CHAPTER - III

METHODOLOGY
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1. METHODS OF RESEARCH

In every scientific study, data is the only base on which any hypothesis can be tested for its retention or rejection. The processes of interpretation, discussion and drawing conclusions cannot be carried out in vacuum if data is not available. Together with data itself, the method or the technique by which it has been collected is equally significant. Scientific method for data collection has been devised in the research work of social sciences. It essentially consists of systematic and judicious observations. This method brings about unity in social sciences. The unity of all sciences consists in its methods, not in its material alone. Regarding research methods Moulay (60) says:

"There is no natural system of classification of educational research methods which would cause each of the methods to fall neatly into place becomes evident when one considers the differences in the classification systems presented by the different authors of text books and articles in the field."

The authors Hillway as well as Good and Scates have given four methods of research. Cornell and Monroe have classified these methods into five categories. They have also mentioned the possibility of a sixth method. Mouly and Best have given three basic categories of research methods, which are practically used in research designs and most authors agree on this classification. These methods are -
(a) Historical Method,
(b) Survey Method, and
(c) Experimental Method.

(a) HISTORICAL METHOD:

It is concerned with the past and it attempts to trace the past as a means of seeing the present in perspective. In this method, Documentary and legal researches are included. Though they are not strictly historical in nature, yet they share somewhat the same problems with historical research.

(b) SURVEY METHOD:

It is concerned with the present and attempts to determine the status of the phenomenon under investigation. It has been further classified into five main categories given as under:

(1) Descriptive Method: It is sub-divided into three categories namely:

(i) Survey Testing,
(ii) Questionnaire,
(iii) Interview.

(2) Analytical Method: It also includes the following categories:

(i) Documentary frequency;
(ii) Observational;
(iii) Rating;
(iv) Critical Incident;
(v) Factor Analysis.

(3) School Surveys.
(4) Social Surveys.
(5) Genetic.
The above two methods - Historical and Survey, need not be discussed because these can be found in all standard books on Research Methodology where these have been dealt with exhaustively.

(c) **EXPERIMENTAL METHOD:**

This method is oriented toward the discovery of basic relationships among phenomena as a means of predicting and, eventually, controlling their occurrence. It has also been categorized into four sub-parts which are as under:

1. Simple Experimental Designs;
2. Multivariate Analysis;
3. Case Study;
4. Predictive (Correlational).

It will be quite out of place to give full and detailed description of the various methods or to discuss their comparative value for obvious reasons. Their description is available in almost all text books on educational research.

Since the nature of the problem in hand was experimentation, the researcher selected 'The Experimental Method' as a method in his research work. As the Experimental Method is directly concerned with the research work, it becomes necessary for the researcher to discuss it in a bit detail.

**THE EXPERIMENTAL METHOD**

The experimental method implies the study of the behaviour in a controlled environment. This is a scientific and reliable method and gives more real and true results. In the experimental method, the cause of a problem is searched before finding out the solution of the problem. In order to find out the real cause of a problem, the observer infers certain causes
as there might be many causes of a particular problem. To find out the veracity of the inference is experiment.

The nature of the experiment in psychology may be of two kinds - qualitative and quantitative. When the aim is to study the type of phenomenon observed, the nature of the experiment is qualitative and when it is to measure the phenomenon observed, it is quantitative. Recently much progress has been made in quantitative experimentation. Experiments have imparted an element of precision to psychology, on the strength of which it can claim to be placed with other exact sciences. Psychology owes most of its progress to this method.

The experimental method has made a very valuable contribution in the field of educational research. The development of psychology as an exact science is responsible for its vast scope for practising its principles in education. In almost all the fields of education e.g., methods of teaching, toning up of the school work, curriculum construction, etc., the experimental method is applied to discriminate the prevalent system from the proposed one for improvement and progress. On the basis of this experimental method, under controlled conditions, many experiments about the method of teaching or organization of syllabii etc. are carried on by psychologists, who ultimately arrive at certain conclusions, which are then recommended to the educators. With the help of these suggestions, the educator becomes able to solve many of the puzzling problems which he quite often encounters in and outside the class room.

