Method of the Study
CHAPTER - V

METHOD OF THE STUDY

In the preceding chapters, the theoretical rationale of the problem and the tools along with their development were discussed. The present chapter has been developed to discuss the method of the study which covers.

5.1 The tools used
5.2 The Sample
5.3 Design of the study
5.4 The procedure
5.5 The statistical techniques used for the analysis of data
5.6 Precautions observed
5.7 Constraints and difficulties faced during the experiment.

5.1 TOOLS USED

For the present investigation following tools were used.

- Cattell's Culture Fair Test of Intelligence
- Group Embedded Figures Test by Witkin
- Development of Summative criterion test (Developed by the investigator)
- Development of Formative Criterion test (Developed by the investigator)
- Development of Achievement Test (Developed by the investigator)
- Development of instructional material (Developed according to Inquiry Training Model)
- Development of instructional material (Developed according to mastery learning model)
- Self-concept Test (Developed by Dr. G.P. Sherry, Dr. R.P. Verma and Dr. P.K. Goswami)

5.2 SAMPLE

In a research project researchers usually come across unmanageable population where in large numbers are involved. So it is difficult to study
the whole population. It is often desirable in order to reduce expenditure, time and energy, to produce greater precision and accuracy, a sample from a population should be taken. Sampling is the process by which a relatively small number of individuals or objects are selected and organized in order to find out something about the entire population from which it is selected. Sampling procedures provide generalization on the basis of relatively small proportion of population.

The present study was conducted on 108 Vth class students from two schools of Rohtak, Harkishan Memorial Public School and St. Thomas Public School affiliated to C.B.S.E., New Delhi. The study followed purposive sampling procedure. It was purposive because two schools of Rohtak, which were easily approached, were selected. On the basis of scores on Cattell’s Culture Fair Intelligence test, 150 students, were randomly allocated to the three groups, viz. two experimental groups and one control group. The three groups were as similar as the availability permitted, they were natural and highly comparable in respect of size and especially in their past achievement in mathematics. Thus, the three groups were comparable with approximinity on experimental measures at the pre-experimental stage.

Initially the sample consisted of 150 students from which 108 students were taken after classifying them according to their cognitive style. Average age of the girls and boys students was 10 years. No, doubt, the sample is small for the results of the study to be generalized but availability of a large sample and feasibility of carrying out such an experimental study with large sample was beyond the control of the investigator. Even earlier investigators conducting such studies through experimental designs have used small samples. Talegaonker (1984) had taken 34 class IX students for his study. Pandey (1986) included 86 students in his sample while Chitriv (1983) has taken three intact sections of class IX for his study with 35
students in each section as his sample. Baveja (1988) took 63 students in her experimental group and 36 students in control group making a total sample of 99 students. Jamini (1990) had worked on two sections of chemistry classes in a school. Passi and Sansanwal while reviewing Research in Education (1991, p.1023) has justified the use of small samples in such experimental researches due to deeper inquest of these studies and available methodological facilities. It is accepted that almost all studies of the nature, as the present one have worked on small samples only.

5.3 DESIGN OF THE STUDY

Educational research is described as experimental when the researcher has firstly, specified a set of researchable hypotheses and secondly, has established a systematic program of data gathering under precisely defined conditions in an effort to test these hypotheses. The hypotheses provide a network of statements relating the impact of an independent variable or a set of independent variables on some outcome variable as independent variables (Ingersoll, 1984).

A good experimental design should provide some information with respect to all the objectives of the experiment (Winer, 1971). Any experimental problem has two-interrelated aspects, the design of the experiment and statistical analysis of the data. The latter aspect is directly dependent upon the former aspect. Statistical methods can greatly increase the efficiency of an experiment and also strengthen the conclusions so obtained (Montgomery, 1984).

Accordingly, 3x2x2 factorial design combined with ANOVA (Campbell and Stanley, 1963) was employed. The factorial design was used as it permits to evaluate the combined effect of two or more experimental variables when used simultaneously.
Information from factorial design experiment is more complete than that obtained from a series of single factor experiments in the sense that evaluation of interaction effects can be made. Also the population to which inference can be made is more inclusive than the corresponding population for a single factor experiment (Winer, 1971).

ANOVA was preferred to increase the precision of analysis of the experimental data which utilized both the pre-test and post test scores. The present study employed two replications of 3 x 2 x 2 factorial design with three fixed variables of which the measures on one variable were repeated for mean gain on achievement scores and the retention scores.

