DESIGN OF STUDY

Research design is one of the most important parts of any research project. It helps in planning the line of action for the proposed research project.

3.1 CONCEPT OF DESIGN:

Research design is the mapping strategy, which is based on sampling techniques. It essentially includes methodology, sampling, research strategy, tools and techniques for collecting the evidences, analyzing the data and reporting the findings. Thus, research design is the statement of the object of the inquiry and how a satisfactory culmination to be effected. A research design is the work before getting the project underway.

Research design is a choice of an investigator about the component of his project and development of certain components of the design. A design of research does not consist of an order sequential step by step procedure. It is a planning stage of research which is usually made logically visualizing its practicability. The selection of research components is done keeping in view the objectives of the research. Research hypothesis also provide the basis for designing a research work. A research design includes following components:

1. Research method or research strategy
2. Sampling Design
3. Choice of research tools and

Kerlinger asserts that research design has two basic purposes:

1. To provide answers to research questions, and
2. To control the variance

3.2 RESEARCH METHODOLOGY:

Research methodology involves the systematic procedures by which the researchers start from the initial identification of the problem to its final conclusions. The role of the methodology is to carry on the research work in a scientific, and valid manner. The method of research provides the tools and techniques by which the research problem is attacked. The methodology consists of procedures and techniques for conducting a study. Research procedures are of little values but they should be used properly, otherwise, the tools and techniques will not get the work done. The proper use of research method must be learned by the researcher.

Research methodology involves such general activities as identifying problems, review of literature, formulating hypothesis, procedure for testing hypothesis, measurement, data collection, analysis of data, interpreting results and drawing conclusions. Thus, research methodology consists of all general and specific activities of research mastery of the research methodology invariably enhance understanding of the research activities.

Thus, it seems that research design and methodology have the same meaning i.e. mapping strategy of research.
The present study was conducted on VII standard students of public school. The data were collected from the above written units by experiment. So the main method of study was **EXPERIMENTAL**

**F. S. Chapin** says –

"An experiment is an observation under controlled conditions."

Thus collected data were used to verify the proposed hypothesis in chapter one. Experimental method is the most sophisticated way of research, particularly in Science. In this we study some variables by controlling some other variables affecting the previous one. When certain variables can be controlled or manipulated directly in research problem by the investigator, the research procedure is often described as an experiment. In the present study each group was first taught by using CD-ROM of Navneet top scorer digest plus which has been prepared on the basis of NCERT VII class syllabus. From the CD only three chapters i.e. Heat, Flow of heat and Light were taught. In the CD-ROM used, the summary of each topic was given and also visual graphics were there explaining some experiments and activities.

**EXPERIMENTAL DESIGN**

Experimental design is the blueprint of the procedures that enable the researcher to test hypotheses by reaching valid conclusions about the relationships between independent and dependent variables. In the present study the experimental design was quasi–experimental design (John.W.Best & James V.Kahn; pg-57; 7th edition; Prentice-Hall India) because random assignment to experimental
treatments has not been applied, the equivalence of the groups is not assured. Of the quasi-experimental design the Counterbalanced design (John.W.Best & James V.Kahn; pg-58; 7th edition; Prentice-Hall India) was applied in the present study in which three experimental treatments were given to all the three groups but in different order. This may be diagrammed as follows:

**Experimental Design**

**Table – 3.1**

<table>
<thead>
<tr>
<th>Topics</th>
<th>GP I (N=34)</th>
<th>GP II (N=36)</th>
<th>GP III (N=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic A*</td>
<td>Treatment I</td>
<td>Treatment II</td>
<td>Treatment III</td>
</tr>
<tr>
<td>Topic B**</td>
<td>Treatment II</td>
<td>Treatment III</td>
<td>Treatment I</td>
</tr>
<tr>
<td>Topic C***</td>
<td>Treatment III</td>
<td>Treatment I</td>
<td>Treatment II</td>
</tr>
</tbody>
</table>

Where,

Treatment I = CAI followed by Discussion Method

Treatment II = CAI followed by Demonstration Method
Treatment III = CAI followed by Activity Method

*Topic A = Light
**Topic B = Heat
***Topic C = Flow of Heat

Further, when more than one independent variable is included in a study, whether a true experiment or a quasi experiment, a factorial design (John.W.Best & James.V.Kahn; pg-59; 7th edition; Prentice-Hall India) is necessary, because most real-world outcomes are the result of a number of factors acting in combination, most significant experimentation involves the analysis of the interaction of a number of variable relationships.