In this connection, the views of Mouly (62) are worth quoting:-
"The purpose of experimentation is to derive verified functional relationships among phenomena under controlled conditions, or more simply, to identify the conditions underlying the occurrence of a given phenomenon. From an operational point of view, it is a matter of varying the independent variable in order to study the effect of such variation on the dependent variable."

Experimentation facilitates the researchers to improve the conditions under which they observe, and thus, to arrive at more precise and exact results. Certainly experimentation is the essence of the scientific method. The experimental method is comprised of three basic and inter-related conditions - control, randomization and Replication. Unless these conditions are fulfilled, the experiment cannot be interpreted because there is possibility of achieving results influenced by factors other than that under investigation.

It is the experimental method which is considered to be the best one in the research work. It will not be out of point to mention the views of Charles E. Skinner (127) in favour of experimental method for researches. He says that -

"The experimental method is often considered to be the method par-excellence for use in certain researches. ..... Today the educational psychologist begins with a clear notion of the objectives spelled out in terms of behaviors to be developed, and then he devises or uses tests and techniques that will enable him to appraise the outcomes of instruction, that is, to find out to what extent the objectives have been realized."

On account of the complexity of an experiment, it is advisable to clarify the basic aspects of the design as the place
and duration of the experiment. Hence the researcher considers it necessary to explain the experimental design of study taken up by him.

(2) **DESIGN OF THE STUDY**

The problem of the researcher is of experimental nature. Experimental design differs in complexity and adequacy from another design on account of the nature of the problem being investigated, the nature of the data collected, the facilities available for carrying out the study and the competence of the investigator. There are a number of combinations of the various experimental procedures. In this connection, the view expressed in the Encyclopaedia of Educational Research by Monroe (49) may be brought into light in the following words:

"As a technical term - 'experiment', designates a type of research in which two or more groups of subjects are employed. Usually there are two groups, an experimental group and a control group. These groups are usually selected so as to be approximately equivalent in all significant respects and the influences (factors) contributing to a specified effect or outcome, are kept the same for the two groups except in the case of the experimental factor in which a specified difference or change is planned."

George, J. Mouly (63) has described the following basic designs, generally used in the research work:

(1) The Single-group Design;
(2) The Parallel or Equivalent group Design;
(3) The Rotation group Design;
(4) The Factorial Designs.
These designs resemble one another on the basis of purpose and principles of scientific experimentation. Mouly (63) points out that:

"They differ in a particular manner in which they attack the problem, in the degree of accuracy with which they meet the criteria of control, randomization, and replication, and, of course, in the adequacy of the answers which they are capable of providing."

It is not worthwhile for the researcher to describe each design in a detailed manner here, as their detailed description is found in all the books on educational research.

As the researcher used the rotation-group design in his research work, it is of paramount importance to pen down some detail of the concerned design.

**THE ROTATION-GROUP DESIGN:**

Regarding this design Mouly (64) says -

"When the experimental and control groups are only approximately equivalent in relevant factors, it may be possible to conduct the investigation by rotating the groups at periodic intervals."

It is clear from the above statement that in this design the control group uses 'X' method and the experimental group uses 'Y' method for the first half of the experiment and then for the second half exchange of methods is made i.e. the control group uses 'Y' method whereas the experimental group uses 'X' method. Thus groups are rotated in this technique. A comparison would then be made of the relative gains of each of the groups under the two methods. If method 'X' proves to be superior when used by the control as well as the experimental group, the result is
fairly clear. On the other hand if method 'X' proves superior when assigned to the experimental group but inferior when assigned to the control group, it might be suspected that the experimental group is better than the control group in its ability to achieve.

Rotation Group Design is a combination of 'Single-group Design' and 'Parallel Group Design'.

Suppose there are two groups 'A' and 'B' and two methods 'X' and 'Y' to be tested. Let 'X' - Experimental Factor. 'Y' - Control Factor.

For the first half of the experiment -
Cycle I - Group 'A' - Method 'X' (Experimental Method).
            Group 'B' - Method 'Y' (Control Method).

For the second half of the experiment -
Cycle II - Group 'A' - Method 'Y' (Control Method).
            Group 'B' - Method 'X' (Experimental Method).