Also, 3 x 2 factorial design was employed for analyzing mean gain scores on self concept test.

The model was a fixed one because all the levels of the variables in each of the designs were determined on a logical basis and were not selected by sampling (Gulford and Fruchter, 1976). Computational procedure was followed according to the technique given by Winer (1971). When a factorial design follows a fixed model in the technique of ANOVA, the error term is always the "within treatment mean squares" (Edward, 1971). There were different sets of dependent and independent variables. The first 3 x 2 x 2 factorial design was computed by ANOVA for the mean gain on achievement scores. Here instructional treatment, cognitive style and category of objectives were independent variables. Gain on achievement scores was the dependent variable which was calculated as the difference in post-test and pre-test scores for each subject.

The variable of the instructional treatment was studied at three levels, namely Inquiry Training Model (T1), Mastery Learning Model (T2) and conventional method (T3). Cognitive style was studied at two level viz., field independent (C1) and field dependent (C2) levels. The third variable of
categories of objectives was studied at knowledge (O₁) category and comprehension (O₂) category.

The schematic layout of the design has been presented in the Fig. 5.1.

**FIG. 5.1: SCHEMATIC LAYOUT OF 3 X 2 X 2 FACTORIAL DESIGN FOR MEAN GAIN ON ACHIEVEMENT SCORES**

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T₁ - Instructional treatment with Inquiry Training Model
T₂ - Instructional treatment with Mastery Learning Model.
T₃ - Instructional treatment with conventional method of teaching
C₁ - Field Independent
C₂ - Field Dependent
O₁ - Knowledge category of objective
O₂ - Comprehension category of objective
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The second 3 x 2 x 2 factorial design was for retention scores. The schematic layout of the design has been presented in Fig. 5.2. Here, the variable of instructional treatment was studied at three levels, namely Inquiry Training Model (T₁), Mastery Learning Model (T₂), and conventional method (T₃). The variable of cognitive style was studied at two levels, viz. field independent (C₁) and field dependent (C₂). The variable of categories of objectives was studied at two levels, viz. knowledge category (O₁) and comprehension category (O₂).
The third 3x2 factorial design was analyzed with the help of ANOVA for gain scores of self concept test. Here instructional treatment and levels of cognitive style were the independent variables and gain scores on self concept test was dependent variable. The variable of instructional treatment was studied for Inquiry Training Model ($T_1$), Mastery Learning Model ($T_2$), and conventional method ($T_3$). The variable of cognitive style was studied at two levels, viz. field independent ($C_1$) and field dependent ($C_2$) levels. The schedule layout of the design has been presented in Fig. 5.3.
FIG. 5.3: SCHEMATIC LAYOUT OF 3X2 ANOVA FOR GAIN SCORES ON SELF-CONCEPT-TEST.

Gain Scores on Self-concept

\[ Y \]

Ci  IC2

Gain Scores on Self-concept

\[ T_1 \]

\[ T_2 \]

\[ T_3 \]

\[ C_1 \]

\[ C_2 \]

\[ C_1 \]

\[ C_2 \]

\[ C_1 \]

\[ C_2 \]

\[ T_1 \]: Instructional treatment with Inquiry Training Model
\[ T_2 \]: Instructional treatment with Mastery Learning Model.
\[ T_3 \]: Instructional treatment with Conventional Method of Teaching

\[ C_1 \]: Field Independent
\[ C_2 \]: Field Dependent

TABLE 5.1
VARIABLES OF THE STUDY

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Independent Variable</th>
<th>Dependent Variable</th>
<th>Variables Controlled</th>
<th>Control Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Instructional Treatment</td>
<td>Gain scores on achievement</td>
<td>Class to be taught</td>
<td>Administrative (Only V Class was taught)</td>
</tr>
<tr>
<td>2.</td>
<td>Cognitive Style</td>
<td>Retention Scores</td>
<td>Subject to be taught</td>
<td>Only mathematics as a subject was taught</td>
</tr>
<tr>
<td>3.</td>
<td>Category of Objectives</td>
<td>Gain scores on self-concept test</td>
<td>Teacher Variations</td>
<td>Same teacher taught all the groups</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Size of the sample</td>
<td>Equal number of students was taken in a group</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Average age of the sample</td>
<td>All the sections included pupils of the age group 10 yrs.</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Situational variables</td>
<td>All the groups were taught for 45 periods of 35 minutes each.</td>
<td></td>
</tr>
</tbody>
</table>
5.4 PROCEDURE

Procedure of the experiment comprised of two main stages which are selection of the sample and conducting the experiment.