In the present study three methods i.e. CAI followed by demonstration method, CAI followed by discussion method, CAI followed by activity method were the three independent variables given to the three groups of which each group were further divided on basis of gender i.e. male and female. So, the factorial design applied in present study was 3 X 3 X 2, as shown below diagrammatically.

Factorial Design

Table 3.2
Where,

\[
\begin{align*}
\text{Tr I} & = \text{Treatment CAI followed by Discussion Method} \\
\text{Tr II} & = \text{Treatment CAI followed by Demonstration Method} \\
\text{Tr III} & = \text{Treatment CAI followed by Activity Method} \\
\text{M} & = \text{Male} \\
\text{Fe} & = \text{Female}
\end{align*}
\]

In the present study all the three treatments were considered as experimental treatments and all the three groups as experimental group. There was no control group in the study.

3.3 VARIABLES OF THE STUDY:
In the experimental study the main functioning proceeds around the variables. To see the effect of these variables is the purpose of experimental study.

Kerlinger says –

“Variable is a property that takes on different value.”

Variables are the conditions or characteristics that the experimenter can manipulate, control or observe. The variables can be classified in various ways, but in the present study three types of variables were employed in conducting this experimental study.

3.3.1 EXPERIMENTAL VARIABLE OR INDEPENDENT VARIABLES

An experiment is conducted to examine the effect of a variable or treatment which is known as experimental variable. The main attention is given in the experiment to observe its effect. In the present study, CAI followed by discussion method, CAI followed by demonstration method and CAI followed by Activity method are the experimental variables.

3.3.2 CRITERION VARIABLE OR DEPENDENT VARIABLE

The basis on which the effectiveness of experimental variable is established or studied is known as the Criterion Variable. The achievement may be the criterion or dependent variable. Thus in the present study the student's achievement before and after the treatment on science achievement test is the criterion variable.

3.3.3 INTERVENING VARIABLES

There are a number of abstract variables in educational experiment which intervene the effect of experimental variable on criterion variable. The learner’s
attitude, motivation and learning process are the intervening variables. A researcher should be careful about intervening variables in conducting an experiment to know the true effect of the treatment. In the present study the researcher tried to control this variable by selecting the sample of students from the population of seventh grade i.e., eleven to twelve years of age and of the same socio-economic status as all the students of sample are selected from the well reputed public schools of urban area of the same city.

3.4 POPULATION:

Population or universe means, the entire mass of observations, which is the parent group from which a sample is to be formed. In research methodology population means the characteristics of a specific group.

A population is any group or individuals that have one or more characteristics in common that are of interest to the researcher. The population may be all the individuals of a particular type, or a more restricted part of that group. Thus population consists of total number of persons inhabiting a country, city, any district or area. In research it indicate a field of study comprising of a segment of population which is taken as a canvas of experiment in a particular area of researches.

In the present study population comprises all the VII grade students of public schools of MuzaffarNagar city.

3.5 SAMPLE AND SAMPLING TECHNIQUE:

The study of total population is not possible and it is also impracticable. The practical limitation, cost time and other factors which are usually operative in the situation, stand in the way of studying the total population. The concept of sampling has been introduced with a view to make the research findings economical and accurate.

W. G. Cochran defined the term sampling –
“In every branch of Science we lack the resources, to study more than a fragment of the phenomenon that might advance our knowledge.”

Here a “Fragment” is sample and phenomenon” is the population. The sample observations are applied to the phenomenon i.e., generalization. A sample is a small proportion of a population selected for observation and analysis. By observing the characteristics of the sample one can draw certain inferences about the characteristics of the population from which it is drawn. Samples are not selected haphazardly, they are chosen in a systematically random way, so that chances or the operation of probability can be utilized.

The process to draw the sample from population to collect the data for solving the problem is called sampling. To draw sample from population some techniques are used, which are called as the methods or techniques of sampling.

In the present study three secondary public schools were selected out of 18 secondary public schools of the Muzaffarnagar randomly. Further the students of VII grade of each school were selected through cluster sampling. One section from each school was taken as a cluster sample. Each section taken consist of 39 to 40 students. Out of the full strength of each group, the students who were absent for two or more days were eliminated from the sample. At last group I consist 34 students, group II consist 36 students and group III consist 35 students. Thus total sample taken were 105
Further each group were assigned all the three treatments randomly.