Cycle I - 'A' - 'X' - R
             'B' - 'Y' - R₁
Cycle II - 'A' - 'Y' - R₂
             'B' - 'X' - R₃

R + R₃ is the result of 'X'
R₁ + R₂ is the result of 'Y'.

The difference between (R + R₃) and (R₁ + R₂) is attributable to the difference between 'X' and 'Y'.

A more adequate design is the rotation of equivalent groups more than two, so that they may be rotated back and forth from one method to the other a number of times.
Keeping in view the discussion of rotation of equivalent groups to get accurate and satisfactory results, the investigator obtained three equivalent groups of boys and also three equivalent groups of girls for the investigation concerning the study of the problem.

The investigator administered the measuring tools described in Chapter - III on boys and girls of Classes VII to obtain three equivalent groups of boy-students and another three equivalent groups of girl-students. Regarding equivalent groups, it is a glaring fact that a researcher cannot have access to identical twins one may obtain equivalent groups in a variety of ways. In learning experiments, for example, one may give all potential subjects the same initial learning test and, on the basis of their scores, derive two or more groups with the same average learning score. Similarly, groups may be equated on the basis of age, intelligence or other factors considered important for the particular experiment.

It has been emphasized by Monroe (50) in Encyclopaedia of Educational Research that -

"Usually satisfactory equivalence will be obtained by matching pupils on the basis of intelligence-test scores (or mental age), chronological age, and initial status in the dependent variable."

This basis was followed by the researcher in his work.

Each of the three equivalent groups A, B and C consisted of 26 boys and another three equivalent groups A, B and C consisted of 38, 37 and 37 girl students respectively were obtained by the investigator on the basis of Intelligence Quotient. The investigator named those groups as Ac₁, Bc₂ and Cc₃ in each
institution for boys and for girls. Here, $C_1$ denotes control group, $C_2$ standing for experimental group I and $C_3$ for experimental group II.

The total duration of the experiment was nine months. The researcher divided this duration into three equivalent terms so that the groups might be rotated after each term and each group might be placed once in each condition control, experimental Group I and experimental Group II during the whole experimentation. The individual position of each group in each school during each term has been shown term-wise as under:

**FIRST TERM:**

(a) Group $A_c_1$ - Controlled.

(Given test after 3 months).

(b) Group $B_c_2$ - Experimental Group I.

(Given frequent tests at regular intervals - say at the end of a month - without giving them the knowledge of their results).

(c) Group $C_c_3$ - Experimental Group II.

(Given frequent tests at regular intervals - say at the end of a month - along with giving them the knowledge of their results).

After the completion of the prescribed period of three months, these groups were rotated. After rotation, the position of each group in each school was as under during the second term:

**SECOND TERM:**

(a) Group $B$ became $C_1$ - Controlled.

(Given test after 3 months).
(b) Group C became $C_2$ - Experimental Group I.

(Given frequent tests at regular intervals - say at the end of a month - without giving them the knowledge of their results).

(c) Group A became $C_3$ - Experimental Group II.

(Given frequent tests at regular intervals - say at the end of a month) along with giving them the knowledge of their results).

Again, after a period of three months, the groups were rotated and the position of each group in each school formed the following shape during the third term.

THIRD TERM:

(a) Group C became $C_1$ - Controlled.

(Given test after 3 months).

(b) Group A became $C_2$ - Experimental Group I.

(Given frequent tests at regular intervals - say at the end of a month - without giving them the knowledge of their results).

(c) Group B became $C_3$ - Experimental Group II.

(Given frequent tests at regular intervals - say at the end of a month - along with giving them the knowledge of their results).

During the whole period of 9 months of programmed testing, the researcher gave detailed direction to each concerned teacher, selected for the teaching of the prescribed subject.
regarding preparation of lesson plans on the topics to be taught from time to time. The investigator corrected their plans for the prescribed topics from time to time and got the topics taught to the students in the scheduled amount of time fixed for the purpose. All the three groups of boys' school and also those of girls school were tested in the same manner stated above.

As regards teacher variable, the investigator equated them on the basis of their intelligence quotient, their qualifications and experience of teaching.

