the variable-whether it is bell shaped or U-shaped, or J-shaped, or skewed, etc. Knowing the shape of the frequency curve is fundamental to the use of precise statistical methods. It is common to assume that the distribution curve of any variable is normal, but this may not be true in many practical situations. Therefore, one can draw the distribution curve for the observed data and verify the closeness of its relation to known distribution curve. If needed, the values of the variable can also be transformed by mathematical manipulations, so as to follow a known distribution curve, the normal curve.

The following are some of the characteristic features of the normal curve.

1. The mean, median and mode coincide.
2. The curve is symmetrical about the mean. The number of cases below the mean in a normal distribution is equal to the number of cases above the mean. Hence the mean and median coincide.

3. The height of the normal curve is at its maximum at the mean. Hence the mean and mode coincide.
4. There is one maximum point of the curve which occurs at the mean. The height of the curve declines as we go on either direction from the mean. The curve approaches nearer and nearer to the base, but never touches it. Its range is unlimited or infinite on both sides.
5. Since there is only one maximum point, the curve is unimodal.
6. The points of inflexion occur at one Standard deviation.
7. The first and third quartiles from the mean are equidistant from the median.
8. The area under the normal curve is distributed as follows:
   a) Mean $\pm$ 1 S.D covers 68·27% of the total area. That is 34·135% area will lie on either side of the mean and 1 SD.
   b) Mean $\pm$ 2 S.D covers 95·45% of the total area and
   c) Mean $\pm$ 3 S.D covers 99·73% of the total area.

d) *Correlation*

There are several techniques of determining whether the variation or change in the values of one variable is associated or paralleled by a change in the values of another variable and of assessing the interrelationship between different variables. Correlation analysis reveals the strength of relation between variables. Coefficient of correlation is a numerical measure of the degree of relationship between the variables.

Of the several methods of measuring correlation, Karl Pearson's method, popularly known as Pearsanion Coefficient of Correlation (denoted symbolically by r) is most widely used. The values of r always range between -1 and $+1$. $r = +1$ indicates a perfect positive or direct relation between the variables, and $r = -1$ a perfect negative, or inverse relation between the variables.

In practice the values of r usually lie between -1 and $+1$ such as $+0{\cdot}8$, $-0{\cdot}4$ etc. The coefficient of correlation describes in one single value, not only the magnitude but also its direction. Thus $r = +0{\cdot}8$ means, that the correlation is positive with a magnitude $0{\cdot}8$. The interpretation of r depends very much on the experience of investigator. He must know the data thoroughly, in order to avoid errors of interpretation and emphasis. He must have knowledge of the significant relationship between the variables and should reach a conclusion based on logical reasoning and intelligent investigation. The closeness of relationship is not proportional to the value of r. If $r = 0{\cdot}8$, it does not mean or indicate a relationship twice as close as that of $r = 0{\cdot}4$.

e. *Standard Error*

Standard error is of fundamental importance in statistical methods. It is the standard deviation of the sampling distribution of a statistic. It measures the sampling variability due to chance or random forces. For example, we can take 100 random samples from a population and compute the means of these samples. We will get a series of 100 means, which themselves form a frequency distribution. This distribution of means of samples is known as the sampling distribution of the means. The standard deviation of the sampling distribution of the means of the samples is known as the standard error of the mean. Similarly we can have the standard error of any sample statistic like, standard deviation, correlation coefficient etc.

6. Statistical Inference

Statistical inference is concerned with the derivation of generalisations concerning a whole class, from observations of a relatively few instances, commonly referred to in statistical terminology, as sample. A sample is not studied for its own sake. Instead the investigator is interested in the sample because he wants.

1. to use it to test some hypothesis about the parent population from which the sample is drawn (problem of testing).
2. to use the sample statistic to obtain estimates of population parameters. (problem of estimation).

Means, standard deviations, correlation coefficients etc. computed from sample observations are called 'statistics'. Thus the mean of a sample data is a statistic. On the other hand, the mean, standard deviation, etc. of a population are called parameters.

a. *Null Hypothesis and Tests of Significance*

In a broader sense, the term hypothesis refers to a tentative statement or proposition that may explain observed facts. The crucial step in research is that of testing the hypothesis and it determines whether the hypothesis is consistent with the facts. A hypothesis which is tested for possible rejection is known as null hypothesis.

Essentially it assumes that some parameter of a population has certain value and the hypothesis is tested by determining whether the corresponding statistic in a sample (drawn from the population) differs so much from the assumed value that the difference cannot be reasonably explained in terms of sampling fluctuations or chance. Null hypothesis is a very useful tool in testing the significance of the difference between assumed and observed values. As against the null hypothesis, alternative hypothesis specifies those values that the investigator believes hold true and of course, he hopes that the sample data lend to the acceptance of the hypothesis as true.

The process of applying the method of statistical analysis in testing hypothesis can be explained as follows :

1. The investigator defines the hypothesis to be tested.
2. He chooses the criterion, whose numerical value is derivable from the observed facts, for testing the hypothesis.

3. He randomly selects a sample of sufficient size and computes the value of the criterion. He understands that the criterion is not a single valued expression, but will vary from one sample of observations to another.
4. He then refers the observed value of the criterion to its sampling distribution - usually to a normal probability distribution - and obtains a measure of the likelihood of the hypothesis. This involves a selection of the appropriate probability distribution and the computation of critical ratio.
5. Finally, if judged, on this probability scale, the observed criterion is not exceptional, he concludes that upon the information available, there are no grounds for discarding the hypothesis; or if the value proves exceptional, the investigator considers the possibility of an alternative hypothesis.

It is important to note that the hypothesis assumed is not disproved or proved by a statistical test of significance. It is only shown to be consistent or inconsistent with the sample evidence. The above determination is made in terms of probability-the smaller the probability the less reasonable it is to conclude that the difference is due to chance. Or the more reasonable it is to conclude that there is real difference between the sample evidence and the hypothesis assumed.

In practice, of course, we do not have the real value of the parameter and our selection is governed by the nature of the hypothesis, alternative to the null hypothesis. Every alternative hypothesis is paired with the null hypothesis. For example, the investigator can test the null hypothesis that the population mean is equal to the sample mean $\bar{X}$. In this case 3 plausible alternative hypotheses are $\mu < \bar{X}$, $\mu \neq \bar{X}$ and $\mu > \bar{X}$

b. *Use of Standard Error*

The test of hypothesis includes the calculation of the testing statistic and its standard error. Standard error is used as an instrument in testing hypothesis. If the difference between observed and expected results is more than 1·96 times the standard error, in the case of large samples, we say that the result of the experiment does not support the null hypothesis at 5% level of significance or the observed difference is regarded as significant at 5% level. Similarly if the difference is more than 2·58 times the standard error, we say the difference is significant at 1% level of significance.

When the hypothesis, in question, is accepted at 5% level, the investigator is running the risk that in the long run, he will be making wrong decisions in 5 out of 100 occasions. Similarly, by accepting the hypothesis at 1% level, he runs the risk of rejecting a true hypothesis in 1 out of 100 occasions. So by testing at 1% level, the investigator seeks to reduce the chance of making wrong or false judgements. Of course, even then some element of risk still remains (1 in 100) that he will make wrong decisions - that is he might have accepted the hypotheses, when he ought to have rejected and vice versa.

7. **Guarding Against Errors**

It may be proper here to caution the reader against certain errors which he is likely to commit in the use of statistics.

The first error is regarding false accuracy. In this case the calculations and computations are carried on to more than the necessary number of significant digits. If the mean test score is reported as 32·445772 it means nothing. We should round off the answer as either 32 or as 32·4, retaining only as many digits as are meaningful.

The second error is due to gross violations of the assumptions implied in statistical formula. Most of the formulae assume that the sample under study has been drawn from a normally distributed population. It may be therefore necessary to get an insight into the nature of the variables involved in the study before applying the statistical method. Fortunately for us, most of the variables studied in applied research answer the assumptions, thus saving us from serious errors.

The third type of error is inherent in any statistical methodology. In most of the results we say that the statistic is significant at 5% level or at 1% level. This signals that, assuming the hypothesis (Null hypothesis) to be true, there is a 5% or 1% chance of rejecting the hypothesis. One must be conscious of this error whenever working with statistical method. Similarly there is also the error of accepting a hypotheses when it is actually not correct. This error is more difficult to assess. These two errors are classified as type I and type II errors. As we try to reduce the amount of error in one category, the other increases. Thus we may have to strike a balance between these two errors. In general the 5% level of confidence is considered to be the best. But it may be necessary to use either 5% or 1% level also depending upon the risks involved in the errors.

The last type of error that should be mentioned is the clerical errors that may attributed to inefficient computations. If all the calculations are done manually, it should be checked, preferably by another person. If a calculating aid is made use of, it is often desirable to repeat the calculation and check. This is an error which should be eliminated completely.

8. Interpretation of Results

After the statistical analysis is over, the researcher proceeds to the next step of interpreting the results. There are two stages in this step. At the beginning, the researcher may summarise and bring together the various numerical values to a common fore-front, which will enable easy comparison and comprehension. Many readers are not likely to probe into the details of calculations, but they all certainly like to see the final results. Therefore, the final results of all calculations should be summarised properly, using tabular forms wherever feasible. Then comes the interpretative part, when the researcher should explain the figures, what they mean in the context of the theory on which the study is based, in the context of the assumptions involved in the study and in the context of the methodology used. It may be difficult to define the exact rules for doing this interpretation. An example may illustrate the point.

Suppose that a study involves a comparison of two groups. The means and SDs may be reported and the test of significance may be applied. The result may indicate that the null hypotheses (namely that the two groups do not differ in the trait under study) is to be rejected. Statistics stops there. To find out the real cause of the difference between the groups, the researcher has to draw from other sources, his methodology, approach, conditions of study and so on.

This interpretative writing is a crucial step where a beginner of research needs guidance. A good comprehension of the whole research project - the variables involved, the sampling procedures, the methodology, the limitations involved - all the factors operate at this stage of interpretative writing.

Finally after each section, it is advisable to summarise the results and their interpretations.

9. Some Hints

In order to increase the efficiency of this task of analysis of data and interpretation of results, the following hints may perhaps be useful.

(a) Do not use the same data or sample to device a hypothesis and again to test it. This should be done on different samples. Or the hypothesis may be made on the basis of some other source and tested on an appropriately selected sample.

(b) Statistical evidence does not provide positive proof the truth of a hypothesis. The essence of statistical testing is that facts are given a chance to disprove the hypothesis.

(c) Statistical evidence by itself is not enough to have confidence in a hypothesis. There must be a rational basis of it. The hypothesis should also fit logically into the relevant body of established knowledge.

(d) The researcher should be very careful in interpreting the results, after applying the statistical tests. Quite often, for example the researcher confuses between correlation and causation. A statistically significant correlation co-efficient simply implies that two or more variables tend to vary together in a given direction and not that one is the cause of another.

(e) The success of statistical tests depend upon the reliability of the data. A poorly collected data cannot be improved by any amount of statistical treatment.

(f) The ideological bias of the researcher (and sometimes of the guide) is a factor to be guarded against. This bias tends to tamper with the testing procedure, the formulation of hypotheses and eventually with the results. A good researcher approaches any problem with an open mind and keeps off ideological and personal bias from polluting the research.

Being continually conscious of these short comings is one way of improving the quality of interpretative writing.

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1. Bernard Ostle (1966) *Statistics in Research*, Oxford and IBM Publishing Co., 45-65.
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4. Gupta, S. P. (1972) *Statistical Methods*, Sultan Chand and Sons, Delhi 3·87-3·93.
5. Asthana, B. N. (1973) *Elements of Statistics*, Chaitanya Allahabad, Publishing House, 381-394.

CHAPTER 18

WRITING OF RESEARCH REPORTS

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Any research has to be described in writing so as to communicate ideas to the reader in a readily understandable form. Hence, while writing emphasis should be laid on the ideas or evidence to be communicated. A good thesis presents clear thinking, logical organisation of material, sound interpretation and an effective style of writing. Hence the preparation of the thesis is a difficult task.

Assignment writing at the tertiary level invariably takes the form of a term-paper, report, thesis or dissertation, as evidence of independent study. Students of the post-graduate degree courses of many universities are required to submit a thesis or dissertation. Even though the use of the terms thesis and dissertation differs from university to university, often the terms are used synonymously. A thesis normally represents a substantial report of original work carried over a period of at least one year. Some research involves the listing of the reported findings of previous research or testing the relevance of the findings of research completed in a different culture and/or country. The major purpose of the thesis writing is to inform and communicate to those interested the specific details about the problem studied and its results and the investigator's interpretation of the results, in a scientifically organised and acceptable pattern.

Overall Format of Thesis

Though the research reports may differ considerably in scope of treatment, they are expected to follow a similar pattern of style and form. The thesis begins with the statement of problem followed by an account of previous work done, description of the research undertaken, and ending with ideas for future studies.

Generally, the format of a paper consists of three parts : the preliminaries, the text and the reference materials.

The usual sequence of topics is as given below :

A. The Preliminaries

1. Title page
2. Preface and/or Acknowledgements (if desired)
3. Table of contents
4. List of tables
5. List of figures, illustrations, graphs, maps, etc.
6. List of appendices
7. Abstract or synopsis (if required)

B. The text or main body of the report

1. Introduction
   a. Statement of the problem - specific questions to be answered.
   b. Significance of the problem.
   c. Purpose of the study.
   d. Assumptions and limitations.
   e. Hypothesis (if any)
   f. Methods of the study (briefly).
   g. Definition of important terms.
2. Review of related literature or analysis of previous research.
3. Design of the study
   a. Procedures used.
   b. Selection of the samples and their characteristics.
   c. Method of gathering data.
   d. Description of data-gathering.
4. Presentation and analysis of data
   a. Summary of the data with tables, figure etc.
   b. Testing of the hypothesis.
   c. Tests of significance (if any)
   d. Discussion, interpretation and/or criticism.

5. Summary and conclusions
    a. Brief restatement of the problem and description of procedures used.
    b. Principal findings and conclusions.
    c. Recommendations for further research.

C. Reference Section
1. Bibliography
2. Appendix

A. The Preliminaries

1. Title Page

The first page of the thesis is the title page. This includes:
a. Title of the thesis.
b. Name of the candidate.
c. Name of the institution to which the thesis is being submitted.
d. Degree for which the thesis is presented.
e. Month and year of submission of thesis.

The title should be stated broadly but concisely and indicate the purpose of the study. It should indicate what exactly the thesis presents. For example, if the study is on the income and expenditure pattern of selected middle income rural families, an appropriate title may be "The Income and Expenditure Pattern of Selected Middle Income Rural Families in Coimbatore" and not "Income and Expenditure Patterns of Families".

The title should be in capital letters, double spaced and centred but where it is long to be centred on one line, an inverted pyramid form should be followed, without splitting words or phrases.

The format given for the title is also used for table titles. The title need not be underlined or written within inverted commas.

A Sample of the Title Page is given below :

THE INCOME AND EXPENDITURE PATTERN OF SELECTED MIDDLE INCOME FAMILIES IN COIMBATORE

by

Radhika, R.

A THESIS SUBMITTED TO THE UNIVERSITY OF MADRAS
IN PARTIAL FULFILMENT OF THE REQUIREMENT
FOR THE DEGREE OF MASTER OF SCIENCE
MARCH, 1975

2. *Preface and/or Acknowledgements*

The preface may include the writers' purpose in conducting the study, a brief resume of the background, scope, purpose, general nature of the research upon which the report is being based and acknowledgements. A preface cannot be written until the research report is in its final form. If the writer has little of significance to say about his thesis that is not already covered in the main body of his report, the preface may be omitted at the master's or doctoral level. In this case the page should be labelled 'Acknowledgements' rather than 'Preface'.

Acknowledgements are due to the persons to whom the writer is indebted for guidance and institutions for providing funds, personnel and other resources for the conduct of the study. Acknowledgements to members of the writer's family, librarians and clerical helpers are unnecessary. The acknowledgements should be simple and restrained.

3. *Table of contents*

The purpose of the table of contents is to provide an analytical overview of the material included in the study together with the sequence of presentation. Hence, this section should include the major divisions of the thesis and provide an outline of the contents of the thesis. Page numbers for each of these divisions are given. The chapter headings are generally capitalised and the sub-headings are in small letters with first letters capitalised. The titles of chapters and captions of sub-division within chapters should correspond exactly with those included in the body of the report. The title page, acknowledgements, list of tables, list of figures and list of appendices may or may not be entered in the table of contents.

The heading TABLE OF CONTENTS in capitals is centred at the top of the page. Two spaces below this, the heading page appears at the right margin. Below this are acknowledgements, list of tables and list of figures, if included. Below this, the heading *Chapter* appears at the left margin. Chapter headings are typed in full capitals without terminal punctuation and numbered consecutively in roman numbers. Sub-headings are normally indented two spaces under the main headings, the initial letter of the first word and of all nouns, pronouns, adjectives, adverbs and verbs being capitalized. Sub-divisions of sub-headings are further indented two spaces, but except for proper nouns, only the first word is capitalised. The final table of contents can be prepared only after the entire final draft of thesis is typed to enable the page numbers to be inserted.

A separate page is included for each list of tables, figures, illustration, graphs, maps and appendices. The heading LIST OF TABLES or LIST OF FIGURES should be capitalised and centred without terminal punctuation. Below this, the heading. Table, Figure or Appendix and page appear at the left and right margins respectively. The number of each table is generally given in roman numbers while Arabic numerals are used for numbering the figures and capital letters A, B, C or small Roman numbers for appendices. The Table, Figure and Appendix titles may be given in capital letters.

The exact title of the table, figure or appendix and the page number should be given:

A sample list of tables is given below:

LIST OF TABLES

7. *Abstract or synopsis (if required)*

An abstract is required in certain universities. An abstract consists of the following parts:

a) A short statement of the problem.

b) A brief description of the methods and procedures used in collecting data.

c) A condensed summary of the findings of the study.

Usually an abstract is short; within 200 words. In some cases the abstract is bound into the thesis; in others it is typed on a separate sheet and placed inside the front cover.