### Design of sampling

#### Table 3.3

<table>
<thead>
<tr>
<th>School I</th>
<th>School II</th>
<th>School III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section A</td>
<td>Section A</td>
<td>Section A</td>
</tr>
<tr>
<td>Group I</td>
<td>Group II</td>
<td>Group III</td>
</tr>
<tr>
<td>N=34</td>
<td>N=36</td>
<td>N=35</td>
</tr>
</tbody>
</table>

- **Male**  
  - School I: N=18  
  - School II: N=19  
  - School III: N=16
- **Female**  
  - School I: N=16  
  - School II: N=17  
  - School III: N=19

#### 3.6 TOOL USED

The effectiveness of techniques of teaching followed in the classroom can be judged by assessing the achievement of pupils before and after experiment. Tool used by investigator in the present study is achievement test of science developed by the investigator. Achievement test developed by the investigator for data collection consists objective type questions based on recall & recognition. It is based on contents of VII grade Science including light, heat and flow of heat.
3. 7 DESCRIPTION OF THE TOOL

The term achievement in academic subjects generally refers to the gain in instructional objectives.

“An Achievement test is a systematic procedure for determining the amount a student has learned”.

Generally achievement testing is viewed as an end-of-course activity that is used primarily for assessing course grade. The achievement test at the end of a period of instruction for the purpose of assessing mastery over the subject is called summative test. This type of test is broad in coverage and attempts to measure all the learning tasks included. Gronlund (1977) has given the following principles –

a) Achievement tests should measure clearly defined learning outcomes that are in harmony with the instructional objectives.

b) Achievement tests should measure a representative sample of the learning outcomes and subject matter included in the instruction.

c) Achievement tests should include the types of test items that are most appropriate for measuring the desired learning outcomes.

d) Achievement tests should be designed to fit the particular use to be made.

e) Achievement tests should be made as reliable as possible and should then be interpreted with caution.
The above considerations were taken into account while preparing the science achievement test for the present investigation.

In the present study the science achievement test prepared consist recall and recognition type questions. The achievement test is prepared in three parts i.e. A, B & C depending on three topics i.e. light, heat and flow of heat respectively. Each part includes very short type questions, multiple choice questions, completion type questions and drawing type questions.

The multiple choice items used in the achievement test consists of a stem and several alternatives. The stem may be a problem, a question, or an incomplete statement. The alternatives include one correct answer and several plausible wrong answers. These wrong answers are distractors. The function of the distractor is to create ambiguity to the students who are uncertain of the answer. All these type of items can be used to measure knowledge outcomes, specifically, those included in the cognitive domain of the taxanomy of educational objectives.

3.8 CONSTRUCTION OF ACHIEVEMENT TEST OF SCIENCE:

To measure achievement of students in science, achievement test was prepared by investigator herself because no standardize test was available. All the necessary precautions and conditions were kept in mind during the test construction. The following steps were followed for the construction of achievement test –

3.8.1 PREPARATION OF ITEMS:

The test items relevant to the achievement were prepared from the different sources viz relevant literature and books. Initially 80 items were prepared for achievement test.

3.8.2 SELECTION OF ITEMS:
Prepared list of items was reviewed. Items were seen from language point of view. The items having ambiguous language were modified or roped. After this process only 68 items were selected.

**3.8.3 EXPERT OPINION:**

After preparation of test items, all the questions were pooled in the form of test to check the structure of items, language and appropriateness. On the basis of experts view 60 items were selected. 20 on each topic i.e. 20 in each part A, B & C.

**3.8.4 SMALL GROUP TRYOUT:**

This initial draft of achievement test was administered on 15 students of VII class. The students were requested to express freely their difficulties and suggestions, if any. This was derived to know the ambiguous statements and to find out each statement conveyed the same sense to them as the investigator had in mind. On the basis of students responses some modifications were made and the tryout form of the test was ready for the tryout.

**3.8.5 TRYOUT:**

The tryout form of test was administered on 60 students. Students were selected on random basis. Only those students were selected which were not sample of final experiment. Scoring “1” was given for the correct answer and “0” for incorrect answer. A master chart was prepared for the scoring of each student as each item. The score on each item by a student were added to obtain total achievement test.