(3) HYPOTHESES

Hypothesis are particularly necessary in studies where cause and effect relationships are to be discovered. They provide direction to research. They bring to light relevant and irrelevant literature and put a check on the collection of useless data. They direct the researcher to judge the relevant situation for the problem at hand. They are the means by which the investigator can clarify the procedures and methods to be used in solving his problem. They also act as a frame-work for the conclusions in a meaningful way.

Regarding hypothesis Mouly (59) says -

"A hypothesis can be considered a tentative generalization about the problem under investigation. It is an assumption or proposition whose tenability is to be tested on the basis of the compatibility of its implications with empirical evidence and with previous knowledge."

According to Deobold E. Van Dalen (17), "A hypothesis serves as a powerful beacon that lights the way for the research worker."
We call any statement about the population, a statistical hypothesis. Testing statistical hypothesis determines if a conjecture about some feature of a population is strongly supported by information obtained from the sample data. This view has been affirmed by the view of Gouri K. Bhattacharya and Richard A. Johnson (2) given below:

"A statistical hypothesis is a statement about the population. Its plausibility is to be evaluated on the basis of information obtained by sampling from the population."

Hence, it is evidently clear that hypothesis is a generalization drawn from the theory itself and when it has been tested and found correct, it becomes a part of theory itself. In scientific research, hypothesis gives points for enquiry in a systematized direction in which the research proceeds. It also helps in selecting useful and retainable things in drawing specific conclusions.

In this study the researcher adopted the Null Hypothesis as it is more exact than the other forms of hypothesis. Garrett (26) has supplemented this view thus:

"A Null Hypothesis is ordinarily more useful than other hypothesis because it is exact."

**THE NULL HYPOTHESIS:**

Gouri K. Bhattacharya and Richard A. Johnson (3) assert:

"When an investigation is aimed at establishing an assertion with substantive support obtained from the sample, the negation of the assertion is taken to be null hypothesis—Ho and assertion itself is taken to be the alternative H1. . . . . . .

The word Null in this context can be interpreted to mean that the assertion purported to be established is actually void."
Garrett (25) has laid emphasis on the importance of the Null Hypothesis as a testing implement. He says - "Experimenter have found the null hypothesis a useful tool in testing the significance of differences". According to the null hypothesis, the researcher assumes that there is no true difference between two population means, and that the difference found between sample means is accidental and unimportant.

In the problem at hand, the following null hypothesis were tested by the researcher:

(1) There is no significant difference in achievement on desired learning outcomes between -
   
   (a) students who are given frequent tests (say at the end of a month) and those who are given only one test after three months.

   (b)(i) students who are given frequent tests without giving them the knowledge of their results; and

   (ii) students who are given frequent tests along with giving them the knowledge of their results.

(2) There is no significant difference in achievement of boys on desired learning outcomes in comparison to girls -

   (a) when they are subjected to frequent testing say at the end of a month and when they are given only one test after 3 months;

   (b)(i) when they are not given the knowledge of their results; and

   (ii) when they are given the knowledge of their results.

(The difference between controlled and experimental groups of boys and girls shall be compared. The comparison of boys and girls shall not be made as difference to sex is always there).
(4) MEASURING TOOLS

The researcher used the following measuring tools and with their help he splitted his each sample, taken from boys' school and girls' school, into three equivalent groups. All the tools utilized in the study are as under:

1. Pre-tests of achievement.
2. Information Schedule for securing family information.
3. Standardized Intelligence Tests -
   a) for children between age group 10 to 16 years.
   b) for adults above 16 years.

The detailed description of each tool has been given in the following pages:

1. PRE-TESTS OF ACHIEVEMENT:

   It was necessary for the researcher to find out the level of achievement of each boy and each girl of each of his sample. For this purpose the researcher went through the whole course of the subject mathematics i.e. arithmetic, algebra and geometry, prescribed for Class VI. He reviewed the books (Government Publication) prescribed by the Education Department of Uttar Pradesh for Class VI. These books are given below:
   a) Arithmetic Part I for Class VI.
   b) Algebra and Geometry Part I for Class VI.

