CHAPTER II

DESIGN OF THE STUDY
This chapter presents the description of the design of the study regarding the design, sample, the tools, the procedure of data collection, and statistical technique of analysis.

2.1 DESIGN:

In the present study a factorial design has been employed. The independent variables in the study included strategies of teaching, sex, personality and intelligence and the criterion variable achievement in mathematics concepts. The classification variable of sex included boys and girls, the variable of personality involved extroverts and introverts, the variable of intelligence involved three levels of intelligence, i.e., low, average and above average, the treatment variable, strategies of teaching was varied in three ways namely lecture-discussion strategy (St A₁), inductive-drill strategy (St A₂) and auto-
instruction-group discussion strategy (St A).

The factorial design (fixed model) was used as it permits to evaluate the combined effect of two or more independent variables when used simultaneously. It is also possible through factorial design, the study of interaction effects of independent variables. In case of factorial experimental designs, the population to which inferences can be made is more inclusive than the corresponding population for a single factor experiment (Winer, 1971).

2.2 SAMPLE:

The sampling method was resorted to at three stages:

(1). For the try-out of the 1st draft of the achievement test- The sample consisted of thirty students.

(2). For the try-out of second draft of the achievement test. A sample of thirty two students was raised.

(3). For the conduct of experiment.

In the first two stages rigorous method of randomisation was not employed. The test was developed on samples drawn out of the IX class students taught by the investigator.

For finding reliability of the tests, a random sample was raised. For conduct of experiment a sample of 300 students was raised randomly from IX class students. Four schools were
selected randomly from government High/Higher Secondary Schools of Chandigarh (U.T.). To have a sample fairly representative of the population, students were selected from (a) Model and Ordinary schools; (b) Boys and Girls schools.

The average age of the sample was 14 years. The break up of the sample is given below:

<table>
<thead>
<tr>
<th>Name of the School</th>
<th>Total Number of students</th>
<th>Number of students in Class IX</th>
<th>taken</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Government Girls Higher Secondary School, Sector-18, Chandigarh.</td>
<td>120</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>2. Government Model High School, Sector-12, Chandigarh.</td>
<td>80</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>3. Government Model High School, Sector-35, Chandigarh.</td>
<td>200</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>4. Kendriya Vidyalaya, Sector-47, Chandigarh.</td>
<td>200</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>300</td>
<td></td>
</tr>
</tbody>
</table>

2.3 **TOOLS:**

The mathematics achievement test, the group test of general mental ability and personality inventory were used as basic tools for the collection of data.
2.3.1 **Mathematics Achievement Test**:

An achievement test was developed to measure knowledge, comprehension and application. The test consisted of items in the two topics of mathematics, namely, set theory and trigonometric ratios. The test was validated and revised at three stages: individual testing, small group testing and field testing. The test consisted of items in the three categories of objectives namely knowledge, comprehension and application on the topics taught to the students through different strategies of teaching. The final draft of achievement test consisted of fifty items. The reliability of the test was calculated by test-retest method and was found to be equal to .81. It was validated for its content only. The final form of the test is given in Appendix-II.

2.3.2 **Specially Developed Material**:

The following materials were developed and used for conducting the study:

- Linearly programmed text on the topic of set theory in mathematics at high school level.

- Linearly programmed text on the topic of trigonometric ratios in mathematics at high school level.

A linear programme on the topic set theory was already prepared by Mr. Chanchal Singh which was used by the investigator.
and the linear programme on the topic Trigonometric ratios was developed by the investigator. The details of development have been given in chapter three. The programme was validated, revised at three stages - Individual test, Small group testing and Field testing.

2.3 GROUP TEST OF GENERAL MENTAL ABILITY (1972):

(a) Jalota’s Group Test of General Mental Ability (Hindi Version):

It was used to measure the intelligence of the sample. The test consists of 100 different items pertaining to numerical ability, reasoning, similarities, analogies and language ability. The time limit for this test was twenty minutes. Separate answer sheets were provided to the students so as to reuse the text-booklets. The author refers to the reliability and its concurrent validity coefficient ranging from .50 to .78 against the examination marks as criteria. The test was administered and scored strictly in accordance with the instruction given in the manual. The raw scores were used to classify the students of each group into three groups i.e., above-average intelligence group, average-intelligence group and below average-intelligence group. The groups were formed by applying the formula based upon the mean and S.D. of the intelligence scores.

Mean ± S.D. formed average group, students having intelligence scores greater than Mean ±1. S.D. were placed in above average group and students having scores less than Mean - 1. S.D. formed below average group.
Eysenck claims that Extraversion and Neuroticism are the two main dimensions of personality and has produced good deal of evidence to demonstrate their importance. To measure the personality dimensions of Extraversion and Neuroticism, Eysenck's personality inventory in English (1964) was used. The original MPI (Maudsley Personality Inventory) is a rough and ready measure of Neuroticism and Extraversion. The inventory has been constructed on the basis of item analysis and factor analysis (Eysenck, 1959). EPI was the modified form of MPI - with 57 statements to be responded 'yes' or 'no'. There are two: A and B parallel versions of EPI. Both are designed to measure the same factors. Form 'A' was used in this study.