B. The text or main body of the thesis

In a thesis, this section may be divided into five chapters.

Chapter I. **Introduction**

The introductory section begins with a clear statement of the problem. The introduction must provide an appropriate orientation for the reader to understand the study. This may involve a history of the problem. Specific purpose of the study is described and all assumptions and limitations are recognised. If any hypothesis is formulated it should be given clearly. A brief statement of the method followed in conducting the study may also be given. Important terms are carefully defined to enable the reader to understand the investigation.

Chapter II. **Review of literature**

This section brings the reader uptodate by providing a background for the present investigation by reviewing the related literature in the field and abstracting the previous studies conducted by other investigators. This part of the thesis gives evidence of the investigator's knowledge of the field.

Chapter III. **Design of the study**

A well written description of the procedure used, provides sufficient detail for another researcher to reproduce the study. The description of procedures should include a reproduction of verbal directions given to the subjects.

If they are lengthy, they can be given in appendix. Selection of the sample and their characteristics should be identified clearly. Methods of gathering data should be explained and data gathering instruments used should be described and evaluated for validity and reliability.

If any apparatus is used, care must be taken to describe the same with figures. It is always advantageous to use standard apparatus.

Chapter IV. **Results and Discussions**

This section is the core of the thesis since this includes the presentation and analysis of the data. The results should be presented in a table followed by its explanation.

The table should be self-explanatory. Through tabular and graphic devices and discussions, the data should be critically analysed and reported.

Chapter V **Summary and Conclusions**

This section should include a brief restatement of the problem, brief description of the procedures used, the major findings and conclusions, representing the most significant results of the investigation. This may also indicate the side problems that have been uncovered. Suggestions regarding the areas for further research may also be given.

This section is the most utilised part of a thesis since the most significant information may be gathered from this.

C. Reference Section

1. Bibliography

The bibliography follows the main body of the text and is a separate but integral part of the thesis, preceded by a division sheet containing the word BIBLIOGRAPHY capitalized and centred on the page. The first page of the bibliography has the centre title, Bibliography. References are arranged in alphabetical order, the last name of the author listed first. Each entry is placed flush with the left margin of the page and subsequent lines are single spaced and indented five spaces. A double space separates the entries. If no author name is given, the name of the publication of the sponsoring organization is listed as the author.

If the number of references is large, the bibliography may be divided into sections, one for books, one for periodicals and one for special documents. Ordinarily a selected bibliography is preferable to an exhaustive list.

The following are a few of the formats used in writing the Bibliography :

1. Oser, B. L. (1965). *Hawk's Physiological Chemistry*, McGraw - Hill Book Company, London.
2. Anderson, J., Durston, B. H. and Poole, M. (1971). *Thesis and Assignment writing*, New Delhi. Wiley Eastern Private Limited.
3. Best, J. W., (1961). *Research in Education*, Prentice-Hall, Inc., Engle Wood Cluffs, N. J.

Journal

1. James, C., Cobey, A.B. and Nicholas Cunningham, (1968). *An Evaluation of a Local Calendar used in Determining the ages of children in a Nigerian Village*, Jl. Trop. Ped., 14, 132.

Language and style of writing

Since the aim of a research report is to convey information in a form which is readily accessible to other investigators, precision, clarity, simplicity of style and brevity are the cardinal virtues of writing a report. In a scientific report there is little place for emotions, personal bias, anecdotes and display of wit. The style of expression should be scholarly, creative and objective. Even profound ideas and concepts can best be explained in simple language and logically connected coherent sentences. Phraseology should be dignified and straight forward and it need not be dull and pedantic. Variety in expression should be one of the major aims to create incentive to read the report. The general style of the report is impersonal, and reporting is usually in the third person or in passive voice, avoiding first personal pronouns. When a reference is needed for oneself, the words like 'the experimenter', 'the investigator', 'the reporter' or 'the author' may be used.

Scientific reporting requires precision in writing. Indefinite terms of quantity, quality or frequency such as 'many', 'often' 'good' should be avoided. Certain terms like, 'majority', more than 80 per cent, may sound even statistically precise, but are not really precise as the range indicated is not clear and definite. Further, while presenting data, a meaningful level of precision should be aimed at, a level of precision suited to the level of the data and not beyond. For example, generally the mean is reported to one decimal place and the standard deviation to two places. Even this need not strictly be followed as long as reported values are meaningful. For standard practices in the matter of spelling, abbreviations, capitalization, punctuation, syllabification and grammatical construction, a good dictionary, a handbook of style and Roget's 'Thesaures' are helpful references. Rereading, revision and careful proof-reading ensure good reporting.

Typing the Report

When the completed manuscript of a thesis or research report is approved by the guide, it can be given to a typist, who is familiar with the mechanics of thesis typing. However, the investigator is responsible for the proper editing of the report and for proof-reading.

If the quality and size of the white paper to be used for the final copies are not specified, a good quality bond paper of about 4 lbs. weight is advised. The usual size of a thesis paper is quarto (8" x 10"). A regular paper may be used for additional copies. Medium-weight black carbon paper should be replaced often enough to insure clear and even copies. The typewriter should preferably have the Pica type which consists of ten spaces in one inch. Electric typewriters, if available, can be used as their performance is far superior. It is better to have a type writer that has the required symbols on the key board so that the hand work of adding them later is eliminated.

Headings

The thesis is divided into chapters and each chapter is likely to have divisions and sub-divisions of the text. The kinds of headings employed include centred headings, side headings and paragraph headings. In addition, each chapter has a chapter number and heading. Normally, major divisions have centred headings and sub-divisions have side and paragraph headings.

Pagination

To each page of the report or thesis, a page number is given, The title page or the initial page of each section such as chapter bibliography or appendix does not have a page number typed on it but a number is allotted for it in the series of pages. Page numbers in Arabic numerals are placed usually at the upper right-hand corner, an inch below the top of the page for the main body of the thesis, beginning from the first page of chapter 1 which is page 1. This has no page number typed on it but the next page is page 2.

The bibliography and appendix are numbered serially and consecutively, following the last chapter. For the preliminary section of the thesis small or lower-case Roman numerals are used in the centre, three-fourth of inch above its bottom edge. Correct pagination should be the final step. Preliminary pagination can be lightly pencil-marked for the scope of changes and corrections.

Quotations

Direct quotations not over three typewritten lines in length are included in the text, enclosed in quotation marks. Long quotations of more than three lines are single - spaced and indented three spaces from both left and right margins without quotation marks.

Footnotes

Footnotes convey matters such as sources of reference, additional relevant information on similar studies, criticisms on the subjects and other information that would interrupt the continuity of the text. Footnotes are used for various purposes. They help to acknowledge the sources of material quoted or paraphrased. In the interest of scholarly honesty, the source or authority must be acknowledged through the use of footnotes. They enable the reader to consult the sources of information independently. They also provide cross reference to other sections of a paper. Footnotes are used, in some situations to present explanatory statements, which would otherwise interfere with the continuity of textual material. There are very useful devices in writing a report but should be used sparingly.

a. Ibid : In consecutive reference to the same work, the latest abbreviation Ibid (ibidem means "the same work") is used. If the page number is different, the page number of the reference follows the abbreviation.

   1. Best, John,W. (1964). *Research in Education,* Englewood Cliffs, New Jersy, Prentice Hall Inc. Pp. 50-56.
   2. Ibid, p. 201

b. op. cit. : If the reference is made to the same work but does not follow consecutively and also to different pages, the abbreviation op. cit (opere citato means "the work previously cited") is used. Best, *op. cit.* p. 255

c. Loc. cit. When the references to the same work as a preceding but not immediately preceding reference, the last name of the author and the phrase Loc cit. (loco citato means, the place cited) are used. Young, *Loc. cit.*

Care should be taken to see that all footnotes are single - spaced, but are separated by a double space. The same bottom margin should be maintained on each page of the typescript, regardless of the number of footnotes.

Presentation of tables

The word, table is usually limited to the presentation of information in a tabular form where as 'Figures' (always spelt with a capital to distinguish them from numbers) is used for any other illustrative material such as graphs, photographs, charts, diagrams and maps. The term 'plate' is invariably used for photographic material.

While presenting the collected data of a thesis, tables are used to give a comprehensive idea of a mass of information. Tables should neither be too complicated nor too simple in composition. The same information should not be presented in tabular form as well as graphical form. Long and unwieldy tables should be placed in the appendix or divided into several tables or reduced by photostating to the page size. In the case of unavoidable need of folding a wide table it should be turned sidewise, with top facing the left margin or binding.

A table should appear as soon as its mention is made in the body of the thesis. If a table is large enough to occupy more than a half page, it should be placed on a page by itself, carefully centred for a balanced effect. If a table occurs on the same page where its discussion is made, only the number of the table should be given in the content. But when a reference is made to a table at a page other than where it is given, the number of table as well as the page should be mentioned.

The tables, in the whole of the thesis including those in the appendix, are given consecutive numbers in Roman capitals. The capitalized word "TABLE" followed by the appropriate Roman numeral is placed at the centre two spaces above the title. Each table must have a title. indicating its contents. It should be two spaces below the word "TABLE" and should be written in full capitals, ending with a full stop. If the title runs to two or more lines, it should be arranged in the shape of an inverted pyramid. If a table is borrowed from any other source, it should be properly acknowledged in a footnote below the last horizontal line of that table.

Figures

For the preparation and presentation of Figures, a number of useful suggestions has been given by the American Society of Mechanical Engineers.[1]

1. The general arrangement of a diagram should proceed from left to right.
2. Where possible, represent quantities by linear magnitude, as areas or volumes are more likely to be misinterpreted.
3. For a curve, the vertical scale, whenever practicable, should be so selected that the zero line will appear in the diagram.
4. If the zero line of the vertical will not normally appear in the curve diagram, the zero line should be shown by the use of a horizontal break in the diagram.
5. The zero lines of the scales for a curve should be sharply distinghished from the other co-ordinate lines.

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1. Report of the Joint Committee of the American Society of Machanical Engineer's on Standards for Graphic Presentation.

6. For curves having a scale representing percentages, it is usually desirable to emphasis in some distinctive way the 100 per cent line used as a basis of comparison.

7. When a scale of the diagram refers to dates, and the period represented is not a complete unit, it is better not to emphasize the first and last ordinates, since such a diagram does not represent the beginning and end of time.

8. When curves are drawn on logarithmic co-ordinates, the limiting lines of the diagram should each be of some power of ten on the logarithmic scale.

9. It is advisable not to show any more co-ordinates line than necessary to guide the eye in reading the diagram.

10. The curve lines of a diagram should be sharply distinguished from the ruling.

11. In curves representing a series of observations, it is advisable whenever possible to indicate clearly on the diagram all the points representing the separate observations.

12. The horizontal scale for curves should usually read from left to right and the vertical scale from bottom to top.

13. Figures for the scale of a diagram should be placed at the left and at the bottom or along the respective axes.

14. It is often desirable to included in the diagram the numerical data or formulas represented.

15. If numerical data are not included in the diagram, it is desirable to give the data in tabular form accompanying the diagram.

16. All lettering and all figures in a diagram should be placed so as to be easily read from the base as the bottom, or from the right-hand edge of the diagram as the bottom.

17. The title of a diagram should be made as clear and complete as possible. Subtitles or descriptions should be added if necessary to ensure clearness.

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CHAPTER 19

DISSEMINATING RESEARCH FINDINGS

K. Kulandaivel & N. S. Narayanaswamy

The Need

Research begins when there is a problem. Either the researcher himself identifies the problem or the problem is posed to him by others. In the field of education the problems may be posed by the teachers, or educational administrators or professional associations or by Government or institutions like N.C.E R.T. Once the research is conducted and solutions to the problems are found it is the duty of the researcher to report the findings to those who have posed the problems to him or who have financed the research project. Even if no body has posed the problem but the researcher himself has identified the problem and conducted research he should report his findings to fellow researchers so that they can understand his findings and proceed further in that area.

Imagine for a moment how we will be today if all the researchers in the world have not published their findings and kept them as secrets to themselves. We would not have had all the scientific and technological instruments and facilities we are enjoying today. In some of our villages some people have the technique of preparing effective medicines for snake bite or some diseases. But they keep the method of preparing them as secrets and do not tell them to anybody. So when they die their techniques also die with them and are completely lost for future generations. The same would have been the fate of scientific discoveries and inventions if the scientists and researchers had not published their findings. So it is very essential that all research findings should be published and made available to those interested in the field and lay public.

Consumers of Research Findings

Who are the consumers of these publications? To which type of readers should these publications be designed? There are three types of consumers who may need research findings. First is the experienced research workers, research associations and professional organisations who will need our research reports with all the sophistications of research. They will study our entire report critically and assess its worth, accept it if it is sound and reject it if it is superficial. Once it is accepted it becomes a new addition to the volume of knowledge already accumulated. It also brings name and fame to the researcher. So it is essential for every researcher to publish his report in detail for the expert consumers and for adding to the body of knowledge.

The second type of consumers are the new entrants to the field of research. They will not be able to digest the detailed sophisticated report, but at the same time need the outlines of the problems, design, methodology, data and findings. These will help the new entrants to understand the methods and outcomes of research and plan similar researches in other areas. These serve as introduction to research for these novices.

The third type of consumers are the lay public who would like to apply these findings in daily life and derive the benefit. These are the beneficiaries of research. Like the water stored in a dam has ultimately to reach the farmers living the remote villages and irrigate their lands, the findings of research has to reach the nooks and corners of the country by means of suitable publications and benefit the people.

Methods of Publication

There are several ways in which the research findings can be published.

1. For the first type of consumers the research report should be published as it is in toto with all details and presented for critical review and acceptance. The cost of publications should be included in research budget and funds should be got sanctioned. The agencies like U.G.C., I.C.S.S.R. and N.C.E.R.T. may also be approached for funds to publish the research reports. These publications should be sent to all the important research workers, research associations, and professional organisations in India and outside.

2. If it is not possible to publish the report in full, it may be published part by part in some leading journals. Orders may be placed for reprints and these reprints may be bound together and got up as full report

3. Another method is to duplicate the report by using stencils, printing the cover page and binding them together. This does not cost as much as the printed publication.

It is possible to sell these publications and recover the money invested. For this it is necessary to establish contact with leading publishing agencies, print them attractively and push the sales as the Madras Institute of Developmental Studies publishes its reports through Sangam Publications. The researcher should not waste his time thinking about the details of publications, pushing sales and keeping accounts.

4. For the second type of consumers, who are the new entrants into the field of research a less sophisticated publication may be adequate. Abstracts of the research reports or theses may be prepared and published in journals. In some universities it is required of the students submitting the theses to prepare and submit abstracts also along with the theses. These abstracts may be published as they are or abstracts may be specially prepared with the details necessary for the second type of consumers and published "The Journal of Educational Research and Extension" published by the Sri Ramakrishna Mission Vidyalaya Teachers College publishes abstracts of the M.Ed. theses and these are found very useful. More copies of these abstracts may be printed and they may be bound and published as abstracts of theses done in one year in a couple of years. Some colleges prepare abstracts for each thesis in two or three pages and publish every year or every alternate year the abstracts of research work done in their colleges. These are very useful to research students. They will give them a bird's eye view of all the researches done in an institution or organisations.

5. The third type of consumers, viz., the lay public are not interested in the details of research, but are interested in the

findings and in applying them in the life to solve the problems. For them the findings and how they solve the problems should be presented in the form of small articles or news items. They should be clothed in simple words that ordinary people can understand. These articles may be published in journals or in newspapers which will reach more number of people. Leaflets and pamphlets containing the findings of research and their applications may be published and circulated among the interested people. Organising seminars, and discussions groups to discuss the findings of research and giving publicity to the proceedings is another method of publication. The commercial institutions which gain by these researches may be encouraged to give publicity to these research findings and educate the public. All India Radio and the Publicity Departments may also be requested to broadcast these findings or exhibit them in the documentaries. Periodical exhibitions may be organised during the local festivals or celebrations in the institutions and the research findings and applications may be published.

Communicating the findings to the relevant people

Some of the research studies are of great importance to the people of certain locality or administrators of the certain departments. For example the findings of the study "The Survey of sanitary facilities in the elementary schools of Perianaickenpalayam Panchayat Union" will be of great interest to the Panchayat Union Chairman, Commissioner, the Panchayat Presidents and the enlighted public in Perianaickenpalayam Panchayat Union Area. It may not be of much interest those living in Madras or Thanjavur. Similarly the findings of "Problems of the Government High School headmasters and headmistresses" will be of interest to all headmasters and headmistresses, the District Educational Officer, Chief Educational Officer, the Director of Education and the Education Department. So the findings of such studies should be communicated to the interested people and seminars may be organised to discuss the findings and how to apply them.

A number of research studies are being conducted in our colleges and universities both at the Masters Degree and Doctorate Degree level. But unfortunately the findings are not made known to the public. So much so research becomes simply an intellectual exercise of the research students without any social implication. While it is true that for the research student this is a training in research, it need not be useless to society. There are innumerable problems that we face in our society at all levels. Each research student can choose in his or her field some genuine problem the people are facing and try to solve it. He should make known his efforts and results to fellow students like him and to the interested public so that others can benefit by his findings. We understand that in Russian universities the candidate has to defend his thesis in front of an audience and answer questions. This will make the student alert to his responsibilities to the public and interest the public in what goes on in the colleges and universities. Some such steps may be taken by our universities also.

The Universities and the U.G.C. may be requested to circulate every year the research studies under progress in the colleges in the university area and in the universities in India. This will help the research student and guide understand the studies conducted in other colleges and get into contact with them to compare the methodologies adapted and the findings derived. This will enable the research students in the countries to come nearer and publish their findings, and benefit from one another. This will also increase the need for publication and the thirst for published materials.

The Techniques

The term "dissemination" or "diffusion" has been commonly used to describe the process of spread of new ideas or research findings among the people. How a new idea from its source of invention to its use in a social system gets diffused, has also been the focus of attention of sociologists. According to Rogers, "Diffusion is the spread of a new idea from its source of invention or creation to its ultimate users or adopters.