   The researcher constructed two pre-tests - One for arithmetic and the other for Algebra and Geometry combined according to the syllabus prescribed as well as taught during the year - commencing from 8th July, 1973 and ending in May, 1974. The researcher touched every topic of the prescribed course, in the selection of sums to be included in the first pre-test.
concerning arithmetic and the second one concerning Algebra and Geometry (combined).

(a) PRE-TEST OF ARITHMETIC:

This pre-test contains sums relating to each topic prescribed in the course book of arithmetic Part I for Class VI - a Government Publication. The topics are as under:

1) Decimals,
2) G.C.M. & L.C.M.
3) Fractions,
4) Brackets,
5) Ratio,
6) Unitary Method,
7) Percentage,
8) Profit and Loss,
9) Simple Interest.

The sums set in this pre-test paper are graded and arranged in increasing difficulty. This pre-test contains 23 sums with maximum marks 50. Out of these 23 sums, 11 sums have one option, three sums have two options and the rest 9 sums are without option. Each student of the sample had to attempt all the sums.

This pre-test may be seen in Appendix - A at page 182.

The researcher was interested to find out whether the students would be able to solve all the 23 sums within the prescribed time limit of 3 hours. He contacted the following six students of Class VI of other institutions of Kanpur City for this purpose and administered that pre-test on them on 12th April, 1974. The names of these students are as under:

1) Ajay Tewari S/O. Shri Badri Narain Tewari,
   86/182, Deputy-ka-Parao, Class VI,
   Junior High School Deputy-ka-Parao, Kanpur (2.30 hours)
2) Naraindra Singh, S/O. Shri Babu Lal,
   87/52, Bhannana Purwa, Class VI,
   Junior High School, Deputy-ka-Parao, Kanpur. (2.35 hours)
3) Krishan Gopal, S/O. Shri Sunder Lal Dhal.
   57/3, Labour Colony, Govind Nagar, Class VI.
   Mani Hindu H.S. School, Govind Nagar, Kanpur. (2.25 hours)

4) Km. Poonam Kapoor, D/O. Shri Madan Gopal.
   124/3, Govind Nagar, Class VI.
   Arya Kanya Inter College, Govind Nagar, Kanpur. (2.45 hours)

5) Km. Chandra Prabha Verma, D/O. Shri Om Prakash Verma.
   124/A-331, Govind Nagar, Class VI.
   Arya Kanya Inter College, Govind Nagar, Kanpur. (2.43 hours)

6) Km. Renu Arora, D/O. Shri Sudarshan Kumar Arora.
   21/1, Block-3, Govind Nagar, Class VI.
   Arya Kanya Inter College, Govind Nagar, Kanpur.

The researcher got favourable results as all of them attempted each sum set in the paper within the prescribed time. Hence the researcher concluded to get the pre-test printed for his use.

(b) **PRE-TEST OF ALGEBRA AND GEOMETRY**:

The researcher made the second pre-test of Algebra and Geometry containing sums of all topics prescribed in the coursebook for Class VI. *Algebra and Geometry Part I* - a Government Publication. These topics were taught during the academic year July 8, 1973 to May 1974. Total number of sums is 17 out of which 9 sums concern with Algebra carrying maximum 25 marks and the rest 8 sums concern with geometry bearing maximum 25 marks. Thus the maximum marks of this pre-test of 17 sums is 50. This pre-
test was administered on 26th April, 1974 on the students whose names have already been mentioned, before printing with a view to confirm whether the students would be able to attempt all the sums. In this case the researcher got favourable results. Hence he decided to get this pre-test also printed for final use on boys and girls of his sample.

Pre-test of Algebra and Geometry may be seen in Appendix - B at page No. 183.

The researcher administered both the pre-test papers constructed by him on both boys and girls of his sample. The first pre-test of arithmetic was administered on 4th May, 1974 and the second pre-test of Algebra and Geometry was administered on 6th May, 1974. The researcher obtained achievement scores of each subject of his sample after examining the answer-books. The scores obtained by each boy and each girl of his sample were noted on the Information Schedule, made for collecting complete information about each subject of his sample so that the researcher might conduct his study on scientific lines.