Stage 1. Selection of the Sample

The present study was conducted on 150 Class V students from the two schools of Rohtak affiliated to C.B.S.E., New Delhi. First, the intelligence test was administered to 150 students of class V. Scoring was done and students were randomly allocated to three groups viz. two experimental groups and one control group. Each group consisted of 50 students. Then Group Embedded Figure Test was administered to all students and each group was divided into two sub-groups viz. field independent and field dependent. Those students getting 12 or above scores were indicative of field independent and those student getting 9 or below scores were denoted as field dependent. Those students getting the median scores were not included in the groups. The final sample comprised of 108 students.

TABLE: 5.2
SAMPLE DISTRIBUTION

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Field Independent</th>
<th>Field Dependent</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group-I</td>
<td>18</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>(Inquiry Training Model)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Experimental Group-II</td>
<td>18</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>(Mastery Learning Model)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Group</td>
<td>18</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>54</td>
<td>108</td>
</tr>
</tbody>
</table>

The three groups were as similar as availability permitted, they were natural and highly comparable in respect of size, average age and specially
their past achievement in mathematics. The investigator was trained in using Inquiry Training Model and Mastery Learning Model for experimental treatment involved in the present study after meeting with guide and some experts of Department of Education, Punjab University and Kurukshetra University.

**Stage 2 : Conducting the Experiment**

The experiment was conducted in five phase as given below:

- **Phase I** Orientations to the models of teaching.
- **Phase II** Administration of the pre-test.
- **Phase III** Conducting the instructional program.
- **Phase IV** Administration of the post test.
- **Phase V** Administration of the retention test.

**Phase I** Orientations to the models of teaching.

The students of the three groups were provided the orientation regarding the different instructional treatments, i.e., the different teaching learning activities involved in implementing each model. The cooperation of the students and the expectations of the teacher regarding students' behavior were also clarified.

**Phase II** Administration of the Pre-Test.

This phase involved the administration of the following tests to the students of the experimental group I, experimental group II and control group i.e. group III.

- Summative Criterion Test / achievement test
- Self-concept test
The answer sheets were scored with the help of scoring key. The scores indicated the previous knowledge possessed by the students and the self-concept of an individual.

Phase III Conducting the Instructional Programme

To find the efficiency of the independent variables, the instructional treatment was manipulated in the form of teaching based on Inquiry Training Model, Mastery Learning Model and conventional method. The lessons based on these were planned among five units of their course of study in mathematics at elementary level. The instructional treatment was given for 45 days to the three groups. The experimental group I was taught by Inquiry Training Model, group II was taught through Mastery Learning Model and group III was taught by conventional method. Same topics were taught to the three groups. The instructions were conducted through well structured lesson plans in the contents selected for treatment. The treatment was conducted by the investigator herself in all the three groups so as to minimize teacher variable and maximize precision.

The inquiry group was given instructions through the instructional material developed by the investigator. The lesson plans were developed as in the book 'Multiple Models of Teaching' (Singh, 1995). Students were motivated to ask questions to gather the data.

The unique feature of this model is the way in which students gather data to solve the problem. They were asked to put such questions which can be answered in 'Yes' or 'No'. In a situation where the question of the student is such which cannot be responded to by 'Yes' or 'No', the teacher reminded her/him of the said rule and asked the students to restructure her/his question, so that the teacher could response in the form of 'yes' or 'no'. After the inquiry session, they were asked to organize the data and to
analyze one another's way of thinking and solve the problem.

Experimental group II was taught by Mastery Learning Model. The Mastery level for the mastery group was decided as 85% i.e., 85% of students should attain 85% of the objectives. Each of the five units was taught followed by a formative criterion test. Feedback was provided the next day. Remedial procedures involved reteaching for low achievers, individual guidance for very weak students and peer tutoring by high achieving students. Only after all learning problems of unit I were solved the teacher moved to the next unit.

The control group was taught for the same period by the investigator by conventional method of teaching.