In the past ideas were transmitted generally between individuals or groups through word of mouth in conversation. These individuals or groups exchanged the messages in turn with others and findings and in applying them in the life to solve the problems. For them the findings and how they solve the problems should be presented in the form of small articles or news items. They should be clothed in simple words that ordinary people can understand. These articles may be published in journals or in newspapers which will reach more number of people. Leaflets and pamphlets containing the findings of research and their applications may be published and circulated among the interested people. Organising seminars, and discussions groups to discuss the findings of research and giving publicity to the proceedings is another method of publication. The commercial institutions which gain by these researches may be encouraged to give publicity to these research findings and educate the public. All India Radio and the Publicity Departments may also be requested to broadcast these findings or exhibit them in the documentaries. Periodical exhibitions may be organised during the local festivals or celebrations in the institutions and the research findings and applications may be published.

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In the past ideas were transmitted generally between individuals or groups through word of mouth in conversation. These individuals or groups exchanged the messages in turn with others and thus it spread far and wide in course of time. This is how the message of Rama, Buddha and Christ spread far and wide from one country to others. There were then no means to expedite the transmission of message except through intensive touring and passing on the message to as many people as possible expecting that the listeners would spread it further. It however took considerable time to spread.

In a rural situation it is possible to educate illiterate home-makers and farmers by arranging informal learning situations to impart or disseminate research findings which would stimulate the desired response in the particular cultural setting.

Hence through the process of communication, people could be educated and stimulated to accept the change towards progress and betterment of the home and family. If the research findings are the solutions for the problems or needs badly encountered or felt by the people, the receptivity of those findings is very high. Science and technology are contributing greatly to the development of communities which aims at raising standards of living at all levels. This technical knowledge needs to be reached and understood by people at various levels. To achieve this, improvements in the communication system and study of how people learn is an important aspect for the scientist. The emphasis is upon the scientific inquiry concerned with understanding the ways in which the system of communication influences people to accept the recommended practices.

Adur Reddy opines that people vary greatly in their knowledge, attitudes, skills, their position in the "diffusion process" and in the "adoption categories", their educational training, age, income level, social status, religious beliefs etc. Some are progressively seeking change, others are slow to change. Some are "eye minded" while others are "ear minded". These individual and collective differences influence the teaching approach. For instance, people with little or no education and low income may respond to personal visits and result demonstrations. The better educated and the more progressive elements of the population, usually respond well to methods like group meetings and discussions, exhibits and written materials.

He also advises if we want merely to inform or influence a large number of people slightly, we should use mass media. If we want to influence a relatively small number of people to make maximum improvements, we should resort to individual contact methods. If we want to change the attitudes or arrive at a consensus of opinion, arrange group discussion or work through village leaders. If we want to teach a skill, use the method demonstration; where the new practice is simple or familiar, the news article, radio or circular letter will be effective, whereas complex or unfamiliar practices will require face to face contacts, written materials and audio-visual aids.

But always combination of methods is good to disseminate any information. For instance Nagoke quotes that combined use of several different methods is of atmost importance in extension teaching and disseminating the findings to the people. The adoption of practices is high when more than five methods are used as compared to single and two to five methods.

According to Ramakrishnan the important media, means and methods of communicating new information, knowledge and skill are meetings, appraising local leaders, demonstrations, field tours, exhibitions and fairs, setting examples, poems, songs and stories, written and printed material or literature, the spoken word, farmer's days training programmes, indirect or direct legalised compulsion, institutions, schools, colleges, youth clubs, non-official organisations, co-operatives and panchayat organisations and audio-visual aids.

A study on "the utilisation sources of information in relation to adaption of improved agricultural practice" by Singh and Jha reported that out of various information sources and communication channels used in their study, demonstration was the most effective followed by exhibition, filmshows, radio, newspaper, including leaflets, bulletins and other published matters.

Bose studied the "communication channels for Agriculture Research" observed that farmers came to know about innovations from the progressive farmers of their caste and from other experienced farmers.

The findings of Sharma and Dey on "Relative effectiveness of radio and T. V. as mass communication of agricultural information" suggest that for better interpretation leading to more gain in knowledge of the innovations through radio, use of other sources of information play vital role in enhancing listeners comprehension.

From the study "communication behaviour of Kosi farmers in relation to high yielding varieties programme" by Singh and Sahay, it is known that that in the progressive village, personal cosmopolite sources and mass media provide information to the majority of the farmers.

In 1972, Shulty and Riggs undertook a study on "Reaching young home makers" found that mass media can bring current knowledge to young families who often do not search for it unless a permanent need exists. Mass media such as news letters make young families aware of new ideas and often suggest further reference. Research in diffusion process has shown that mass media are most effective in the awareness and interest stages of the process. More people become aware of new ideas from mass media than by any other sources.

Home practices are an integral part of the social and cultural organisation having a deep root in the values, systems, traditions and the religion of the society. Through education that is, dissemination of information or knowledge, it will be possible to make the rural people aware of existing undesirable practices, so that with the realisation of the undesirable, an understanding the need for deviation from the usual will be developed. After comparing the existing practices with those recommended, the homemakers or the farmers can be motivated to gain knowledge and accept the recommended change in their behaviour. The goal of dissemination of knowledge or information or research findings is to bring about an improved way of living and family and community welfare.

When disseminating an information one must know the situation and the factor that facilitates the acceptance or adoption of the new ideas or innovation.

Inter personal communication involves a face to face relationship between the communicator and the recipients and thus is of a direct nature based on personal contacts. Information are to be treated in such a way that they can be effectively transmitted through the channels of communication to the recipients. The way messages are treated determines the quality and quantity of the stimuli and to what extent the audience may be motivated to respond. If the audience is required to be involved emotionally then the message is to be treated and presented in such a way that it evokes an emotional response. The same message can be treated differently so as to invoke the audience intellectually. By treating message, the appropriate pattern of stimuli could be designed, which would to some extent determine the kinds of responses the audience might have. Therefore it is essential to understand and know what kind of response is required in meeting the objectives of a particular programme of education. Information are to be treated keeping in mind the general and specific objectives of the programme, psychology of learning interests, needs, attitudes, level and the cultural pattern of the recipients.

Rural people are illiterate and have not been exposed to formal learning and teaching situations. They do posses intelligence and are able to undergo mental process of 'learning', 'perceiving analysing reasoning', 'establishing the relationship', 'generalizing' 'remembering' and 'putting knowledge into practice'.

The interaction begins when the recipient is exposed to messages. Messages may be altered by recipient as the pattern of interaction continues according to their orientation, cultural setting, previous knowledge, aspirations and expectations, values, attitudes, and group influences.

Now a days we can see the newspapers, books, radio, cinemas, disseminating new and improved information to the people so as to change their attitudes towards better goals.

Messages can be diffused through many media ie. talk, mass meeting, drama, radio, pamphlets and literatures and visual aids.

Farm people want knowledge to improve themselves and their community.

They want knowledge to improve their ways of living and their living itself. Scientists and technicians who are always in the pursuit of knowledge have what farm people want.

Farm and home advisers, Extension workers and information people obtain the knowledge from the scientists, interpret it and select out of it what the farm people want and communicate it to them.

Today a large number of people are engaged in this process of passing on knowledge, of diffusing it among our farm people. They are communicating ideas, thoughts, impressions, feelings, or information to enable farm people to learn new skills or do old things in a new and better way.

In communicating information to a large member of people and creating the desired impact on them, we have to make use many media particularly the mass media such as the news papers, magazines, leaflets, posters, exhibits, films and the radio. All these media have to be so co-ordinated that the same information is given out in different forms to the same audience at the appropriate time or times. While with person to person contact we can more easily communicate information, this method cannot be used for conveying information to a large number of people speedily. Some of the mass media such as the radio, posters and exhibits, can reach a vast number of people quickly, but through them only essential information could be conveyed. The radio has another handicap. It appeals only to the ear and unless one is listening very carefully, the message will not be received. The press can provide more information than the radio. The leaflets and bulletins can give more details than the press can do. But they suffer from the handicap that they can reach only those who can read.

Ours is the golden age of newspapers and magazines, of bulletin and brochures. The world is full of readers, waiting for interesting material to be read. Words are pouring out of the printing presses every minute of our lives - thousands and millions of words directed towards different audiences and serving different tastes Newspaper stories, magazine articles, leaflets, pamphlets bulletins, circular letters, publications, wall newspapers and radio scripts are increasingly being written by extension people, and read or listened to. The written word is helping make advisory work with farm people more interesting.

Publications like leaflets and folders, pamphlets and bulleitin written for the common people giving details of the innovations from what is called literature.

The leaflet is a basic document. It is a source material for other media of communication. It serves the specialist well in his farm group contacts.

Leaflets are mostly for giving a how-to-do or process story, a set of improved practices to be followed in growing a crop, or the steps to be followed in solving a home or farm problem.

Its lead can be simple and direct, and does not need any suspense element in it, so can be the rest of the writing. The facts are listed in a logical and time sequence. Each paragraph contains one main fact with its supporting sub-facts. Since the leaflet is more for helping farm people take up a new practice or practices, it has to provide all the information needed by them for putting ideas into action.

Many prefer to list the ideas and sub-ideas one below the other, without enlarging them into complete sentences or paragraphs (unlike in other forms of writing). This helps in pinpointing the number of things involved, and the order in which they are to be taken up. This also helps in giving the reader a feeling that what he has to do is simple and easy.

Illustrations play a bigger role in a publication than they do in a magazine story. This makes the publication more attractive, and helps the reader understand and remember all the facts better. In fact, some subjects lend themselves very well to be given mostly in the form of illustrations with very little of supporting text.

Radio has opened a new era in the field of mass communication. It can be useful in establishing better relationship among individuals, groups and communities. It reaches every-body and educates mass mind. Through radio man can send his thoughts to millions of people in short time. It can create a sense of participation provided the programme is well chalked out.

Popular newspapers, magazines, radio, television and cinema are important mass media. But films are the most powerful instruments which have today exerted great influence on the minds of the people. Millions of people go to films and are influenced by them. Consciously and unconsciously films are one of the most effective means of arousing interest. Information could be disseminated to a large number of people-literate or illiterate through the films.

Short films like documentaries and news reals now have assumed the proportion of a movement playing a very significant role in a mass communication media. They provide information and education to the masses.

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CHAPTER 20

THE NEED FOR RESEARCH ORIENTED COURSE AT THE POST-GRADUATE LEVEL

N. Krishnamurthy, Pitchai, Chandramani & Janabhai Giri

The economic and cultural development of a country depends upon its educational system and the success of the educational plan depends upon the curriculum[1]. If the curriculum is not salutary, batches of young ones in the whole country would be wrongly moulded and for generations the nation would suffer. By changing the pattern of curricula, countries like Japan, China, Russia and France have achieved marvellous progress.

Importance of Research

In India the importance of research in educational development is being increasingly felt. This is done to the fact that in highly developed countries education has become more and more effective and purposeful because of the flourishing of research. In Russia, students at Soviet Higher Educational Foundations take part in research work as part of their regular studies. A tenth of all their graduation projects are devoted to actual problems and have a practical application.[2]

Role of Educational Institutions in Promoting Research

In any country, colleges and other educational institutions are considered to be temples of learning, abodes of knowledge and marks of civilisation and culture, helping the community they serve, to develop in the social, economic, educational and cultural fields. But colleges affiliated to traditional universities in India are far from their ideal. They stand as isolated islands away from the communities with a one-way path only drawing students therefrom.[3] They merely impart bookish knowledge and that too mostly borrowed from western countries. The education imparted is not related to life around and there is a wide gulf between its content and purposes and the needs and aspirations of the people.

It is high time that the colleges in India change their pattern of education and communicate knowledge that would benefit the local community and the nation at large.

In order to develop the colleges into centres of nation - building activities and integral parts of local communities disseminating useful knowledge, teaching imparted should be combined with research and extension. Only when teaching is based on practical knowledge of real life, it could be effective and purposeful. Practical knowledge could be acquired only through research; they could be made useful to the society through extension work. This is no doubt an important point strongly in favour of integrating research with teaching.

Impact of Research on the Student

Undertaking research helps a student to grow intellectually and develop wholesome habits. A research project calls for a good deal of creative thinking, thoughtful planning, scientific approach, skill in handling unforeseen situations, manual skill, critical observations and careful expression. It induces the student to make an orderly analysis of the problem so as to reach a definite goal. According to NCERT reports the following faculties are developed in a student who undertake a research project :

1. The spirit of enquiry or the desire to get knowledge
2. Creative tendency to make new things or improve existing things.
3. A clear and consistent process of thinking and linking up of observations by interpreting the data intelligently, and
4. Ability to use one's hands and figures quickly and skilfully to keep up the tempo of the experiment.

A student who undertakes research is very likely to develop scientific attitude to the problems of life in general; because when he develops a project his creative ability is directed in fruitful channels and this enables him to acquire certain characteristic habits and positive attitudes in life.

Stage of Education at which Research could be introduced

In colleges it may not be possible to undertake much basic research for two reasons :

1. the courses offered have a time limit

2. the resources of a college are limited. However considerable amount of applied and action research may be done in colleges in the fields of Medicine, Agricultural Sciences, Agricultural Economics. Sociology, Social work. Engineering technology. Home Science, Bio-chemistry etc. Thus it is quite evident that research should become an integral part of education. The question that one faces is " At what stage of education should research form a part of the regular curriculum?"

If some kind of simple, inexpensive, project work could be introduced at the high school level it could indeed be ideal. India is a developing country. Even after twenty seven years of independence our literacy level is only twenty nine per cent despite the fact that primary education is free in all states. Our resources are slender and hence it would be out of question to suggest under the present conditions, the introduction of research or project work at the school level. Considering higher education, the Pre-university classes are large and unweildy and hence project work cannot be made compulsory. But at the undergraduate level it can certainly be introduced. Well, our Government and educationists do not prefer it. We only hear now and then a solitary voice pleading in favour of it.

Need for Research at the Post graduate level

Whatever might be the reasons for not introducing research at PUC and undergraduate level there is every reason for introducing research at the Post-graduate level. The reasons are (1) The numbers enrolled are few (2) the best students are admitted (3) the students have sufficient basic knowledge and maturity (4) they have the thirst for knowledge and aptitude for creative work (5) only experienced and highly qualified teachers handle the

vii. Possibilities of using indigenous materials for home construction and home beautification

viii. Planning houses

ix. Designing labour saving equipment

x. Tackling food adulteration and rising prices.

xi. Creating consumer consciousness.

c) *Child Development*

i. Various aspects or organisation and administration of pre-schools

ii. Human relationships at home and outside

iii. Marriage and adjustment

iv. Growth and development of children-physical, social, emotional and mental.

v. Factors promoting children's health, their recreation and education

vi. Child practices

vii. Welfare programmes for children - normal and handicapped.

d) *Clothing and Textiles*

i. Printing and dyeing

ii. Care of clothing

iii. Designing and dress making

iv. Standardising measurements for different age groups and different figure types.

v. Study of the new fabrics available in the market

vi. Consumer's problems regarding clothing and textiles.

e) *Home Science Extension Education*

i. Leadership among women and youth

ii. Community organisation

iii. Impact of community development and Panchayat Raj on different categories of people.

iv. Evaluatory studies on personnel involved in extension work
v. Programmes of community development
vi. Suitable methods for effective communication
vii. Functional, literary and adult education

II. Areas of research in Physics at Post-graduate level

i. Effect of heat generated in engines in industries
ii. Harnessing solar energy
iii. Development of solar batteries

III. Areas of research in Chemistry

i. Chemical aspects of atmospheric pollution
ii. Improvement of cotton fibre by chemical methods
iii. Development of different types of dyes
iv. Quality improvement of alloys
v. Corrosion of metals used in industries
vi. Production of high yielding varieties of grains by radiation
vii. Preservation of foods
viii. Treatment of sewage water
ix. Desalting of water
x. Detection of Food adulteration
xi. Production of substitutes for scarce materials like cement.

IV. Areas of research in Biochemistry

Biochemistry is a comprehensive and rapidly growing subject. It embraces many fields such as Agriculture, Engineering, Animal Husbandry, Pharmacology, Physiology, Medicine, Molecular Biology and Microbiology. It is concerned with the chemistry of all living things-plants and animals. Hence there is vast scope for research in Biochemistry. There are scores of problems in the community which need the attention of a biochemist. To illustrate:

i. In the industrial city like Coimbatore water and the atmosphere are highly polluted. The effect of pollution on human beings and plants and animals living both on land and water would make an interesting and useful study.

ii. A study on the diseases characteristic of the region like fluorosis and leucoderma may help to eradicate the diseases.

V. Areas of Research in Physical Education

There are many areas in Physical Education that can be explored with the minimum facilities available at post-graduate level in physical education in India. For instance, all education as well as physical education programmes should be based on a thorough knowledge of the needs, interests, aspirations and characteristics of different ethnics groups. We have little information on this aspect about our children. Hence research studies could be undertaken in the following fields.

i. Physical fitness
ii. Administration and curriculum development
iii. Psychological and biological aspects of physical education.

VI. Areas of research in Sociology

i. Health hazards to workers in industries
ii. Collection and analysis of socio-economic problems of students.

Students point of view on research

It was felt that it would be highly interesting and informative to ascertain the views of post-graduate students, on this vital subject, "the need for research at post-graduate level". So a questionnaire was administered to one hundred and fifty two post-graduate students in the final year, in thirteen different subjects namely Chemistry, Biochemistry, Physics, Home Science

Education, Physical Education, Social Work, Cooperation, Electronics, Statistics, English Literature, Economics, and Botany comprising a well represented sample.

An analysis of the responses revealed that ninety four out of the one hundred and fifty two students coming from seven disciplines namely, Home Science Education, Physical Education, Social Work, Cooperation, Electronics and Statistics had project/thesis or both as part of their post-graduate studies. The remaining fifty eight students majoring in English Literature, Economics, Physics, Chemistry, Botany and Biochemistry do not have thesis or project included in their curricula. Therefore the answers for several subsequent questions were analysed keeping in view these two broad categories - students doing research at post-graduate level and students who do not have such research experience.