During evaluation of answer-books, the researcher paid full attention to the objectivity of marking the sums. He felt that the sums of geometry presented a difficulty in objective marking, on account of figures, definitions and description. The neat and clean figures and good handwriting certainly affect the mind of the marker and brings in subjectivity in marking. Regarding Algebra and Arithmetic, this type of difficulty did not arise as the researcher divided the solution of each sum into parts and fixed suitable marks for each part out of the total marks for each sum. He then awarded marks for each correct portion of the solution of each sum. Thus the researcher
remained objective in marking the sums of Algebra and Arithmetic. This objectivity in marking the answers encouraged the researcher to select only arithmetic, concerning with one course book, for the study of the effect of frequent testing, at hand.

(2) INFORMATION SCHEDULE FOR SECURING FAMILY INFORMATION:

Presuming that age, economic status, parental education, marital status, number of siblings, position of the student in the family etc., have a significant impact on adjustment, education and environment of the individuals and on the progress of their study, the researcher prepared an Information Schedule for getting family information from each boy and each girl of the sample and contacted each boy and each girl of his sample for the completion of the schedule. Entries like name of father and mother of the subject, educational qualifications of each, physical health of each, profession of each, number of brothers and sisters of each subject and his/her own position in the family, residential accommodation and conveyance available in the house, were easily made in the Information Schedule according to the statement of each subject of the sample.

The investigator had to face a great difficulty in getting information about the age of father and that of the mother on 1st April, 1974, as well as the income of the father and the mother along with additional income of any other member of the family. Generally, students of Class VI do not know typical information of this kind. Some of the students brought correct information about parental ages and their total family income. But some parents shirked from giving this type of information. Hence the researcher had to contact them personally at their
residence to collect such information for the correct entries in the Schedule. The researcher discussed the importance of his research in hand with such parents and convinced them that their total income would be kept confidential and would in no case be disclosed to any of the authorities of the Income Tax Department. With such an assurance from the researcher, possibly correct the total income of those families was known to him for proper entries. The researcher received information about age of the parents, residential accommodation and conveyance without any difficulty.

The researcher consulted the record of each institution and noted the correct date of birth of each subject of his sample. Age of each subject as on 1st April, 1974 was calculated and its entry was made in the Schedule.

The researcher obtained I.Q. of each subject of his sample by administering the Intelligence Test (described elaborately in the following pages) for its entry in the Schedule.

The achievement scores of the pre-test for arithmetic attained by each subject of the sample were also noted on the Information Schedule.

Information Schedule for securing Family Information may be seen in the Appendix - C, at page 184

(3) STANDARDIZED INTELLIGENCE TESTS:

The investigator was always eager to use intelligence tests of known reliability and validity for obtaining equivalent groups. Consequently he had to review thoroughly some standardized intelligence tests which could be suitably used under Indian situations. He reviewed the following standardized tests of intelligence for final selection:—
(a) Jalota, S.S.
"Saharan Mansik Yogyata Parikshan" (Hindi).
(b) Jalota, S.S. and Tandon, R.K.
"Group Test of General Mental Ability" (English).
(c) Tandon, R.K.
"Group Test of Intelligence for Adults" (Hindi).
(d) Tandon, R.K.
"Group Test of Intelligence for Children" (Hindi).
(e) Kulshrestha, S.K.
"Indian Adaptation of Binet-Simon Scale".

After much consideration, the choice of the researcher fell on the following two group tests of intelligence - one for children and the other for adults, because these are verbal Group-Tests and are easy to handle and also latest in construction:

A- Tandon, R.K.
"A Group Test of Intelligence for Children", Captioned as 'Samooohik Mansik Yogyata Pariksha', 1971 (2/70).
Copy of the Intelligence Test may be seen in the Appendix - D, pages 185-192.
Answer Sheet of this intelligence test may be seen in the Appendix - E, page 193.