**Administration and Scoring of Eysenck Personality Inventory:**

Eysenck's Personality Inventory was administered as per instructions printed on the sheets. First few responses of the students were checked. There was no time limit for this inventory.

**Scoring:**

The response sheets were scored according to the instructional given in the EPI manual. The scores were used to divide the sample into extroverts and introverts.

**PROCEDURE:**

Pre-test, Post-test experimental design was used. The sample was given:
- General Mental Ability Test.
- Test of Introversion and Extroversion.
- Pre-test (Achievement Test).
- Post-Test (Achievement Test).

Three groups each containing 100 students were made by random sampling.

- Group I was taught through strategy $A_1$.
- Group II was taught through strategy $A_2$.
- Group III was taught through strategy $A_3$.

The diagramatic representation of the procedure is as given below:

```
TOTAL SAMPLE
300

(1) General-Mental Ability Test
(2) Personality Test
(3) Achievement Test (Pre-test)

Group I (100 students) Group II (100 students) Group III (100 students)
1. Teaching through Strategy $A_1$ 1. Teaching Through Strategy $A_2$ 1. Teaching Through Strategy $A_3$
2. Achievement Test (Post-Test) 2. Achievement Test (Post-Test) 2. Achievement Test (Post-Test)
```

2.5 COLLECTION OF DATA:

The collection of data followed the scheme as presented above. The following types of data for the sample were available
for further analysis:

- Intelligence test scores.
- Personality test scores.
- Pre-test scores (Achievement Test).
- Post-test scores (Achievement Test).

2.6 **STATISTICAL ANALYSIS OF DATA**:

In the present study, intelligence, personality traits and three types of teaching strategies. The effect of these three variables was evaluated on the criterion variables of achievement in respect of knowledge, comprehension and application.

Guided by the design of the study, the main analysis included the use of analysis of variance and t-ratios, which have been described below. The details of each have been given in chapters five, six and seven.

2.6.1 **Experimental Control**:

Lendquist (1956) gives three types of errors which arise in conducting the experiment. These errors are type S, type R and type G. Type S error are those which characterise sampling procedures. In the present study this error was minimised by selecting sample through randomization and applying statistical technique of analysis of variance on gain score.
Type G errors arise from countless extraneous factors which tend to have some effect on all the members of one treatment group which thus create systematic differences in the criterion from group to group. These group differences were minimised by assigning the same teacher (the investigator) to all the three groups during a period of experimentation. Every effort was made to administer experiment under similar conditions. Time factor was also controlled.

Type R errors arise from variation in treatment effects from replication to replication. These were controlled by randomisation of treatment.

2.6.2 Control of Variables (Organismic):

The socio-economic status, educational background of the students was assumed to be same, as all belonged to schools of Union Territory of Chandigarh, and belonged to middle income group.

2.6.3 Stimulus Variables:

The general class of things that relate to the environment situation or condition of stimulation, refer to stimulus variables. By assigning the same teacher to all the three treatment groups. The investigator tried to control stimulus variables.
2.6.4 **Response Variables**:  

It refers to any variable that refers to some response of an organism. Such variables were controlled by using 'achievement test' as pre-test and post-test measurement of achievement in mathematics.

2.6.5 **Analysis of Variance**:  

It was used to obtain a global picture as to whether there were any significant differences in achievement of different categories of educational objectives by different groups having learnt the same material through different types of teaching strategies. It was applied to ascertain the main effects of teaching strategies, intelligence, personality and sex along with their interactions.

2.6.6 **t-test**:  

In view of significant F-ratios, the t-test was employed to find out the significance of difference between means related to different groups and different variables.

2.7 **Other Techniques of Analysis of Data**:

2.7.1 **Measures of Central Tendency and Dispersion**:

Mean and Standard Deviation were worked out to study the nature of sample-distribution in relation to dependent variables namely mathematics achievement scores and intelligence scores.
2.7.2 Skewness and Kurtosis:

Skewness and Kurtosis were worked out to see the trend of departure of the sample distribution from the normal probability curve.

2.7.3 Graphical Representations.

2.7.4 Analysis of Variance:

Analysis of variance design $3 \times 2 \times 2 \times 3$ (teaching strategies $\times$ sex $\times$ personality $\times$ intelligence) was employed to analyse the achievement scores. Analysis of variance was computed on gain scores as guided by pre-test, post-test experimental design and also to avoid the use of analysis of co-variance. The results of analysis were used to test hypothesis.

2.7.5 t-ratios:

These were computed for testing the significance between means of different groups.

2.8 Operational Definitions of the Concepts Used in the Present Study:

Personality:

Extroversion-Introversion as measured by E.P.I.

Intelligence:

It includes only verbal intelligence as measured by Jalota's Mental Ability Test.
Strategy:

Three teaching strategies were defined as follows:

**Strategy I (A₁)**: In strategy I two topics namely - set theory and Trigonometric ratios will be taught through lecture then followed by deductive and then discussion that means, Lecture - Deduction - Discussion.

**Strategy II (A₂)**: In strategy II these two topics will be taught through Inductive followed by discussion and then Drill that means,

Inductive - Discussion - Drill.

**Strategy III (A₃)**: In strategy III these two topics will be taught through programmed instruction followed by Discussion than Demonstration, that means,

Programmed Instruction - Discussion - Demonstration.