One hundred and forty two students constituting ninety four per cent of the total sample answered in the affirmative to the question as to whether their subjects lend themselves for doing research. There was no difference observed in the opinions of the two groups studied.

It was heartening to note from their answers to the questionnaire, that the post-graduate students irrespective of whether or not they did research as part of their course were aware of the numerous benefits resulting from doing research. This denotes that the time has come and the climate has been created for the policy makers at the University level to introduce changes in the present day educational system.

Besides a general scrutiny of the benefits derived from research, a special attempt was made to analyse the viewpoints of those students who do not at present have research included in their educational system. It was interesting to note that eighty per cent of this category expressed their desire to have research at post-graduate level. They envisaged wider experience and practical knowledge, greater scope for developing one's abilities, better insight into the problem of the community as the major outcomes of such research. On the otherhand the remaining twenty per cent did not want research at post-graduate level because they were worried that it would be adding to the burden of the already overcrowded syllabus to be completed within a short time.

Thus this brief study indicates that students are also in favour of the introduction of research at the post-graduate level.

Conclusion

The colleges and students will not take real interest in undertaking research programmes unless research is made an integral part of the M. Sc. curriculum. A research project if undertaken on the lines indicated not only would make the student gain the skills already enlisted but also make him understand the problems around him and his role and responsibility as a member of the society, in alleviating human misery. It would further inculcate in him first the feelings of devotion, selfless service and dedication to the nation. Hence there is every need for research oriented course at the post-graduate level.

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CHAPTER 21

DIFFICULTIES IN CONDUCTING RESEARCH-STUDENTS' POINT OF VIEW

N. Krishnamurthy, R. Pavanasam & S. Sithalakshmi

Introduction

Research, as a guide to developing new practices has been accepted in many disciplines like Agriculture, Medicine, Home Science. Physical, Biological, and Social Sciences and Education. Research has found its place in the post-graduate courses too and students are having projects or dissertations or thesis, as the case may be, as a partial fulfilment to earn their degrees at Masters' level. The students of these courses select some problems for their research work and conduct their work under the guidance of a teaching staff of the institution. While the full time students have to do the research work along with their course work, the part-time students of certain disciplines in education, physical education, agriculture etc. can undertake research work, after finishing their theory and practical examinations.

The weightage given to research work in terms of papers or marks varies from course to course. In the same way, the minimum requirement for passing and also the statement of marks in grade sheets vary among the different disciplines. However, the underlying purpose in providing research experience to post-graduate students in general, remains the same. The aims of students in undertaking research, the benefits derived by them through such research, the areas of research they are interested in, the difficulties they face while doing research and their suggestions were studied in order to get students' view points on research.

To collect material for this study, all the arts, science and teacher training colleges in Coimbatore where there are post-graduate programmes were approached. The total sample consisted of 152 post-graduate students in the final year majoring in 12 different subjects namely Home Science (with five branches) Education, Physical Education, Social Work, Co-operation, Physics. Statistics, English Literature, Economics, Chemistry, Botany and Bio-chemistry. The data were gathered by administering a specially prepared questionnaire, after obtaining permission from the respective Principals and Heads of Department.

An analysis of the sample revealed that 94 out of the 152 students coming from six disciplines namely Home Science, Education, Physical Education, Social work, Co-operation and Statistics reported that they have projects/thesis or both as part of their post-graduate studies. The remaining 58 students majoring in English Literature, Economics, Physics, Chemistry, Botany and Bio-chemistry do not have research included in their course. However the students majoring in Physics in Sri Ramakrishna Mission Vidyalaya Arts College are provided with project experience, through the curriculum of this course does not demand the same.

The interest of the students in undertaking research was noted by studying their aims in undertaking the post-graduate course. points of view on the benefits accuring from research and opinions regarding inclusion of research experience at the post-graduate level.

1. Aims of students in undertaking post-graduate students

"To get a decent job" was stated to be the aim in joining the post-graduate course by 54 per cent of those who have research included in the course and 50 per cent of those who do not have research at post graduate level. Widening knowledge was reported to be the aim by 44 per cent of the total sample. The other aims mentioned were

to improve professional qualification

to prepare themselves for advanced studies and research work

to get masters' degree

to acquire a good status in the society

to serve the nation

to fulfil personal interest in the subject

to get higher salary and promotion in jobs

to support oneself

to spend time usefully and make use of available opportunities

to go abroad

and to fulfil parents' wishes.

The aims are varied in nature and reflect the great expectations students have during the course of their studies.

2. Benefits obtained by doing research at post-graduate level

One hundred and forty two (142) students constituting 94 per cent of the total sample answered in affirmative to the question as to whether their subjects lend themselves for doing research. There was no difference observed in the opinions of the two groups studied. Practical, advancing and dynamic nature of the subjects, scope for application of findings of research in the day to day life, lack of earlier research in the field, scope for obtaining a broader perspective of the subject through research, possibilities for exploration of the subject and developing novel ideas and concepts and preparing for jobs in the future, were given as reasons for their answer.

As far as benefits in doing research were considered, both the groups gave a number of benefits as given below:

1. Widens knowledge in the subject and experiences of students
2. Students are given the taste of Methodology of research and are prepared for advanced research at a later stage.
3. Students gain practical experience in the field.
4. Students are able to specialize in one area.
5. Qualities such as originality, individuality, self confidence and self reliance and will power and determination are instilled in students.

6. Research enables one to work for and work with the community around.
7. Scientific and research attitudes and creative thinking are inculcated in students.
8. Research prepares a student to face the challenges of life.
9. Research experience provides for wider job opportunities.
10. A spirit of team work among the students and guides is developed through research.
11. Research improves the standard of the post-graduate education.

It is heartening to note that the post-graduate students irrespective of whether or not they do research at present, are aware of the numerous benefits the experience offers to the students. This denotes that the time has come and climate has been created for policy makers at the University level to introduce changes on the present day educational system.

3. Opinions of students regarding inclusion of research experiences at Post-graduate level

Besides a general scrutiny of the benefits derived from research, a special attempt was made to analyse the view points of these students who do not at present have research included in their educational system. It was interesting to note that 80 per cent of this category expressed their desire to have research at Post-graduate level. They envisaged wider experience and practical knowledge, greater scope for developing one's abilities and better insight into the problems of the community as the major outcomes of such researches. On the otherhand the remaining 20 per cent of this group did not want to undertake research at Post-graduate level, owing to their fear of examination and they were worried that research would be adding to the burden of the already over crowded syllabus to be completed within a short time. This fact also needs the consideration of all who are involved in changing the system of education and examination.

An analysis of the research work being done by the students and also what they consider as the areas worth exploring revealed that students give importance both to fundamental as well as applied research. Even those who do not have research experience at present are able to suggest current problems for further study which reveals their great interest, scientific attitude and awareness about the national needs. These students also evinced great interest in undertaking research oriented vocations in their further life.

5. **Difficulties of students while undertaking research**

The study revealed difficulties of students in undertaking research mainly in the following areas:

1. Selection of the problem
2. Selection of the subjects/sample
3. Conducting the study
4. Writing the report
5. Other difficulties

1. *Selection of the Research Problem*

The following problems were encoutered in selecting the research problem :

a. Choosing the specific area of research from the vast field of study.

b. Coining the exact title of the problem

c. Inability to choose topics of personal interest (imposition of the research problems on the students)

d. Lack of clear understanding of the nature of the problem chosen.

e. Inadequate knowledge to prepare the research design.

and f. Non availability of specialists in the field for consultation purpose.

2. *Selection of the subjects/sample*

In this area the difficulties experienced were as stated below :

a. Inability to conduct interviews

b. Language problem on the part of the students

c. Illiteracy of the sample

d. Suspicion, on the part of the sample to give frank and correct answers.

e. Sample being wide; spread over a large area.

f. Difficulty in obtaining permission from officials and working with them.

3. *Conducting the study*

The following bottlenecks were faced in conducting the study :

a. The study taking great amount of time

b. Difficulty on the part of students to travel to places of study.

c. Study being expensive

d. Lack of facilities such as equipment and materials.

and e. Absence of proper guidance and motivation from the guide

4. *Writing the report*

Several difficulties were expressed in writing the report, which are enumerated below :

a. Inability to present facts

b. Lack of adequate knowledge in statistics and research methodology (specially for students without a background in mathematics)

c. Language Problem

d. Inability to tabulate and interpret data

e. Non-availability of reference books in the area of research

f. Inability to arrive at suggestions for further research due to lack of experience

g. Beginning to write at the last moment resulting in shortage of time.

and h. Difficulties in getting the manuscript typed, paper shortage etc.

5. *Other difficulties*

   a. The thesis or project is not given due credit in terms of weightage or marks.

   b. Cost of preparation of the thesis is very high.

The difficulties thus expressed by the students reflect their deep concern on the various aspects of research work and their analytical mind.

5. **Suggestions for overcoming the difficulties**

The students were asked to come out with suggestions for solving the problems enumerated and the following is the summary of their suggestions.

1. Thesis should be made a compulsory and an integral part of the post-graduate course with more credit.

2. The research problem should not be imposed on the students. They must be given the freedom to choose topics of their own interest, while care should be taken to impart sufficient knowledge and training to select the research problem. For example seminars may be conducted to orient students to research.

3. Theory portions should be cut down to make room for research.

4. Post-graduate students must be given financial assistance in the form of research fellowships.

5. Laboratory facilities with adequate equipment must be provided. Some suggested even separate laboratories for research students. They also wanted training in operating modern equipment.

6. Library facilities must be improved.

7. Courses on research methodology should be organized and strengthened. The syllabus may include 'computor programming' also, to keep pace with modern development. Research students must be given practical training in operating calculators, punching machines etc. Sample research design may be given to the students before they prepare their own research design.

8. Statistical work may not be over emphasized; but on the other hand, selection and preparation of tools, sample, procedure and other related matters in connection with research procedure may be emphasized in order to bring down the tension of non-mathematics students.

9. Students can be given the freedom to submit their research report in regional language also.

10. The guide must be sympathetic and treat the students properly.

11. Internal assessment should be brought about. The guides must have a say in the valuation of the thesis since they are closely associated with the research student and the project throughout the period.

12. A specific period (say 6 months) of time for research work alone should be allotted when the students should be free from other course work and examinations.

13. University awards should be established for outstanding research work to serve as incentives for the research scholars.

14. Jobs should be guaranteed for the post-graduates with research experience.

15. The co-operation of the concerned agencies and institutions (industries, hospitals etc.) who may be associated with the research work should be assured. The educational

institutions to which the research student belongs should take care to see that this co-operation and co-ordination are elicited.

16. Research 'cell' or 'forum' may be organized in localities where there are a number of institutions undertaking research, to facilitate exchange of ideas and experiences.

17. There should not be any restrictions for the students to seek for expert advice from the guides or use any laboratory facilities from other colleges and universities, in both selecting the research problem and working on it.

18. There should be some descrimination in selecting students for post-graduate studies. It is suggested that aptitude tests must be conducted while selecting the students.

Thus this brief study has thrown light on several aspects of research. The practicability of the various suggestions put forth, by the students in the existing educational set up needs further investigation and analysis by all the educational authorities.

QUESTIONNAIRE TO FIND OUT THE OPINIONS OF POST-GRADUATE STUDENTS ABOUT RESEARCH

Name of the respondent :

Class : College :

Major subject :

1. What are your aims in undertaking post-graduate studies ?

2. Do you have thesis or project or both as part of your P. G. course ? (Please tick against relevant column)

   Thesis ☐ Project ☐

   Both ☐

3. Please mention the topics of thesis/project you have undertaken.

   Thesis :

   Project :

   Reasons for choosing the topics

4. If you do not have thesis/project do you wish that they should have been part of the course ?

   Yes ☐ Reasons :

   No ☐ Reasons :

5. What are the benefits that students get by doing research as part of their studies ?

6. Do you feel your major subject lends itself for doing research ?

   Yes ☐ Reasons :

   No ☐ Reasons :

7. What are the specific topics/areas in your subject in which you can undertake research work ? (Give a few examples)

8. What changes do you suggest in the present course to accommodate thesis/project ?

9. What are the problems/difficulties you are facing in doing research ?

   Selection of the problem :

   Selection of subject/sample :

   Conducting the study :

   Thesis/project writing :

*10. What facilities and changes do you expect to undertake research effectively ?

*11. What are your suggestion for following up (continuing) your research project ?

12. What are your plans after your post-graduate course ?

* Applicable only for those who have thesis/project as part of their course?

CHAPTER 22

GUIDANCE IN RESEARCH

Rajammal P. Devadas

There are three stages in the educational process in the colleges and universities. The first is a period for mastering knowledge, when the student gets all the available information through books and teachers, directed chiefly to the acquisition of tools and assimilation of facts and principles. This stage culminates in the B. A. / B. Sc. / B. Com. / B. Ed. degree. The second stage is the mastering of techniques by which knowledge is tested and additions made to the sum total with initiative and intelligence, wherever conditions permit. At this stage the student ought to work independently and learn the art of scientific investigation, to perform critical and constructive research, and receive M.A./ M.Sc./ M.Com. / M.Ed. degree. The third stage is the period of discovering or 'real research' towards the doctors' degree. The results at this stage must be new facts and principles penetrating the frontiers of knowledge and going beyond them. Basic and applied research are the most creative elements in our civilization. A large sum of money is also being spent from the national budget, on basic and applied research.

With the introduction of thesis at the Master's degree level, and increase in the number of candidates for higher degrees, preparation of the candidates in the methodology of research has become necessary. They need training in identification and delimitation of problems, in scientific methods of research work, in library and thesis techniques, in the proper organisation of work, and in channellising thinking. They need also standards for judging their progress and the completed task. All these constitute "Guidance".

To guide means to direct, conduct, regulate, manage, to set direct oneself order and govern. Guiding is synonymous with leading, steering, piloting, engineering and monitoring. Guidance also means expanding the horizons of understanding for the guide and the student, developing excellence and admiring excellence in others and innovation and wide scholarship.

A sound head, an honest heart, a humble spirit and a determined will, are the characteristics of the best guides. Guiding research requires numerous attributes from the personality of the guide and an adequate infra-structure. These include :

1. Personal qualities
2. Ability to inspire, motivate and guide
3. Up to date knowledge and depth in the special area of investigation and in the methodology of research
4. Understanding how knowledge can be transmitted and communicated
5. Wide contacts
6. Resources - library, laboratory, community assets and others
7. Skills in research procedures
8. Accessibility and adaptability
9. Clarity in direction and training
10. Creativity
11. Skills in writing, editing and publishing papers

and 12. Follow up.

1. Personal Qualities

To the young aspirant in research, the guide is the source of information and inspiration. In order to inspire, the guide should possess the human qualities of love, concern, commitment, patience, leadership and dedication. Care for the individual research student, concern for his health, nurturing his welfare, progress and ultimate success, commitment to the cause of the research candidate and full identification with his dreams and aspirations, patience as evidenced in not rushing the student, readiness to face difficulties and overcome them with his own resourcefulness, unquestioned leadership and dedication to the area (discipline) of specialization and the research undertaken, are the qualities which make a good guide. The love manifested by such a guide would dispel fears, doubts and hesitances from the research students.

Ingenuity, intelligence, spirit of adventure, love of science, curiosity, scientific temper and taste, willingness to work hard, perseverance, persistance and tenacity of purpose are some of the prerequisites for a good guide. Pasteur once said, "Let me tell you the secret that has led me to my goal. My only strength lies in my tenacity." The guide should be pioneering, always exploring the frontiers of knowledge with an unsatiable passion. His initiative, drive, dynamism and enterprise must infect the scholars under his guidance. These qualities help to facilitate guidance in an atmosphere of freedom and use of democratic procedures. These qualities would also enable the research candidates to put forth their best efforts unflinchingly.

2. **Ability to inspire, motivate and guide**

The personal qualities which make up the personality of the guide, inspire and influence the research scholar to emulate the master. The research scholar will develop implicit faith in the guide. The influence of the guide will leave a lasting imprint on him. Inspiration is a powerful motivating force. Motivation translates inspiration into action. Motivated to strive without sparing any effort, the research student goes all out to examine the research subject, use suitable procedures, gather the relevant information, study the problem in all its aspects and analyse the data.

The guide should set a pace that would draw the best talent in research and generate sparks of excellence. He should identify skills and attract young students to research. He should be practical and relevant in his suggestions so that his influence is broad-based. By being an attentive listener, he can become aware of the problems of the research scholar. He should help him become aware of the practical applications of his investigations in solving human problems. Then, guidance will become a self propelling activity. The guide and the research scholar should have positive interactions to deliberate and probe together, give and take, and agree upon well considered decisions. The guide should invite criticisms and be open to others' ideas and alternatives. If necessary, advisory committees for research could be appointed.

3. **Knowledge and depth in the special area investigated and in the methodology of research**

The guide must be fully conversant with the subject matter of the research project which he guides. He must have full knowledge of all ramifications of the different methods which could be used in the particular investigation. The guide should have a flair for sieving effectively the world's scientific literature. He should be an indefatigable reader. Long working hours, day and night, in the laboratory, library and field should be considered as a norm.

The guide should help the scholar in all aspects-to plan the research design, identify the problems, collect data and check them and to arrive at conclusions. In the laboratory work, he should check the accuracy and purity of chemicals, help in the analysis by explaining the principles, and in the interpretation of results.

The guide should reveal the challenge of the new problems. He should introduce new concepts, new experiments and new techniques using the vast background of his accumulated knowledge. He should advance the understanding of life processes by relating the research to biological, physiological and sociological dimensions. The guide should visualize new dimensions in thinking through the use of mathematical constructs, computer analysis and innovative educational programmes and exhort the student to keep moving towards the future. Scientific problems should stimulate both the guide and the student. The guide should re-examine and re-interpret past studies on the basis of new knowledge.