B- Tandon, R.K.
"A Group Test of Intelligence for Adults", Captioned as 'Samooohik Mansik Yogyata Pariksha', 1973 (1/61).
Copy of the Intelligence Test may be seen in the Appendix - F, pages 194-201.
Answer Sheet of this Intelligence Test may be seen in the Appendix - G, page 202.
ABOUT THE INTELLIGENCE TESTS:

Samooihik Mansik Yogyata Pariksha (2/70), a group test of intelligence for children, 1971 and Samooihik Mansik Yogyata Pariksha (1/61), a group test of intelligence for adults, 1973 have some common qualities and also uncommon qualities, given as under:

(a) COMMON QUALITIES:

(1) Both the tests are for Hindi speaking areas;
(2) Both can be administered within 40 to 45 minutes;
(3) Both are scored with stencil key separate for each - allotting one score for one correct answer.
(4) Tables for conversion of raw scores into Deviation I.Q. have been provided in the manual of each test.

(b) UNCOMMON QUALITIES:

Uncommon qualities of both the intelligence tests may be comparatively studied as under:

TEST FOR CHILDREN.

1) Meant for school going pupils of the age group 10-16 years.
2) Contains 91 questions each providing 4 or 5 alternatives.
3) Standardized on 1667 school students of Classes VI to XI.
4) Reliability co-efficient is .93 by Split Half Method and Kuder Richardson Formula.

TEST FOR ADULTS.

Meant for literates above 16 years.
Contains 100 questions, each providing 4 or 5 alternatives.
Standardized on 1428 subjects of Classes from Intermediate to Post-Graduates.
Reliability Co-efficient.

a) Split Half Method .59 to .99 with an average of .91.
b) Kuder Richardson Formula .85.
5) **Validity** - Correlated against examination scores for X .36, for XI .59 and for XII .42.

6) **Noms** - provided for Age-wise means, Age-wise Percentiles, Age and Grade-wise Standard Scores, Age and Grade-wise Deviation I.Q.

4) **TEACHER-MADE TESTS**

In connection with the frequent testing according to the programme of research, the researcher had to set 9 test papers, from time to time each based on the courses taught within each prescribed period.

In Uttar Pradesh, generally the schools reopen on 8th July every year after the summer vacations which commence from 21st May and end on 7th July each year. The teaching of the new courses, usually takes place after 15th or 18th July every year. Revision of the courses taught during the previous academic session is made from 8th July to 18th July every year. It is a general practice followed in every institution, that time table according to subjects allotted to the respective teachers is finally set up during second and third week of July every year.

The researcher contacted both the Principals of the schools selected for the sample and made a request for construction of such a time table as would provide a period facilitating
the researcher to get the students of both the sections of Class VII for teaching of arithmetic to them. The researcher should also get three separate rooms with seating arrangement for the three sections A, B and C made by splitting students of the original two sections of Class VII, on the basis of I.Q. Moreover, the investigator also demanded facility of four teachers, qualified to teach arithmetic to the students, to work according to the direction of the researcher during that period of teaching arithmetic. Three of these four teachers thus selected would teach the prescribed topics of arithmetic, whereas the fourth one would remain free during that period so that he might be asked to teach arithmetic on any day when any one of those three teachers would absent himself on account of any casualty. The Principals of both the institutions were kind enough to agree on the proposals of the researcher and extended their full cooperation for carrying out the testing programme on right lines.

The researcher contacted four male teachers and four female teachers, qualified to teach arithmetic in Junior High School Classes of each institution and directed them to teach and finish Ratio Proportion and Graph prior to the commencement of the planned programme as the researcher had to split the students of Classes VII-A and VII-B into three equivalent groups based on I.Q. after administering Intelligence Test on them, in each school.

On 7th October, 1974, the researcher started his programme of teaching square root through the concerned teachers selected for the purpose in both the institutions. The whole testing programme was divided into three terms of 9 months -
each term consisted of 3 months. Since the tests for frequent testing were to be administered on the students at the end of one month, the researcher had to construct nine different test papers from time to time according to the planned programme of testing.