**TABLE 5.3**

**TIME SCHEDULE OF THE EXPERIMENT**

<table>
<thead>
<tr>
<th>Treatment Group-I By Inquiry Training Model</th>
<th>Treatment Group-II By Mastery Learning Model</th>
<th>Treatment Group-III By Conventional Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration of Pre-test</td>
<td>5th July 1999</td>
<td>5th July 1999</td>
</tr>
<tr>
<td></td>
<td>6th July 1999</td>
<td>6th July 1999</td>
</tr>
<tr>
<td>Instructional Treatment</td>
<td>7th July 1999 to 31st Aug. 1999</td>
<td>7th July 1999 to 31st Aug. 1999</td>
</tr>
<tr>
<td>Administration of Post-test</td>
<td>1st Sept. 1999</td>
<td>1st Sept. 1999</td>
</tr>
</tbody>
</table>

**Phase IV : Administration of the Post Test**

Immediately after the treatment was over, the subjects were to be assessed on criterion measures to know the effect of the treatment. For this, the students were administered the post test for all the treatment
variables using the same criterion test as the pre-test. Also students were
administered the test to determine self-concept.

Phase V: Administration of the Retention Test

One month later, the achievement test was again administered to the
students to get a measure of retention. Again the obtained answer sheets
were scored with the help of scoring key.

5.5 STATISTICAL TECHNIQUES

The following statistical techniques were employed to analyze the
data obtained from the experiment to test the hypotheses.

1. Graphical presentations.
2. Descriptive statistics like means and standard deviations of
   achievement scores.
3. Factorial design 3x2x2, Analysis of variance for mean gain on
   achievement scores.
4. Factorial design 3x2x2, Analysis of variance for retention scores.
5. Factorial design 3x2, Analysis of variance for gain scores on self-
   concept.

For further investigation t-test was used for testing the significance of
difference between the means gain on achievement scores, retention
scores, scores on self-concept test.

5.6 PRECAUTIONS OBSERVED

Following precautions were observed during the course of experiment
(pre-test, post-test) for ensuring effectiveness and high precision in
experimental condition which may have contributed to results.
1. All the subjects were oriented to the tests and respective models of teaching as per their treatments in the beginning of the experiment.

2. No undue stress or control of any kind was imposed on the subjects at any time during the study and the experiment was conducted in a relaxed natural setting.

3. All the subjects were taught by the investigator herself to avoid any variation in the teacher variable.

4. The effectiveness of the experimental treatment was ensured by establishing rapport and liaison in the school, maintaining natural setting, harmonious atmosphere, providing sufficient time for various activities in the experimentation and the like.

5. It was ensured that the topics on contents of treatment had not been previously taught to the students and not even taught by any other teacher during the experiment to any of the groups, Group 1, 2 or 3.

6. During each of three treatments, attempt was made to stick to the limits of the specific model for treatment to the respective group and not to deviate from the teaching learning activities in the lesson plans of the treatment during execution.

7. Separate material was provided for every student during experimentation so as to avoid any disturbance or chances of unfair observation. Thus it was ensured that the material provided to the students for testing, treatment or during orientation was adequate to meet this demand.

8. Teaching periods of 35 minutes duration were utilized fully for treatment and time was not wasted during experimentation.
5.7 CONSTRAINTS AND DIFFICULTIES FACED DURING EXPERIMENT

It will not be improper to mention some of the difficulties faced or the constraints of the experiment for the knowledge of those who intend to conduct such researches in future. Such constraints of the experiment also need to be taken note of.

These are:

a) It is quite an effort to make teachers and principal agree to cooperate in the experiment.

b) It is an essential requisite for every experiment that the treatment be fully provided to every student which implies his/her regular presence in the school during the days of treatment. Thus it was ensured that the sample groups were regularly attending the school excepting some unavoidable circumstances.

c) Considerable difficulty was faced during the process of making lesson plans for treatment since these were the strategies meant for specific purposes. It was some time not possible to adopt certain content of the treatment according to model of teaching in the lesson plan and hence, that too had to be accommodated according to the specified method.

d) Some difficulty was also faced during the orientation of students towards their respective models of teaching. In the beginning, specifically in Inquiry Training model, the student appeared to be hesitant to come forward and to ask questions. After the motivation and encouragement, the students began to take interest in teaching learning activities.

e) The experimenter had to teach the lessons as per the syllabus and time schedule also, as they were pursuing a regular course of studies Thus the experimental schedule had to be adjusted accordingly.
f) Specific events like anxiety, fatigue or interest and the like factors were beyond the control of the researcher. These could have a stimulating or distributing effect upon the performances of the subject. These factors were not taken in the account, their effect can not be more than marginal.