In order to be up-to-date, the guide must develop access to the latest publications and be a regular peruser, better still, subscriber of the relevant periodicals, journals, news bulletins and other research publications in the field. Now-a-days, the daily news papers and popular periodicals also cover news on research. They are good markers for the research guide, to seek the original papers and get first hand information on the subject. Scientific knowledge must be combined with practical guidance in an atmosphere of freedom, keeping the grass roots in research.

4. Understanding of how knowledge can be transmitted and communicated

Guidance in research calls for efficient communication between the guide and the research student. For that purpose, guidance requires an understanding of the human factors of initiative and achievements. Some of the most perplexing and urgent problems of our times are not technological, but human-organizational, social and political. One way to achieve this understanding, is through sharing of knowledge gained through meaningful experience. Research is the opposite of fossilised tradition which is marked by repetition, continuity, security and predictable behaviour. Research depends on inspiration, insights, hunches, non conformist questionning, assumptions, innovation and learning. Creative thinking and innovation are essential ingredients of research and growth. The guide must be sensitive to these needs of the research scholar and develop a dynamic relationship with him. The guide should have the ability to communicate his instructions and comments accurately without ambiguity. He must use the written word, models and illustrations for the purpose. Often oral transmissions get distorted, mixed up or forgotten. Therefore using a note book to record all transmissions will be extremely helpful.

5. Wide contacts

For effective guidance of research, contacts with all the sources of information are essential. These may be other institutions doing similar work, their libraries and laboratories; administrators such as the District Collector, Panchayat Chairman, District Education/Medical/or Agricultural Officer, Publishers of scientific works, leaders in the particular field of research and others. Personal contacts through visits and phone calls often help to save several days of correspondence and avoid delays.

Contacts with other scientists and investigators who are engaged in similar work are useful for comparing notes and eliminating meaningless repetitions. Valuable contacts are developed when the guide is a member of professional associations and attends national and international conferences in the subject.

6. Resources-Library, Laboratory, Community Assets and others

For meaningful guidance, the guide must be surrounded by up-to-date literature in the subject. He must be situated in a centre where good library and laboratory facilities are available. The guide himself should develop a personal library and have all the accessories which promote research. He should collect reprints of published papers and maintain a classified filing system with the reprints and cards as ready reckoners, for sighting and citing references. If reprints are not available, important papers can be copied through the micro-filming, xeroxing or photo-state services available in the University of Madras and other centres and kept in file for use. Clippings are also useful resources. All the assets and resources in the community must be located and used.

7. Skills in research procedures

Most investigations require knowledge of, and skills in particular procedures. The research guide should be able perceive the needs of the research he is guiding and make sure that he has the 'know-how' and can demonstrate it to his students. Unless he has mastery of the methods and procedures, the candidates will loss faith in his leadership.

Almost every research endeavour needs statistical treatment and appraisal and the art of graphic illustrations. The guide should know the fundamentals of the statistical and other procedures also.

8. Accessibility and adaptability

For the research scholar, who is in constant need of guidance, the guide must be accessible. This is a difficult problem, since most research guides are busy with numerous other duties, and chores, which take them 'out of station' on many occasions. The guide must find time for those whom he guides. He must show a great capacity for adapting to changes and changed requirements of the research. It is common to find research students who are stubborn about the choices they have made. The guide should be in a position to discriminate between what will work and what will not work and convince the students.

9. **Clarity in directions and training**

The first step in developing the research scholar is training. Research must be built around people and their abilities. The late Dr. Homi Bhaba used to first pick out the man and then build the research around him. Only then creative know-how can be built up rather than borrowing techniques from abroad. The guide should be willing to get the candidate gain experience even at the risk of failures and help him to tackle the task with self confidence and ability.

The research student must review thoroughly all the available literature on the selected topic, in the country and abroad before presenting an outline of the proposed thesis for approval. The objectives should be defined clearly. The guide should take an active part in the planning, organization, operational conduct, data analysis, and interpretation of the findings. He should visit the field for an 'on the spot study' and obtain first hand information. He should give proper instruction and supervision. Through graduate seminars extensive experience should be provided in critical reading, evaluation of the methods and summarization of the results in relation to current knowledge in the field. Experience in oral presentation should train the scholar in public speaking and develop his confidence in evaluating his research.

Through judicious decentralization, delegation, constant reporting, control and evaluation, guidance must be regular, prompt, clear, definite and objective. The work must be expedited and facilitated. Only then, the journey of the research scholar through the dark labyrinth of investigations will be smooth. Through constant interplay, encouragement and culture, self development of the student should be promoted to result in autonomy, motility and leadership.

Research guidance must be pursued with understanding from the beginning. The students must be exposed to the work of great scientists and the scientific processes. Study of superior performance will help in forming ideals and attitudes and in acquiring skills. An examination of the methods of great scientists indicates that they advanced toward their objectives without any consciousness, they were at one instant collecting data, at another instant making generalizations and at still another instant passing again to the particular. Unity in the scientific process, unity in the application of science and unity of all knowledge to test truth and put it in order, are evident in their work. Research and reflection are knit together in their endeavours.

Students must be helped to proceed to work on their research and thesis with what intelligence, honesty, expedition and skill they possess. Laboratories, seminars, graduate study, research, publication of the results of research are the leading features in research guidance. Research requires humility of spirit in search of truth whatever it may be, and through whatever channels it may come. The students must be impressed about this truth.

10. **Creativity**

What factors make for creativity in research? How does research help to increase productivity? Creativity is in a large measure due to the guide or director of research, who builds up the morale by :

Being passionately devoted to getting new results;

Not being interested in side-lines;

Encouraging young people to put forward ideas for new lines of research;

Selecting the promising researchers;

Letting them work uninterrupted;

Surveying progress of research;

Applying stimulus and recognition when required;

and Giving credit where due.

Creativity is maximum when,

The general intellectual environment is favourable;

There is exposure to great scientists and discussions with them;

Frequent meetings, symposia and colloquia are organized to become well informed and take rapid advantage of new discoveries elsewhere;

Responsibility is delegated;

Decisions are taken quickly after due consideration among competing priorities and consultations;

Objectives are clear, guidance specific;

and The organization is efficient.

For creativity, the guide should promote cross fertilisation of ideas and prevent growth of human potential barriers between departments. He must have a first class information system with up-to-date papers and maintain sound human relationships. Young people are likely to provide creative ideas and their ideas should flow upwards and be considered. They must be provided with facilities and opportunities to present their good ideas to bear fruit and given fair recognition when merited.

11. **Skills in writing, editing, and publishing papers**

Volumes of data remain unclassified, untabulated, unanalysed and unedited in several centres. If the guide is skilled in editing and has a flair for publication, the situation would be different. Scientification of information acts as an intellectual stimulus. The guide should have the ability to review, correct, amplify and update the manuscripts prior to publication. Endless patience is required to draft, redraft, correct, recorrect and finalise the paper, to meet the needs of readers from diverse backgrounds and interests. The guide should acquire a great deal of experience by constantly writing scientific literature himself. Then alone he can teach and demonstrate to the research scholar, how to state facts in a simple, direct, clear and effective manner.

In the current competitive world of higher education, research publications are a prerequiste for promotion and status. One is judged by not how much he has taught, but how much he has created and 'added new' to scientific thought. The new contributions are judged by the scholars' publications in standard journals in the country and abroad. Handsome national and international awards are being announced periodically for the best contributions in certain fields. In order to publish papers, the research design, conduct of experiments and results must be acceptable from the beginning to the end.

12. **Follow up**

Research guidance is a continuous effert; follow up is essential within the study and also after a study is concluded as basis for future studies and action.

CHAPTER 23

EVALUATION OF RESEARCH REPORTS

P. A. Guruswamy & R. Jayaraman

The end product of the research work is the report. The planning, execution and evaluation in that order are the major steps in all human actions like teaching and extension. And research is no exception to this general rule. They together help us to carry to a successful completion of the work on hand whether research or other projects.

What is evaluation

It signifies our attempt to know how far a given project has achieved its desired objectives. It has been defined in Encyclopaedia of Social Work in India as an activity involving a systematic process for forming objective judgements and drawing useful conclusions and action programmes.........All evaluation activity is, therefore, in the nature of a positive service, and, as such, should end with an indication of the ways and means of bringing about better results from the operation of the programme"[1]. Again this can be either self-evaluation or evaluation by others. Whoever may be the evaluator, the overall purpose remains unaltered i.e., to appraise the strong points and weak points of the work with a view to bettering the future performance in this regard. Evaluation thus is and should be an integral part of all research activities. The importance of evaluation of research reports becomes all the more important when considering the poor quality of a good deal of them published in India and abroad. This is more so in the case of social research. For example: after careful evaluation of a stratified random sample of 125 research articles published in 1962 in America, a panel of 166 authorities concluded that only 19 per cent would have been accepted by them for publication and another 41 per cent would have been rejected[2]. Most of us who have analysed atleast some of the published studies would emphatically agree on this point.

The problem is how to improve the quality of our social research. Our society now faces vital and growing social crises and is willing to expend large sums to find solutions. Research workers should respond to the increasing needs and pressures, in spite of many handicaps, by raising the standards of their efforts. Hence the need for evaluation of research.

The following set of guidelines constitutes a type of instrument for analysing research reports. It consists of some criteria which are practically self-explanatory, relatively obvious and simple to apply and which deal with some features of research reporting that are sometimes overlooked. These guidelines may be useful to the overgrowing number of students taking courses in social research, to neophyte practitioners in research, to consumers of social research, to writers of research reports and to those who must judge them.

1. *Title given*

The title should, not only precisely identify the area of the problem but also should be clear, concise and descriptive enough to permit the study to be included in its proper category. It must also avoid superflous words such as "a study of" or "an analysis of" and catchy, misleading and vague phrases. In short, the title should not give room to the impression that it has been given for the sake of giving a title.

2. *Prefatory materials included*

The report should contain a title page, approval sheet, preface or acknowledgements, table of contents, list of tables and list of figures; also the mechanical features of the above materials should be in accord with the required style manual.

3. *Problem raised*

A problem is a felt need, a difficulty, an "itch to know". It should be obviously important and worth-while; also one that has a good chance of being solved with reasonable time and effort. It is, therefore, usually only a small part of a larger problem, a portion small enough to be digestible. It should not be something entirely new but should have arisen as a result of previous work done by the author or by others. A properly posed and stated problem, in declarative or question form, is probably the most important part of the research project. Natural scientists say that a problem well stated is a problem half-solved. It must therefore be in terms which are succinct, specific and precise so that it leads naturally to all the succeeding steps. An unspecified, implied or poorly delineated problem is a serious handicap to the researcher, for "an investigator who begins his study in confusion has nowhere to go but into more of it". Moreover the researcher must be equal to the problem under investigation. In other words, the problem should be neither too big nor too small for the researcher.

4. *Previous work cited*

There should be evidence of a good literature search and a good grasp of the current "state of the art". Failure to cite previous studies implies discourtesy or ignorance. The most recent papers should be given the most attention, for they give the most recent findings and include older sources. While previous papers should be documented and critically appraised in regard to the adequacy of their sample, faulty techniques and unwarranted conclusions by the researcher, too much detail or a long list of references are not necessary. A good project sets out to replicate or extend the previous work with improvements to reduce bias, eliminate flaws, consider pertinent variables, settle unsolved issues or check contradictory or uncertain findings. An accompanying bibliography should identify other sources for the reader. To put it differently: Does the review of the literature establish a theoretical framework for the problem, preferably as a series of postulates? Does it bring together pertinent data and theories and weave them into a network of relationships - a series of postulates - that point up relevant issues, reveal gaps in knowledge, and prepare the way for the logical leap to hypothesis construction?

5. *Objectives stated*

These are the ultimate goals, the socially useful reasons for solving the problem. They should be limited to a small number (one is enough), be obviously important, fairly specific in scope and clearly stated as objectives. They should grow out of the problem naturally as rather broad generalisations which can be broken down into a group of hypotheses. The research report should amply cover the objectives stated; this is very important.

6. *Hypotheses formulated*

A common trend is to present several objectives and only one or two hypotheses; it should be the reverse. Hypotheses are reasonable and rather narrow generalisations which are to be tested during the study and either accepted or rejected: therefore, the mark of a true hypothesis is that it is testable. A hypothesis suggests where the investigator can search most profitably for facts and how to detect relevant relationships between them. Facts must be obtained to solve a problem; facts, however, "never speak for themselves but only to someone who has a hypothesis which he wishes to test". Hypothesis may be stated as either positive or negative; if the latter, they are called "null hypothesis". In research it cannot be proved that something is so; it can only the proved that something is not so. The whole purpose of a research project is to propose a series of plausible consequences growing out of the objectives based on the problem and to reach conclusions after testing them as to which of these postulated hypothesis may be accepted and which rejected.

7. *Assumptions made*

It is impossible for an investigator to control all the elements in his project and so he must base his work on many assumptions. An assumption is a reasonable but presently unprovable factor. The more rigorous the research, the fewer the assumptions and therefore everyone should be justified. If the worker frankly enumerates them in his report, it shows that he is aware of what he is doing and that he is honest. Some assumptions may remain implict, but others - such as the validity of instruments, adequacy of sampling and control of variables - should be acknowledged. In short, the basic assumption involved in the solution of the problem must be made clear.

8. *Concepts defined*

A concept is in reality a definition in shorthand of a class or group of facts. "Aggression", "society", "community" are illustrations of concepts into which are condensed a number of events or phenomena under one general heading. The purpose is to present in simplified form the thinking about phenomena, events and processes. It may be stressed that no concept is easy to define; hence different scholars may define the same term in different manner. Therefore the investigator must define in clear and unequivocal language the important variables and terms used in the study, i. e., they must be formulated in operational terms.

9. *Population studied*

Conclusions cannot be drawn concerning a population until the nature of the units that comprise it is clearly identified. If a population is vaguely defined, one does not know what units to consider when selecting the sample. The reasons for selecting the chosen population, such as availability or convenience, should be well explained. It cannot be assumed to be a normal population unless very large and heterogenous; otherwise the normality of the distribution must be proved.

10. *Sample drawn*

This is a key factor on which many projects are founded. Many problems in scientific research cannot be solved without employing sampling tools. Since most social phenomena consist of a large number of units, an investigator cannot always interview, test or observe each unit under controlled conditions. Sampling tools solve this dilemma, for they help a researcher select representative units from which he can gather data that permit him to draw inferences about the nature of the entire population. Sampling tools save time, money and energy and provide a means of probing into problems that are too unwieldly to be tackled by conventional methods. No researcher can afford to be unfamiliar with sampling procedures and the pitfalls that may be encountered when utilising them[3].

A true sample must be either representative of the population or drawn by using a table of random numbers so that every member of the population has an equal chance of being selected. In either case the procedure is difficult and complicated and the size and nature of the sample must be defended as appropriate. With good technique, a small sample correctly drawn is better than a large sample poorly selected. If a control group is used, it must be chosen with equal care. Only with a sample rigorously drawn and free from bias - a rare thing in social research - can the results be generalised. Most workers describe as a sample what are really the sub populations with which they are working, even though they call them experimental and control groups and the findings of their studies can therefore be said to apply only to their particular sub-populations and "all others like them". If the sub-populations are described in detail, the reader can decide whether he can apply the findings to his own situation.

11. *Tools used*

What tools of data collection be used is another important problem encountered by social researchers. They refer to such instruments as interviews, questionnaires, observation, tests, scales, inventories etc. through which data are obtained. Poor instrumentation is a common and serious flaw in much social research. To make certain that the instruments will correctly and consistently measure what is to be measured, they should have at least been pretested in a pilot study or calibrated in some way. A " faint tinge of validity" is not enough. Any original instrument should be described fully and illustrated with examples. It is ridiculous for a worker who has formulated an "armchair" untested measuring device to claim that the results he obtains with its use can be accepted with any degree of assurance. Several poor instruments, when used on the same project, are not necessarily more valid than one. Instruments borrowed or modified from the work of others, with courteous acknowledgements, are good; better yet are well-known, published, standardised instruments with appropriate norms.

12. ***Procedure followed***

This is often one of the best parts of most reports. The steps in carrying out the project should be described in sufficient details so that they may be completely understood; the measure of this is that the entire procedure could be replicated by another worker who would wish to repeat the project. Nothing should be left incomplete or omitted. Since the findings of a study can be no better than the tools and methods used to solve it, scholars usually examine this section of the report with extreme care.

13. *Safeguards taken*

Many sources of error and bias creep into research but some of these may be anticipated and guarded against. Plenty of time is one safeguard; sampling adequately, pretesting instruments, training assistants, controlling some variables, eliminating the "halo" effect, refining procedures, allowing for errors and calling on experts for judgements and assistance are some other safeguards commonly employed. The failure to apply adequate safeguards is a serious flaw in many social researches.

14. *Evidence presented and analysed*

The presentation and analysis of the data constitute a vital part of the study, for these materials represent the researcher's contribution to the advancement of knowledge. The analysis of the data may be covered in one or more chapters, which may consist of tables, figures and paragraphs of discussion that point out important aspects of the data. Raw data may be recorded in the most convenient form for collecting; but in the body of the report, data relevant to each hypothesis must be classified in ways that reveal the pertinent information required to confirm or disconfirm the hypothesis. In many studies, the raw evidence is subjected to specific statistical treatments and the values that are obtained rather than the raw evidence are reported in the study. When this procedure is followed, the treatment to which the data were subjected should be clearly specified.

In the analysis of the data, the researcher points out the important facts that the collected evidence reveals and notes their relationships. He does not repeat all the detailed information that is in the tables and graphs, but rather interprets what the facts mean - their causes and effects and whether they confirm or disconfirm the hypotheses. Extracting the meaning from the data is one of the most difficult and most delightful phases of an investigation. If more than one explanation can be given for a particular fact, the researcher discusses all explanations, not merely the one he favours. After drafting an explanation, he examines the data for exceptions, tries to account for them and restates his explanations if necessary. Any uncontrolled factors that may have affected the results and their possible implications, are discussed. If the results of the investigation are in agreement or disagreement with other studies, this fact is pointed out and possible explanations are given for any differences. When stating the results of the study, careful qualifications are included that stipulate the precise condition or limits to which the conclusions apply.