All the nine Teacher – Made Tests, constructed for testing purpose, along with other concerned particulars have been shown in a tabular form, which can be inspected at a glance as under:

Continued next page.....
### Table Showing Teacher-Made Tests

<table>
<thead>
<tr>
<th>Term</th>
<th>Test Paper Number with Month and Year</th>
<th>Topics of Arithmetic Examined</th>
<th>Distribution of Marks Sums</th>
<th>Maximum Groups on whom Test Paper was administered</th>
<th>Date of Answering Books were shown to Examinees</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1st Test Paper (Nov. '74)</td>
<td>Square Root. -</td>
<td>50</td>
<td>50</td>
<td>11.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2nd Test Paper (Dec. '74)</td>
<td>Square Root. 6</td>
<td>9</td>
<td>15</td>
<td>14.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area of Floor.8</td>
<td>27</td>
<td>35</td>
<td>16.74</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3rd Test Paper (Jan. '75)</td>
<td>Square Root. 3</td>
<td>4</td>
<td>7</td>
<td>16.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area of Floor.6</td>
<td>11</td>
<td>17</td>
<td>18.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Area of 4 walls.</td>
<td>6</td>
<td>20</td>
<td>21.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>II</td>
<td>4th Test Paper (Feb. '75)</td>
<td>Circumference and area of a circle</td>
<td>35</td>
<td>50</td>
<td>15.75</td>
<td></td>
</tr>
<tr>
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<tr>
<td></td>
<td>5th Test Paper (March '75)</td>
<td>Circumference and area of a circle</td>
<td>5</td>
<td>12</td>
<td>19.75</td>
<td></td>
</tr>
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</tr>
</tbody>
</table>

**Note:** After the Third Test Paper, the Groups were rotated - With the result of rotation Group B became C1 Controlled, Group C became C2, Experimental Group I and Group A became C3, Experimental Group II. Teaching was started for the Second Term.

**Appendix:** Numbers and Page Numbers.

**Remarks:** Scores were recorded.
(1)  (2)  (3)  (4)  (5)  (6)  (7)  (8)  (9)  (10)  (11)  (12)

6th Test Paper (Apr.'75)

<table>
<thead>
<tr>
<th></th>
<th>Circumference and area of a circle.</th>
<th>3</th>
<th>4</th>
<th>7</th>
<th>Bc1 Controlled.</th>
</tr>
</thead>
</table>

Average. 6 11 17 —- Cc2 Exp.Group I.

Simple Interest. 6 20 26 50 Ac3 Exp. Group II.

NOTE: After the Sixth Test Paper, the groups were again rotated — Consequently Group C became C1, Controlled Group A became C2, Experimental Group I and Group B became C3, Experimental Group II. Then Arithmetic course for Class VIII reviewed and topics selected after summer vacations. Teaching was restarted on July 14, 1975.

III 7th Test Paper (Aug.'75)

<table>
<thead>
<tr>
<th></th>
<th>Cube Root with allied Problems.</th>
<th>15</th>
<th>35</th>
<th>50</th>
<th>50</th>
<th>Ac2 Exp.Group I</th>
<th>14.8.75</th>
<th>16.8.75</th>
<th>Pages 214 &amp; 215.</th>
<th>Scores were recorded.</th>
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</table>

8th Test Paper (Sept.'75)

<table>
<thead>
<tr>
<th></th>
<th>Cube Root.</th>
<th>5</th>
<th>12</th>
<th>17</th>
<th>Ac2 Exp. Group I</th>
<th>24.9.75</th>
<th>26.9.75</th>
<th>Pages 216 &amp; 217.</th>
<th>Scores were recorded.</th>
</tr>
</thead>
</table>

9th Test Paper (Oct.'75)

<table>
<thead>
<tr>
<th></th>
<th>Cube Root.</th>
<th>3</th>
<th>4</th>
<th>7</th>
<th>Cc1 Controlled.</th>
<th>20.10.75</th>
<th>22.10.75</th>
<th>Pages 218 &amp; 219.</th>
<th>Scores were recorded.</th>
</tr>
</thead>
</table>

Field Book. 6 20 26 50 Bc3 Exp. Group II.

Knowledge of results was given to all the subjects of all the groups.
5. SCHEME OF MARKING

The researcher marked the sums of traditional type, objectively by following the scheme of marking developed by him. The investigator split the solution of each traditional sum into proper steps and he divided the total marks, prescribed for the correct solution, into parts and noted these marks against the correct answer of each step in the scheme of marking.

The scheme of marking may be seen in the Appendix 'X', pages 233 to 252.