15. *Summary and conclusions*

The summary and conclusion chapter is the most widely read part of a study because it recapitulates the information that has been presented in the previous sections of the report. Most readers scan the summary first to obtain an overview of the problem and to determine its usefulness to them. If the study is pertinent to their purposes, they examine the remaining chapters. In the summary, the researcher should briefly review the procedures, findings and entire evolvement of the problem. The important points in the study are brought together in the summary, but not all the evidence upon which they are based is repeated.

As far as the conclusions reached are concerned, essentially this consists of the acceptance or the rejection of the hypothesis which has been proposed earlier. Some workers find it hard to face the fact that negative conclusions and failures are also respectable and worthwhile reporting. Four common and serious flaws may crop up. One is to rationalise away the breakdown of the stated hypothesis and to bring in new elements not previously mentioned. Another is to extrapolate the findings and conclusions to situations and to populations not represented in the sub-populations studied. A third is to lean on the "fudge factor" to reach the expected conclusions. A fourth, and the most serious, is to draw conclusions not warranted by the findings.

16. *Limitations recognised*

No matter how carefully planned and executed, every research project has limitations and weaknesses which may or may not be the fault of the investigator. In any case, it is his obligation to be intellectually honest and aware and to point them out as a caution to the consumers of his research and as a guide for future workers in the area.

17. *Further work projected*

Work on one problem usually raises one or more other problems. It may be good to mention these problems or some new related hypothesis or the application of different techniques or replication with greater rigor, improved design, better instruments or a more representatives sample. In any case, the investigator should be in the best position to suggest related research and it is his duty to do so.

18. *Bibliography and Appendix*

A bibliography consists of all the literature cited throughout the text. The bibliography should follow the main body of the text and precede any appendix material. The bibliography may be arranged alphabetically by author in a single list or if extensive, may be grouped by type under such headings as books, articles, documents, newspapers or unpublished material and arranged alphabetically by author in each group.

Original data and supplementary materials such as figures, charts, tables and graphs which, in the interest of conciseness, do not appear in the text proper should be included in the appendix. The tools used to collect data also should be presented here. If more than one type of material is included in the appendix, it should be set-up under different headings classified as Appendix A, Appendix B, etc.

19. *Report Format and Style*

The report should be neat, attractive and divided into appropriate sections or chapters. It should be free from padding with irrelevant words, phrases, quotations, statistics, examples and other data that are not essential for accuracy, clarity and completeness. One should see neither major topics are developed insufficiently nor minor ones over-expanded. The language used should be simple and straight-forward.

Norms for correction of reports

The evaluation of the research reports on the basis of the above guidelines entails that the examiner goes through carefully the *whole* report and not some parts of it as is usually done by many in the field. Secondly, marks should not be awarded lumpsum to the report. Instead, a set of norms as suggested below may be used for this purpose.

A Schematic budget of marks for evaluation of Research Reports

	Norms	Marks
1.	Title of the study	5
2.	Problem raised and previous works cited	10
3.	Objectives, Hypothesis, Assumptions and Concepts	5
4.	Methodology including population studied, sample drawn, tools used, procedures followed and safeguards taken	15
5.	Data presentation and analysis	25
6.	Summary and conclusions	15
7.	Limitations of the Study	5
8.	Amount of time and work involved at various stages of the study in terms of pretesting, nature of field work, processing etc.	5
9.	Report format and style including pictorial representations	10
10.	Miscellaneous considerations	5
	Total	100

Who should evaluate?

There should be two examiners, one external and one internal. The external system will ensure objectivity and impartiality of the evaluation process. But an investigator's extent of involvement in the research work, sincerity of purpose, integrity, sense of observation and such other qualities can be adjudged satisfactorily only by the professor who guides him throughout the work. When two examiners evaluate the thesis, the average marks should be considered as the final. However, it must be noted that the difference in marks given by the two persons to a candidate should not exceed 15, where a moderator comes into the picture. Another related problem faced in this connection concerns with the personal interview or viva-voce of the candidate. In some Universities already this practice is being followed. It helps the examiners to assess more correctly the candidate's performance in this regard. It also affords an opportunity to the candidate himself to explain in person the important features of his study and defend them before the board of the examiners. During the personal interview, the candidate may be examined in respect of the following qualities:

1. Problem-awareness
2. Expression
3. Clarity
4. Observation
5. Scientific attitude
6. Intellectual curiosity and drive
7. Originality
8. Depth

Evaluation of Research in Physics

'Scientific research differs from other kinds of research in that it is a continued search for scientific knowledge and understanding by scientific methods.'

Progress in research can be evaluated only in terms of the objectives of the research programme. The main objectives of a Ph.D. programme should be some or all of the following.

1. To acquire advanced knowledge in the field of specialisation.
2. To gain sufficient experimental skill to build the apparatus used for the research investigations.
3. To gain experience in the methods of analysis of data.
4. To interpret the results in terms of existing theories or a new theory proposed by the candidate.
5. To undertake theoritical investigations.
6. To design and construct any new device applying the basic knowledge in physics.
7. To acquire sufficient mathematical ability to understand and investigate problems in physics and allied disciplines.
8. To develop in the candidate originality of approach to solve problems in physics and allied disciplines.

Evaluation comes at the initial stage itself i. e. when a candidate joins the Ph.D. programme. Only really talented students shall be selected for the Ph.D. programme.

The vexing problem of selecting promising people for research needs attention because there is at present no objective means of measuring the qualities required. However this is a problem which psychologists may be able to solve in time. For example it may be possible to devise a test of a person's knowledge of everyday things, that will be a measure of his curiosity and powers of observation. Tests may also be devised to measure ability to generalise, to formulate hypothesis to fit given data. Possibily love of science may be tested by determining the response - being delighted or not - on learning of scientific discoveries.

Ordinary examinations are not a good guide to a student's ability at research, because they tend to favour the accumulators of knowledge rather than the thinkers. Brilliant examinees are sometimes not good at research, while on the other hand some famous scientists have made a poor showing at examinations. Since our examination system is based on memorisation tests, admitting students strictly on the basis of their rank at M.Sc. level may not be correct or realistic. Admission to Ph.D. research may be therefore based on an *objective entrance examination* and also on an interview of candidate to find out his aptitude and ability to carry out research work. The project report system that is going to be introduced by the Madras University for all science subjects at M.Sc. level may be of great help in selecting students who are having the two most essential attributes for the research worker, a love of science and an insatiable curiosity.

Unfortuantely the post graduate courses as they exist now in most universities have old fashioned syllabii with little or practically negligible quantum of modern development in the subject. Besides the student is not trained to gain sufficient experimental skill to build his own research apparatus. Further our university course in pure or applied science is a course of instruction in existing knowledge and not an education for discovering new knowledge. So the Post M.Sc. course or M.Phil course may be of great use to candidates selected for Ph.D. Programme.

After acquiring a wide and advanced knowledge in the subject the candidate has to acquire a deep and advanced knowledge in the field of specialisation in which he is going to start his research. So a specialisation course in a particular field is necessary and this course may be of one year duration. This course may as well include problem selection and literature collection.

Evaluation of the candidate who has undergone this course may be by an oral examination. Oral examinations may be more widely used so that the level of thinking and understanding may be evaluated by a board of experienced examiners in a personal encounter. These examinations shall be conducted as an exploration of what a student has accomplished as a result of his course. Further the purpose of the oral examination is to aid in judging the candidate's ability to perform the type of original investigation his thesis will require. He may be asked to discuss some physical problem from an independent and preferably original point of view and to answer questions on his selected field or closely related fields. The results of this examination are determined by the candidate's knowledge and understanding of the research problem, by the clarity organization and originality of his exposition and by indications of ability to do original research. The chairman of this qualifying oral examination must be the professor under whom the student hopes to do his research. If the student passes the examination he may proceed immediately to do research for the thesis under his thesis supervisor. At the end of one year after the student has started his research a viva-voce examination may be conducted to ascertain the desirability of his continuing in Ph.D. programme.

After a period of two years of research the student may be allowed to submit his thesis. Some universities require that the Ph.D. thesis should be evaluated by a board of examiners one or two of whom are from abroad. While this requirement had some justification a few years ago, in the present context this practice may be discontinued. The physics community in India should now take upon itself the responsibility of evaluation of Ph.D. thesis.

There is no doubt that the panel of examiners and their mode of selection plays an important role in judging the quality of a thesis. In the interests of maintaining a fairly high and uniform and standard of our Ph.D. degrees it is desirable to adopt a uniform system of evaluation. Panels of experts in each field of specialisation can be prepared on an All India basis by the University Grants Commission or National Council of Science Education. Two experts from these panels and the thesis supervisor may constitute the board of three examiners for thesis evaluation. The examiners shall recommend the thesis for the Ph.D. award only when the thesis comes up to the required standard. They shall also see whether papers based on the thesis are publishable.

Before the final award of the degree is made a detailed viva-voce examination of the candidate by all the thesis examiners should be held. This helps to know the candidate's theoritical understanding, clarity of thought and exposition of the subject of his research. This can also be an incentive to the candidate to increase his awareness of the relation of his research work to the broader area of related investigations and indeed to the whole of physics. Any doubts regarding the thesis work and its interpretation can also be clarified at the viva-voce examination. The faculty members, students and members of the public may also be allowed to attend this final viva-voce and questions from the audience shall be entertained at the discretion of the examiners. The board as a whole may decide the award after completing the viva-voce examination.

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APPENDIX I

RESEARCH PERSPECTIVES IN EDUCATION AND PSYCHOLOGY

H. Visvesvaran

There is a great need to conduct research in all aspects of Education, particulary in Educational Psychology. Some Teachers Colleges and some faculties of Education and Psychology in some Universities have understood this need and have been conducting research and experiments in these fields. But such research and experiments should not be done in isolation here and there. There should be an organised and cooperative effort on the parts of all the Teachers Colleges and Faculties of Education and Psychology to explore the possibilities of research in the field of Education and Educational Psychology and carry them out in cooperation with each other.

It seems that the age of reason has not yet dawned in India as far as Psychology is concerned. We teach Psychological concepts as found in western text books and our students study them and accept them as truths. It is not questioned whether these concepts, evolved on the basis of experimentation in western countries, are applicable to Indian conditions. Efforts are not adequately taken to verify the conclusions arrived in the west and modify them or change them wherever necessary. Thus implicit acceptance of western conclusions is against the spirit of experimental verification and the very process of development of Psychology. So it is essential to build up a scheme of Psychological experimentation and research and verify the concepts of psychology in an Indian setting.

Who will do this research and where can this be done? There are many national scientific laboratories in our country where eminent scientists are engaged in research and discover many new things and prove and disprove many accepted concepts. But there are no such national laboratories in psychology. Psychology is being taught as a discipline by University Departments and arts and training colleges. It is here that we have many psychologists engaged in teaching and research. Their time is mostly spent in teaching courses and they have at their disposal only a limited time to guide the research work of post-graduate students. They do not also have adequate laboratory facilities and materials to carry on research. So, for paucity of time, personnel and facilities, these colleges and University Departments are not able to pursue independent research on their own accord and come out with new research findings. So they easily accept the psychological concepts developed at the western countries and teach them to their students.

But this is not a satisfactory state of affairs. Our University Departments and Colleges teaching psychology should develop into research laboratories with qualified men and adequate materials to do research. They should, besides guiding the research work of Post-graduate students, take up independent research and publish papers. Research and teaching should go hand in hand in them. Only then the concepts they teach will be real and meaningful to our conditions.

This paper is to deal with the scope of research in the area of psychology of learning. The area of learning is fundamental both to education and psychology and discoveries in this area are bound to affect educational practices. In fact no other area in psychology can influence educational practice as learning. Hence it is essential to direct the attention of research workers to the area of learning and encourage them to take up more and more research studies both to break new ground and to verify in Indian setting the concepts arrived in the West. But the research worker does not have a clear picture of the scope of research in this area. Hence many of them touch upon certain areas of learning and neglect the other areas completely. Studies are repeatedly conducted in certain areas which could have been beneficially conducted in neglected areas. The purpose of this paper is not to enter into any academic discussion on the areas of learning, but only to indicate the possibilities of research in the area of learning.

The area of learning can be sub-divided into

a. The capacities of the learner-His intelligence and abilities.

b. The individual differences in learning.

c. Readiness to learn.

d. Motivation and learning.

e. Incentives and learning-reward and punishment.

f. Interest and attention.

g. Remembering and forgetting.

h. Transfer of learning.

i. The nature and course of learning.

j. Emotion and learning.

k. Measurement of learning - evaluation.

Unless these areas are touched upon by research workers it cannot be said that the area of learning is fully explored. The possibilities of research in these areas have to be found out. An attempt is made in the following pages to indicate certain topics for research.

1. Finding out the typical mental ability at each grade and age level.
2. Development of Intelligence tests to provide an estimate of the child's ability to learn.
3. Finding out the measurable traits that are the best indicators of general learning ability.
4. Finding out variations in these traits that children of the same chronological age show and how much overlap is there in learning ability among different chronological age groups.
5. How is age related to variations in learning ability? Is there greater difference between bright and dull 12 year-old children than between bright and dull six year old children?

6. How do bright and dull children of the same mental age differ other than in rate of mental growth, and which of these differences require classroom adjustments?
7. What can children with various I. Q.'s be expected to accomplish? What final educational and vocational level can they achieve ?
8. How can we use the results of Intelligence tests to predict learning ability ? How much confidence can we have in various types of intelligence tests ?
9. What special abilities and aptitudes should we consider as we work with children ? To what extent are special abilities, such as artistic and mechanical ability, related to general mental development ?
10. In average ability of pupils to learn, are there sufficient differences among schools to require substantial adjustments in teaching methods and educational materials ?
11. How to adjust instructional goals and materials to pupil differences in learning ability ?
12. At what age does ability to memorize stop or decrease ?
13. What are the factors that develop the power of memory ?
14. What is the capacity of children of various age groups to memorize different digits ?
15. How far is vocabulary test a measure of general intelligence and capacity to learn ?
16. What is the normal distribution of M. A. or I. Q. or Ability to learn among the groups of children in our classrooms ?
17. Studying a group of children who are identical in Mental age and comparing them on measures of other traits.
18. How to idiots behave ? What are they capable of ?
19. How do imbeciles behave ? What are they capable of ?
20. How do morons behave ? What are they capable of ?
21. Finding out the average I. Q. 's of persons doing different professions and different levels of academic achievements.

22. Finding out the relationship between the socio-economic level of the family and intelligence of the child.
23. Relation between rural urban population and intelligence.
24. Relation between father's occupation and intelligence of children.
25. Finding out the medium I. Q.'s at different levels and types of College students.
26. Relationship between ability or disability in reading and the scores achieved in group intelligence tests.
27. A study of teachers' comments and students' performance.
28. The effect of repeated praise or blame or the work achievement of introverts and extraverts.
29. A study of the leisure time activities of children as a clue to their interests.
30. A study of memorisation and recall of sense and nonsense syllable.
31. A study of the learning ability and its relation to the age of the learner.
32. A study on the rate of forgetting.
33. A study of how similarity of materials learnt affect the rate of forgetting.
34. A study of the effectiveness of the alternative practices of reading and recall on the speed of learning.
35. A study in retention of (classwar) learning.
36. A study on the effect of review on learning.
37. The effect of cramming on permanent learning.
38. A study of the effects of distributed practice on the rate of learning.
39. A study of the combination of sensory experiences and the rate of learning.
40. The effect of Guided Learning on the rate of learning.

41. A study of the relationship between thoroughness in learning and the rate of forgetting.
42. A study of the relationship between reading ability and the behaviour of the student in the classroom.
43. Development of norms for reading at each grade level.
44. A study of the relationship between reading ability and the level of intelligence.
45. A study of the distribution of reading ability among different standards.
46. A study of the relationship between comprehension from reading to comprehension from listening.
47. A study of the reading ability from elementary school to the college level.
48. A study of efforts taken and techniques taught by schools to improve reading ability of students at each standard.
49. A study of the reading ability and the High School drop out.
50. Improvements in reading rate and comprehension of subjects training with reading accelerators and tachistoscope.
51. The effect of changed environmental conditions upon the results of college examinations.
52. The interrupted task method in studies of selective recall.
53. Study of vitamins B deficiency and learning of rats.
54. The influence of voluntary induced tension on problem solving.
55. Similarity in stimulating conditions as a variable in retroactive inhibition.
56. The effect of different environments during infancy on adult behaviour of rats.
57. The effect of the reward upon the maze performance of rats.
58. The role of incentive in conditioning and extinction.
59. Extinction with and without sub-goal reinforcement.

60 Interferences with recall of original responses after learning new responses to old stimuli.

61. An experimental test of the "Transfer of retroaction surface".

62. Temporal conditioning Vs. anxiety reduction in avoidance learning.

63. Retroactive inhibition or facilitation from interpolated learning as a function of time.

64. The effect of instructions upon sensory preconditioning of human subjects.

65. The effect of some early experiences in the latent learning of adult rats.

66. Food taken as incentives for learning.

67. The effect of magnitude of reward and degree of deprivation on the acquisition of a complex maze habit.

68. Amount of reinforcement and level of performance.

69. Drive-level and reinforcement.

70. Anxiety, anxiety reduction and stress in learning.

71. The role of secondary reinforcement in partial reinforcement learning situation.

72. The behaviour of white rats under food and electic shock stimulation.

73. An experimental test of the continuity theory of discrimination with pattern vision.

74. Quantitative studies of the interaction of simple habits.

75. Critical conditions influencing sensory conditioning.

76. Experimental studies of punishment.

77. Generalisation of Secondary reinforcement from the primary drive.

78. A study of motivating conditions necessary for secondary reinforcement.

79. Complex learning and conditioning as a function of anxiety.

80. The effect of emotionally toned words on non-serial order learning.
81. Strength of conditioning in rats under varying degrees of hunger.
82. Higher order conditioning with constant motivation.
83. Retention and subsequent extinction of a simple running response.
84. The nature of the effect of free-environmental experience in the rat.
85. The effect of early perceptual learning on the behavioural organisation of adult rats.
86. Early visual and motor experience as determiners of complex maze learning ability under rich and reduced stimulation.
87. A learning set in maze learning.
88. The retention of materials presented during sleep.
89. The effect of magnitude of reward on maze learning in the white rat.
90. The effect of spacing of trials on the acquisition and extinction of a conditioned operant response.
91. Retroactive inhibition as a function of degree of generalisation between tasks.
92. The influence of attitude on the conditioned eyelid response.
93. The acquisition and extinction of conditioned eyelid responses as a function of the percentage of fixed - ratio random reinforcement.
94. Visual discrimination learning with simultaneous and successive presentation of stimuli.
95. The effect of intense stimulation experienced during infancy on adult behaviour of rat.
96. Experiments on the influence of the amount of reward on learning in young chicken.
97. Motivation as a factor in the acquisition of new responses.

98. Further effects of added Thiamin on learning and other processes.
99. The ability of the Vitamin deficient rat to discriminate between diets containing and lacking the Vitamin.
100. Transfer of response in the discrimination of brightness and size by rats reared in total darkness.
101. Distributed practice in Motor learning. Score changes within and between daily sessions.
102. Experimental studies in rote learning Theory. Reminiscence following learning by massed and distributed practice.
103. Distribution of practice with varying speeds of syllable presentation.
104. Comparison of reminiscence in serial and period-associate learning.
105. Pre-learning syllable familiarization and the length difficulty relationship.
106. The concept of habit, family hierarchy and maze learning.
107. The good-gradient hypothesis applied to some 'field force problems' in the behaviour of young children.
108. A comparison of learning under motivated and satiated conditions in the white rat.
109. The role of similarity in retroactive inhibition.
110. The influence of machanical guidance in maze learning.
111. A comparison of learning and retention of materials presented through the visual and the auditory media.
112. The retention of Verbal and motor skills.
113. A study of the phenomenon of differential motivational control of the utilization of habits.
114. Mental set in relation to retroactive inhibition.
115. Classroom experiments on mental set.
116. The effect of manual guidance on maze learning.
117. The direction and extent of intra-serial associations at recall.

118. The effect of stimulus position on visual discrimination by the rat.

119. The relationship between anxiety level and several measures of intelligence.

120. Fear as motivation and fear-reduction as reinforcement in the learning of new responses.

121. The effect of activity upon learning and retention in the cockroach.

122. The role of anxiety in serial rote learning.

123. Anxiety reduction and learning.

124. Time as a determinant in integrative learning.

125. Electric shock for correct responses in the visual discrimination habit.

126. An experimental test of the theory of associative interference.

127. The effect on subsequent maze learning ability of graded amounts of Vitamin B in the diet of very young rats.

128. Meaningful similarity and interference in learning.

129. An investigation into the causes of retroactive interference.

130. A quantitative investigation of the delay of reinforcement gradient.

131. Learning ability in rats given electro convalsive shocks in late infancy.

132. The experimental analysis of motivational factors in perception.

133. An experimental analysis of learning without awareness.

134. A quantitative study of mearning by a conditioned salivary technique (semantic conditioning)

135. Stimulus generalisation of conditioned responses.

136. An investigation of the establishment and operation of mental sets.

137. A repetition of the Blodgett experiment on latent learning.

138. Acquisition of a simple spatial discrimination as a function of the amount of reinforcement.
139. The effect of delayed feeding on white rats in a problem cage.
140. The similarity factor in retroaction.
141. Maze learning in the absence of primary reinforcement.
142. Mediated association in the learning of paired associate materials.
143. The relationship between success and the laws of conditioning.
144. A study of training conditions necessary for secondary reinforcement.
145. An experimental study of Guthrie's theory of reinforcement.
146. An experimental test of Freud's docrine of the relation of hedonic tone to memory revival.
147. Judgement of emotional responses from motion picture views and from actual observations.
148. An experimental study of the mental processes of the rat.
149. The role of effect in the performance of a distance discrimination by albino rats.
150. The differential response in animals to stimuli varying within a single dimension.
151. An experimental theory of the continuity and non-continuity theories of discrimination learning.
152. An experimental test of the sign-Gestalt theory of trial and error learning.
153. The factors determining the difficulty of blind alleys in maze learning by the white rat.
154. Some factors affecting the conditioning of the galvanic skin response.
155. The effect of coffeine on experimental extinction of conditioned reactions.
156. The effect of restricting early experience on the problem solving capacity of dogs.

157. The effect of early restriction on activity of dogs.
158. Length of practice period and efficiency in motor learning.
159. Effect of a 'set for speed' on 'learning without awareness'.
160. Analysis of the function of a secondary reinforcing stimulus in a serial learning situation.
161. Temporal and effort factors in the acquisition and extinction of an avoidance response.
162. The effect of sleep prior to learning.
163. An experimental test of the law of assimilation.
164. The effect of individual failure and success on memory measured by re-learning.
165. Obstacles to the development of reflective thinking in the secondary school and practices used to overcome them.
166. Implications of creative experiencing for the school leavers.
167. A study of the evaluative practices in a particular standard in a particular school.
168. Guiding the intellectually gifted children in the group processes.
169. A selection of supplementary books for remedial readers in the fourth, fifth, and sixth graders.
170. Using problems in High School chemistry laboratory for reflective thinking.
171. A study of the incentives used in schools and their effect on learning.
172. The use of group rivalry as an incentive to learning.
173. The relation of speed in learning to the amount retained.
174. An investigation of the ability to work in groups and in isolation.
175. A study of the threat of failure as an incentive to learning.
176. Recitation or recall as a factor in the learning of passages.

177. The influence of pleasantly and unpleasantly toned words on retention.
178. Effect of continuous work upon the capacity of learning.
179. Can children learn anything that adults can and more efficiently?
180. Retroactive inhibition and facilitation in the learning of school materials.
181. A comparison of incidental and purposeful memory for meaningful and non-sense materials.
182. A study of the level of aspiration of academically successful and unsuccessful High School Students.
183. The effect of spaced learning on the curve of retention.
184. Effect of early father absence on scholastic attitude.
185. The effect of sleep on retention of learning.
186. The effect on forgetting of retroactive and proactive inhibitions.
187. The effect of the passage of time on retention of a specific list and on transfer effects.
188. The relationship between proficiency of the learning of various kinds of materials and the chronological age of the learner.
189. Frequent test as a motivating factor in large lecture classes
190. The study habits of failing and successful candidates in college classes and high school classes.
191. Methods of learning as factors in the prediction of school success.
192. A study of the methods of how the poorest student studies.
193. A comparison of logical and verbatim learning of prose passages.
194. Effect of periodic self-evaluation on students' achievement.
195. Over learning and the retention of meaningful prose.
196. Class results with spaced and unspaced memorizing.

197. The relationship between the length of interval separating two learning tasks and performance on the second task.

198. A study of the reading readiness test as a predictive measure of readiness to read in a first grade group.

199. A study of the educational needs of the gifted pupil.

200. A diagnosis of the reading abilities and difficulties of a group of pupils.

201. The prevalence of reading retardation among juvenile delinquents.

202. A study of the slow learning class with special reference to speech.

203. The effect of incentives on the learning of spelling.

204. Reading problems in elementary schools.

205. Reading readiness in the first grade developed by use of text books and by experience charts.

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2. Bugelski,B.R. (1956) *The Psychology of learning*. New York: Henry Holt and Company.
3. Ausubel, David. P. (1968) *Educational Psychology - A cognative View.* New York: Holt, Rinehart and Winston, Inc.
4. Smith, Henry P., (1962) *Psychology in Teaching*. Englewood Cliffs, N.J. Prentice-Hall, Inc.
5. Chester W. Harris, (Ed) (1960) Encyclopedia of Educational Research, New York: Macmillan Company, Third edition.

APPENDIX II

USEFUL REFERENCE MATERIAL

A. Useful Source Material for Educational Research

1. ALEXANDER, C. and BARKE, A. J. (1950) *How to Locate Educational Information & Data.* New York : Bureau of Publications, Columbia University.
2. BISWAS, A. and AGGARWAL, J. C. (1971) *Encyclopaedia Dictionary and Directory of Education.* New Delhi: The Academic Publishers.
3. BLISHEN, E. (1969) *Blond's Encyclopaedia of Education.* London : Blond Educational Ltd.
4. BRICKMAN, W. W. (1949) *Guide to Research in Educational History.* New York : New York Union, Bookstore.
5. BUCH, M. B. ed. (1974) *Survey of Research in India.* Baroda : Centre of Advanced study in Education.
6. BURKE, A. J. and BURKE, A. M. (1967) *Documentation in Education.* New York : Teachers College Press, Columbia University.
7. BUROS, K. (1933-1960) *Mental Measurement Year Books.* New Brunswick : Rutgers University Press.
8. DEIGHTON, L. C. (1971) *Encyclopedia of Education.* New York : The Macmillan & The Free Press.
9. GOOD, C. V. (1945) *Dictionary of Education.* London : McGraw-Hill Book Co.
10. GRAY, R. A. *Doctor's Theses in Education.* Guidance Monograph Series (1968) Boston : Houghton Mifflin Co.
11. HARRIS, C. W. (1960) *Encyclopedia of Educational Research.* New York : MacMillan.
12. Indexes and Abstracts, (1932) *Educational Index.* New York : Wilson.
13. Indian Year books of Education (1947-1973) New Delhi : N. C. E. R. T.

14. Marrone, R.L. and Rasor, R.A. (1972) *Behaviour Observation and Analysis.* Sanfrancisco : Rinehart Press.

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26. Winn, R. B. (1943) *Encyclopedia of Child Guidance.* New York : Philosophical Lib.

27. Worcester, C. M. (1932) *Psychological Register, Mass:* Clark University.

28. *American Periodicals*

   i. American Educational Research Journal
   ii. Educational and Psychological Measurement
   iii. Journal of Educational Psychology
   iv. Journal of Educational Research
   v. Journal of Teacher Education

29. *British Periodicals*

   i. British Journal of Educational Psychology
   ii. Educational Research
   iii. International Journal of Psychology
   iv. Occupational Psychology.

30. *Indian Periodicals*

   i. Indian Educational Review
   ii. Indian Journal of Adult Education
   iii. Indian Journal of Applied Psychology
   iv. Indian Journal of Experimental Psychology
   v. Indian Journal of Mental Retardation
   vi. Journal of Educational Psychology
   vii. Journal of Educational Research and Extension
   viii. Journal of Psychological Researches
   ix. Journal of the Karnataka State Education Federation
   x. Journal of English Language Teaching
   xi. Maharastra Educational Journal
   xii. Quest in Education
   xiii. Rajasthan Board Journal of Education
   xiv. Teacher Education
   xv. Teacher Today
   xvi. The Educational Review
   xvii. The Educational Quarterly
   xviii. The Mathematics Education

B. Useful Source Material for Humanities Research

1. Inter-University Board of India, *Research in Progress* (Vol. 4) *Humanities* (1972). New Delhi: Inter-University Board of India, (Also year or series of the same)
2. Inter-University Board of India, *Bibliography of the Doctoral Dissertations* (1857-1970), New Delhi: Inter-University Board of India.
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19. ICSSR, (1974) *Union Catalogue of Social Science Periodicals*. (Series for various States) New Delhi: Publications Division of ICSSR.

20. ICSSR (1973). *A Survey of Research in Sociology and Social Anthropology Vol. I. II and III*. Bombay: Popular Prakashan Pvt. Ltd.

21. *Indian Periodicals*

    i. PEO, *Documentation Bulletin-Series*

    ii. ICSSR, *Research Abstract Quarterly*

    iii. *International Cooperative Alliance ICA Regional Bulletin*

    iv. *All India Cooperative Review*

    v. *Cooperative News Digest*

    vi. *Agricultural Situation in India*

    vii. Indian Journal of Agriculture

    viii. Index to Indian Economic Journal

    ix. RBI, Statistical Statements realing to Cooperative Movement.

    x. Journal of Institute of Economic Research.

    xi. Indian Industries.

xii. Indian Journal of Industrial relations.

xiii. Journal of Institute of Bankers.

xiv. Inter-Discipline

xv. Behavioural Sciences and Community Development.

xvi. Population Review

xvii. Political Science Review

xviii. Indian Journal of Political Science

xix. Economic and Political Weekly

xx. Indian Journal of Public Administration

22. *International*

i. Review of International Cooperation, ICA, London.

ii. Co-operative News Service, London.

iii. Documentation Bulletin for South-East. Asia, ICA.

iv. Journal of Developing Economics, Tokyo.

v. Review of Economics Studies, (Scotland).

vi. World Abstracts on Rural Sociology and Agricultural Economics (UK)

vii. Agricultural Cooperative Bulletin, ICA (London)

viii. Journal of Agrarian Affairs-Contemporary Issues, (London)

ix. Americal Journal of Agricultural Economics.

x. Social and Economic Studies. (Indonesia)

xi. Rural Economic Problems (Japan)

xii. International Social Science Journal. (UNESCO.)

xiii. Journal of Social Science, (Taiwan.)

xiv. Asian Studies, (Philliphines.)

xv. Bulletin of the Historical Research (London.)

C. **Useful Source Material for Home Science Research**

1. Indian Journal of Medical Research
2. American Journal of Clinical Nutrition
3. Proceedings of the Nutrition Society of India
4. Indian Journal of Nutrition and Dietetics
5. Social Welfare
6. The Indian Journal of Home Science
7. Journal of Family Welfare
8. Yojana
9. Journal of Educational Research and Extension
10. Housing Review
11. Home Economics
12. House Craft
13. Journal of Home Economics
14. Women's Forum
15. Journal of Extension
16. Visual Education
17. Social Change
18. Indian Journal of Extension Education
19. Kurukshetra
20. Rural India
21. The Indian Textile Journal
22. The Textile Magazine
23. Man made Textiles of India
24. Indian Silk
25. Crative Needle Craft

APPENDIX III

MECHANICAL AIDS IN INFORMATION PROCESSING PLACE AND USE OF CALCULATORS AND COMPUTERS IN RESEARCH

T. R. Soundararaja Rao

1. Need for Aids

The impact of scientific discoveries is felt in every walk of life. So too in research activities. In the early days of research, the activity was almost equated to speculative thinking. Then came the tendency to apply scientific methods to research and the research process became more meaningful and reliable. The study of communication, nature of information and the processes of encoding and decoding have influenced research programmes. Now, we have many aids to help the research worker in the processing of information one collects.

The use of such aids stems from the following considerations. In the past the time factor in research was treated rather liberally and the research process itself was slow in the processing of information. The modern tendency has been to cut down this time factor. Man wants to calculate faster. This has been achieved by the use of aids.

The second factor is that of accuracy. Human error in calculation can be controlled considerably but not eliminated. Speed factor worked against accuracy, particularly with human beings. The use of aids combines the speed factor with accuracy.

The third important factor in favour of the use of aids, which is perhaps more convincing than the first two, is that it relieves the precious human mind to work on higher mental tasks than mere calculation. A laborious part of the research work is taken out by these aids, which can be operated quite easily so much so the scientist or the research worker is now free to apply his energy on more important aspects of the research programme. This is an extremely important aspect because this greatly accelerates the process of research.

2. Types of aids

There are several types of aids in the field of information processing. The quantification of qualitative data and the application of statistical methods were probably responsible for the use of calculators. There are different kinds of such calculating aids.

1. Aids like ready reckoners, statistical tables, logarithmic tables. These are available in printed form and a research worker has only to look at the relevant table.

2. Aids like slide rules, graphs, nomographs, abacus which require some manipulation in its use. One should learn how to use these devices.

3. Calculators which are activated mainly by human energy. Many of the crank driven calculators require that the data is put into the machine by depressing certain keys and then rotating a handle will make the machine function.

4. Calculators which are activated mainly by electrical energy. This is similar to the above mentioned calculators except for the fact that the machine operates on electrical energy. The cranks and gears are usually linked with an electric motor which makes them work.

5. Electronic calculators are of recent origin. This type of calculators which make use of electronic devices, are very handy and small and work much faster than the other calculators. Most of these calculators have very little moving parts so that they are quicker and more efficient.

6. Computers, the most modern of the aids, which can process any type of information can perform many more different types of operations and calculations than the calculators.

Each of these aids have their own advantages and disadvantages. A good research worker has to be conscious of these before making use of these aids.

3. **Tables, graphs, slide rules etc.**

These aids are quite simple. Every research worker must be able to refer to a table or use a graph to get required information. This type of aids has the advantage of being very simple and readily understood by any person; it needs very little training.

4. **Calculators**

There are different types of calculators and the exact operations differ from model to model. Most of the calculators can perform the following operations. Addition, subtraction or a combination of these operations on a number of values, chain multiplication, squaring and adding, division. But some of them cannot do square-root operation. This is a big disadvantage. The older type of calculators did not care for the position of decimal point. They perform the calculations on integers and the decimal point is fixed by the operator. Modern electronic calculators do this automatically-a big advantage.

Before selecting a calculator, the research worker must be conversant with his requirements and find out if the calculator can perform them.

Most of the modern calculators are made with accounting needs in view. In ordinary routine accounting work, the need for finding out square roots or using trigonometric functions is rare and hence the problem.

Some calculators include some sort of a device for storing the results of intermediate calculations and use them later.

Thus before selecting and using a calculator one should know what it can do and what it cannot do. But in any case these devices relieve the research worker from a very big mental strain and frees him for higher work.

5. Computers

Much is talked about computers. It is perhaps the most important invention of the 20th century; its impact is being felt in every branch of science. It will perhaps have a more pronouncing impact than the invention of the printing press. The printing press opened the doors of quick, efficient propogating of information. It is also true in a way that the computer is one of the most foolish machines. It cannot perform anything by itself. Some one has to instruct the computer as to what it has to do. And if the instructions go wrong, the computer does not bother, it follows those wrong instructions and produces nonsense. This art of instructing the computer as to what it should do, is termed programming. A good research worker should have at least an elementary knowledge of this 'Programming' so that he can use the computer to his advantage. He may not know anything about the computer mechanism. He is like a lay man who has learnt to tune a radio and listen to the music, without the knowledge of the interior of the radio.

The simplest programming language which any research worker can learn with a little effort is FORTRAN II. This word FORTRAN stands as an abbreviation of FORmula TRANslation. A more advanced form of this language is FORTRAN IV. This programme language is most suitable for scientific calculations.

If one wants to use a computer, one should first prepare to deal with the machine. We must communicate the data and the method of processing to the machine and this is achieved primarily through punched cards. All information is translated into punched cards and these cards activate the various circuits in the computer to produce necessary results.

The following are a few illustrative FORTRAN statements and explain what the computer will do when it meets such statements.

a) **In-put/out-put statements.**

READ 100, A, B, N

The computer will read the values of A, B and N and retain it in its memory.

100 FORMAT (F 4·2, F 5·3, I 4)

This indicates the nature of variables A, B and N.

PUNCH 100, A, B, N

The computer will punch the values of A, B and N on a card.

PRINT 100, A, B, N

The computer will print the values of A, B and N in the appropriate form.

b) Arithmetic Statements.

SUM = 2·0 * A + 4·0 * B + A ** N

The computer will calculate $A^N + 2A + 4B$ and store the answer under the name 'SUM'. The values for A, B & N should have been supplied earlier.

c) Control Statements.

GO TO 40

The computer takes instruction from a statement numbered 40 and proceeds further.

DO 50 I = 1,100

....

....

50 CONTINUE

These two statements form a loop. The computer will execute all the instructions between these two statements a hundred times and then go to the next step. This is useful when the same calculation is to be repeated a number of times with different values.

IF (BANK) 45, 55, 65

This statement is useful if one wants to direct the computer to take different directions of computation depending on the value of "BANK". If the value is negative, the instruction from statement number 45 is followed. If the value is Zero, the instruction from statement number 55 is followed. If the value is positive the instruction from statement number 65 is followed.

DIMENSION TN(50), TV (50)

This statement instructs the computer to reserve 50 spaces in its memory to store 50 values of TN and another 50 spaces to store 50 values TV.

Computers can do different kinds of jobs. To illustrate a few, it can be used to do all kinds of sorting and classification. Give a long list of numerical values or names; it can sort them according to our requirements. The formation of frequency distributions can be classified as a kind of sorting work. Another example is that of analysing the marks obtained by a student and declaring the results. It can do various types of calculations, no matter how complicated they are. It can do logical computations - depending upon the truth value of a statement, do different calculations; it can simulate situations as directed by the research worker and it can feed us back with results in various forms.

When a researcher wants to make use of a computer, he has to make necessary preparations for the same. The preparation includes the following.

i. A very clear, well defined, idea of what information he is going to put into the computer and what out-come he wants. In other words, he must be very clear about his job.

ii. Either the researcher or some one else must prepare the programme for the job. This is a technical job which requires learning and training.

iii. He must prepare the data, in the form in which it could be fed into the computer. This is necessary because of physical limitations.

iv. He must be alert during processing for meeting any error in the processing which the computer may not be able to deduct.

v. He must be able to read and interpret the output from the computer.

The high cost of the computer time and our lack of skill in its uses are perhaps the two reasons which have prevented the common research worker from using this versatile instrument. As a substitute, we can plan for smaller data processing laboratories.

6. Data Processing laboratory

A data processing laboratory may be conceived as a place where the researcher has facilities for processing the data. This laboratory may be a common one for two or three research institutions. This will also be a link between the research worker and the computer centres.

The equipment for a typical data processing laboratory may be as follows.

i. Calculating devices
ii. Card punches
iii. Verifiers
iv. Sorter-counter
v. Programme library

If the laboratory is to be used by about 40 research workers, we may require roughly 8 calculators, 2 card punches, 1 verifier, one sorter-counter. The utility of the centre may be increased by a staggering of the research work. At present, the bulk of the research work starts at the same period and ends on the same date. This results in the need for processing equipment towards the end-a rather heavy demand and the equipment may be idle at some other period. This is an avoidable factor and the stress on the research guides can also be reduced if some kind of staggering could be done.

Also such a laboratory would provide for a rich experience to the research worker and would broaden his vision. There is also a note of caution that is necessary here. It should not be misconceived that this laboratory is a place which can relieve the research student of all processing work. The laboratory should provide the equipment, which the individual cannot afford to own but the responsibility of using them should be on the student or research worker.

APPENDIX IV

CONSTRUCTION OF ATTITUDE SCALES THE LIKERT METHOD

R. Sudarsanam

Likert's Summated Ratings

The method of Summated Ratings owes its origin to Rensis Likert. "This method is an application of item-analysis procedures borrowed from test construction techniques" (Remmers, 1954). The steps involved in this procedure are as follows:

The first step relates to the collection of a number of statements, according to certain criteria, which express different shades of opinion. The carefully edited list of statements is then presented to a jury and classified into two categories as those which express a favourable attitude and those which express an unfavourable attitude. The next step is to try out the entire list on a small sample of the subjects, whose attitudes are to be tested later. Every statement is endorsed by the subject on a five point scale, ranging from 'strong agreement to strong disagreement'. The next step involves quantifying the indicated responses. A system of arbitrary weights is usually used so that strong agreement with favourable statements, and strong disagreement with unfavourable statements are given the highest weight. A subject's score is the sum total of the weights assigned to the responses he has made. The items are then analysed for their discriminating power. Several statistical procedures have been developed for item-analysis work. It is customary to split the whole group into two groups as having highly favourable attitude and highly unfavourable attitude. The mean score and the standard deviation for each item are calculated for each group and the difference between the means tested for significance by the use of 't-test'. Items which show high critical ratios are selected for inclusion in the final scale. The final scale is used with the five categories of responses and scored as before.

The chief advantage of Likert's method over Thurstone's is the avoidance of the elaborate classification of statements at the initial stage.

Criteria for the Choice of Statements

The following set of criteria can be used in selecting statements for the construction of the attitude scale. A list of about 300 statements have to be drawn and out of them, statements which satisfy the following criteria have to be selected. Otherwise, statements will be vague and ambiguous.

Criterion 1 The statement should express one opinion or thought; it should involve only one idea.

Criterion 2 The statement should not be factual; it should be capable of eliciting an opinion.

Criterion 3 The statement should be so worded that it is easily understood by all the subjects.

Criterion 4 The linguistic structure and words should be simple and should not lead to multiple interpretation.

Criterion 5 The statement should not be composed of double negatives.

Criterion 6 The use of modifiers (like only, just, merely, all, etc., and adjectives) should not be such as to cause ambiguities.

Criterion 7 The statement should not be such that it is endorsed by almost everyone or by almost no one.

The statements that are finally selected on the basis of these criteria should be subjected to a pilot-study in co-ordination with a questionnaire on the subject's socio-economic-educational back-grounds for necessary correlational studies. The statements are sent for jury opinion and classified as those expressing favourable attitude or unfavourable attitude. Now the attitude-scale and Questionnaire are ready for pilot-study.

Pilot Study

The introduction letter to the subjects, attitude scale and questionnaire should be duplicated. The investigator should personally administer the questionnaire to the subjects and explain to them the purpose of the study and how the subjects should answer the questionnaire and the attitude scale items on a five point scale. (Seven point scale may be too subtle for regular use). Then the subjects should be allowed to answer the items under supervision thus avoiding the influence of mutual consultations. Whenever doubts are raised by the subjects, they should be requested to underline those ambiguous phrases or sentences - which could help the investigator correct these ambiguous or confusing expressions while preparing the final questionnaire. No time limit should be fixed; the subjects should be encouraged to answer the questionnaire completely. Having administered the questionnaire, the next step is to score the responses to the attitude scale items. For each statement, the subject asked to make a tick on one of the five-point columns.

The items may be scored as follows. The favourable items may be weighted as follows:

5 points for a tick in 'strongly agree' column,

4 points for a tick in 'agree' column,

3 points for a tick in 'no opinion' column.

2 points for a tick in 'disagree' column, and

1 point for a tick in 'strongly disagree' column.

The weights should be in the reverse order for the unfavourable items. Each individual's score is the total number of points for all the items. A few items may be however, found unmarked and a weight of 3 points may awarded in each of these cases. The possible range of scores for the scale may be calculated from the total number of items with weightages of 1 and 5 respectively for statements expressing unfavourable or favourale attitude. A mid-point score indicates neither favourable or unfavourable attitude.

According to the total scores of the subjects, the subjects may be arranged in descending order from those of highly favourable attitude to less favourable ones. This arrangement will help in selecting those statements which will discriminate the subjects with greater degree of reliability. The main aim of the pilot study is to select items which discriminate those with favourable attitude from those with unfavourable attitude. For this purpose, the item analysis may be carried out as described below.

Item Analysis

The entire group should be arranged according to the attitude score. Twentyseven per cent of the area covered by very high scores and 27% of the area covered by very low scores are the optimum groups for use when item-analysis data are to be obtained. "We make use of the proportions of successes in the highest and lowest 27% of the sample simply because these data are those employed in obtaining a discrimination index" (Davis, 1949). Now there will be two groups of subjects and for each statement in the subjects of these groups, statistical analysis relating to critical discrimination ratio should be found out. So each statement is then analysed to find out the frequency of different weights, both in the 'High' and the 'Low' groups. From these frequencies, the mean and the standard deviation for each item may be calculated, so that the difference between the means may be tested for significance by the t-test. The formula for calculating the critical ratio is as follows:

$$t = \frac{M_1 - M_2}{\sqrt{\frac{SD_1}{N_1} + \frac{SD_2}{N_2}}}$$

where

M_1 denotes the Mean of the item in the 'High Group'.

M_2 denotes the Mean of the item in the 'Low Group'.

SD_1 denotes the Standard Deviation in the 'High Group'.

SD_2 denotes the Standard Deviation in the 'Low Group'.

N_1 and N_2 denote the number of cases in the Groups.

This formula is a little cumbersome, especially when a number of repeated calculations are involved. This can be easily transformed into a more convenient form where the critical ratio can be calculated without the need for completing the calculations of the means and standard deviations. This transformation is applicable whenever N_1 and N_2 are equal. The transformed formula is as follows :

$$t = \frac{\Sigma Fx - \Sigma fx}{\sqrt{A + B}}$$

where

x denotes the weight

F denotes the frequency of the weight in the 'High Group'.

f denotes the frequency of the weight in the 'Low Group'.

Σ denotes the summation of similar terms.

$$A \text{ equals } \Sigma Fx^2 - \left(\frac{\Sigma Fx}{N}\right)^2$$

$$B \text{ equals } \Sigma Fx^2 - \left(\frac{\Sigma fx}{N}\right)^2$$

The derivation of this formula is shown at the end of this paper. The results may be tabulated for each statement in a convenient form as shown in the table below:

Table 1 : **A sample table showing tabulations for calculation of critical ratio**

Statement No. 76	High Group			Low Group		
Weight 'X'	F	FX	FX²	f	fx	fx²
1	—	—	—	2	2	2
2	—	—	—	8	16	32
3	3	9	27	3	9	27
4	7	28	112	7	28	112
5	12	60	300	2	10	50
Total	22	97	439	22	65	223

Using the above formula 2,

$$A = 11{\cdot}4 \qquad B = 31{\cdot}0$$

$$t = \frac{97 - 65}{\sqrt{11{\cdot}4 + 31{\cdot}0}}$$

$$= \frac{32}{\sqrt{42{\cdot}4}} = \frac{32}{6{\cdot}51} = 4{\cdot}910$$

The above table is an adaptation of the table suggested by Pauline Young. (Young 1961)

Final selection of Statements

The critical ratios should be calculated for all the items and a preliminary selection of 40 items or 50 items having high critical ratios may be made. It may be found that a few statements may have negative discrimination and they should be omitted. The top 40 selected statements may not cover all the areas or aspects that may be pertinent to the topic of study. And there may be too many statements expressing unfavourable opinion. Two courses are now open; One, to select all the statements as such without any consideration for the coverage of all the aspects and two, to drop statements in areas over-represented and select suitable ones from other areas. It should be understood that a coverage of all aspects is more important since such a treatment would give a broader basis and cover more of the factors which are likely to affect the attitudes. It may however be decided that no statement with a critical ratio below 2·69 be selected, this being the minimum critical ratio required at 1% level, for 80 degrees of freedom. Equal number of statements expressing favourable attitudes and unfavourable attitude may be selected by selecting statements above a suitable critical ratio for each group. In this way necessary number of statements may be finally selected for final study.

Finalising the questionnaire

The responses to the various items in the questionnaire should be then analysed with a view to finalising their wording and format. Many of the common items like 'age', 'sex', 'material status' etc., may not need any revision. On the basis of the pilot study, it may be seen that some questions relating to new information may need to be included and some redudant questions omitted. There may be enthusiastic responses to our request for their suggestions for improving a particular area and for the final study: these 'suggestions' may be grouped under pertinent heads and presented with a request that they may be ranked according to the order of importance. All loaded questions may be omitted and answers to open ended questions may also be collected under the above 'suggestions', and the subjects may be asked to rank them. The final tool, thus evolved, will contain a letter of introduction, the 40-item attitude scale, the questionnaire and the suggestions for ranking in order of importance to the subjects. Such a tool will be of immense help for making differential and correlational studies.

A case-study

Now I shall seek to show how these steps were followed in my study titled, "A study of the attitude of teachers of English in Coimbatore to using modern techniques of teaching English", which I did as part fulfilment of my M. Ed., programme. As the content topic was teachers teaching English, all the probable areas in teaching English (Part I) and relating to teaching profession (Part II) were listed. "A professional attitude is a specialised occupational tendency to act, arising from skill in a highly complex and limited field" (Bogardus, 1954). The areas denoting one's attitudes under Part I were,

i) Towards English as a language.
ii) Towards organisation of the English work.
iii) Towards Teaching prose-aims, choice of methods and lessons; classroom techniques, use of audio-visual aids and follow-up work.
iv) Towards Teaching poetry.
v) Towards Teaching Non-detailed lessons.
vi) Towards Teaching composition lessons.
vii) Towards Tests and Examinations in English.
viii) His love for English language and literature.
ix) Popular opinions on English

The areas under part II were

i) Towards Teaching Profession.
ii) Towards his colleagues.
iii) Towards his students.

A list of 250 statements was drawn and sent to a panel of seven members consisting of a College Professor of English in a Training College, a lecturer in a Training college, two headmasters, a headmistress and two senior teachers in English with a request that the statements may be weighed against the criteria of initial selection and may be classified into those expressing a favourable attitude and those expressing an unfavourable attitude. The consensus of opinion of the jury was thus worked out, and on their advice many statements were omitted and some reworded. At this point there were 172 statements under part I and 18 statements under part II.

A socio-economic, educational questionnaire was then prepared and suggestions under separate headings were invited. Sufficient space was left in the questionnaire form for purpose of eliciting frank responses; the subjects were not required to write their names.

Then the sample for pilot study was drawn from Coimbatore Educational District which has 54 Boy's and Mixed schools and 18 girls' high schools; of these, there are two Government secondary schools, 15 Municipal High Schools, 20 Board High Schools, 8 high (aided Mission) schools and 27 (aided Non-mission) High Schools.

Six representative schools were selected and 39 of B.T. teachers (male and female) and 41 of secondary grade teachers (male and female) representing different age-group and experience were selected for pilot study.

The possible range of scores for both the parts is from $(190 \times 1) = 190$ to $(190 \times 5) = 950$. A score of $(190 \times 3) = 570$ indicated a neutral attitude while score above 570 indicated a favourable attitude and score below 570 an unfavourable attitude.

The entire group of 80 was arranged according to attitude score and the top 27% i.e. 22 scripts and the bottom 27% (22 scripts) were selected for item analaysis. For each statement, the table of analysis was drawn, as illustrated earlier. The critical ratio was worked out for each statement. A coverage of all aspects was desired. So it was decided that no statement with a critical ratio below 2·69 should be selected, this being the minimum critical ratio required at 1% level, for 80 degrees of freedom. In order to accommodate selecting equal number of statements expressing favourable attitudes, statements that expressed unfavourable attitudes with a critical ratio below 3 48 were omitted. In this way part I was formed with 40 statements (19 favourable and 21 unfavourable) and part II with 10 statements. Placing of these statements was decided by lots. The Questionnaire was suitably edited. Thus the final attitude scale was constructed.

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Derivation of the formula for 't'

$$t = \frac{M_1 - M_2}{\sqrt{\dfrac{\sigma_1^2}{N_1} + \dfrac{\sigma_2^2}{N_2}}}$$

$N_1 = N_2 = N$ by selection.

$$M_1 = \frac{\Sigma Fx}{N} \quad \text{and} \quad M_2 = \frac{\Sigma fx}{N}$$

Therefore $\quad M_1 - M_2 = \dfrac{1}{N}\left[\Sigma Fx - \Sigma fx\right]$

$$\sigma_1^2 = \frac{\Sigma Fx^2}{N} - \left(\frac{\Sigma Fx}{N}\right)^2 \quad \text{and} \quad \sigma_2^2 = \frac{\Sigma fx^2}{N} - \left(\frac{\Sigma fx}{N}\right)^2$$

Therefore

$$\frac{\sigma_1^2}{N} = \frac{1}{N^2}\left[\Sigma Fx^2 - \frac{(\Sigma Fx)^2}{N}\right] \text{ and } \frac{\sigma_2^2}{N} = \frac{1}{N^2}\left[\Sigma fx^2 - \frac{(\Sigma Fx)^2}{N}\right]$$

Hence

$$\frac{\sigma_1^2}{N} + \frac{\sigma_2^2}{N} = \frac{1}{N^2}[A+B] \text{ where } A = \Sigma Fx^2 - \frac{(\Sigma Fx)^2}{N}$$

$$\text{and } B = \Sigma fx^2 - \frac{(\Sigma fx)^2}{N}$$

Therefore

$$t = \frac{\dfrac{1}{N}(\Sigma Fx - \Sigma fx)}{\dfrac{1}{N}\sqrt{A+B}} = \frac{\Sigma Fx - \Sigma fx}{\sqrt{A+B}}$$

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