**3.8.6 ITEM ANALYSIS:**
Item analysis plays an important role in test construction. It is concerned with item difficulty and item discrimination. Item difficulty is the proportion of individual completing the items successfully whereas the item discrimination index refers to the degree to which it differentiates between those obtaining high and low scores. For the purpose of items analysis total scores of students were ranked for highest to lowest. Then 27% subjects with higher and 27% of subject with lowest scores were selected as higher and lower group respectively.

3.8.7 ITEM DISCRIMINATION:

If a high group does better than the low group on an item, then item is said to be discriminating well. The following formula for the index of discrimination ‘D’ was used.

**Item Discrimination = \( P_H - P_L \)**

Where,

- \( P_H \) is percentage of correct responses of high groups.
- \( P_L \) is percentage of correct responses of low group.

3.8.8 ITEM DIFFICULTY:

It indicates the percentage of people answering an item correctly. Item difficulty was calculated for each item by the following formula –

**Item Difficulty = \( \frac{(P_H + P_L)}{2} \)**

3.8.9 PREPARATION OF FINAL FORM:
On the basis of discrimination value and difficulty value final form was prepared. Only those items were selected for final form whose discriminating power and difficulty value both are more than 0.30. Out of 60 only 46 items were selected for final form.

**TABLE SHOWING DIFFICULTY VALUE AND DISCRIMINATION POWER**

Table 3.4

<table>
<thead>
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<th>S. No.</th>
<th>High Group(P_H)</th>
<th>Low Group(P_L)</th>
<th>P_H+P_L/2</th>
<th>P_H-P_L</th>
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<tbody>
<tr>
<td></td>
<td>No. of correct answers</td>
<td>P_H</td>
<td>No. of correct answers</td>
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</tbody>
</table>
3.8.10 RELIABILITY:

Reliability is the consistency of the test. It means repeated measurement of the same test on same sample will give nearly the same result. Test – retest reliability was calculated on the basis of sample. Data was administered as final form for this purpose. Correlation between test and re-test was found to be 0.82.

3.8.11 VALIDITY:

The achievement test involves the questions of science for the students of VII grade. All the items were selected for this purpose keeping in mind the standard and mental level of the students. Test was given to different experts. All the items were screened by their suggestions. Hence the test has content validity.

3.9 ADMINISTRATION OF TOOL

For the present study the investigator divided the whole sample into three groups i.e. group I, group II and group III of 34, 36 and 35 students respectively. First of all, the whole achievement test prepared by the research i.e., part A (for the first topic), part B (for the second topic) and part C (for the third topic) was administered on all the three groups as pre-test to check previous knowledge and equate the group. After pre-test all the three groups were given all the three treatments i.e. CAI followed by discussion method (Treatment I), CAI followed by demonstration method (Treatment II) and CAI followed by activity method (Treatment III) one by one with different topics as shown in Table 3.5.

**Table showing administration of tool**

Table – 3.5
<table>
<thead>
<tr>
<th>Groups</th>
<th>GP I</th>
<th>GP II</th>
<th>GP III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=34</td>
<td>N=36</td>
<td>N=35</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Topics</th>
<th>Pre-test (Part A, B and C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topic A</td>
<td>Treatment I*</td>
</tr>
<tr>
<td>Topic B</td>
<td>Treatment II**</td>
</tr>
<tr>
<td>Topic C</td>
<td>Treatment III***</td>
</tr>
</tbody>
</table>

Where,

- Treatment I* = CAI followed by Discussion method
- Treatment II** = CAI followed by Demonstration method
- Treatment III*** = CAI followed by Activity method

For pre-test the students were given all the three parts i.e. A, B and C of achievement test prepared by researcher to students of each group all together with time of 60 minutes. The researcher reached the institution according to the schedule. First researcher administrated the science achievement test as pre-test on all the three groups as shown in Table 3.5. Then researcher taught the subject content to the students of all the three groups of VII class for 5-6 days each on each topic.

All the groups were taught the same content by researcher herself. Each group was taught each topic for 5-6 days, 35 minutes daily one by one i.e. first in one school to group I, then in another school to group II and then in third school to group
III. The science achievement test's each part i.e. A, B and C were administered after every treatment of each topic as post test simultaneously for the collection of data as shown in table 3.6

SYNOPTIC PRESENTATION OF TREATMENT

Table 3.6

SAMPL E

Group I
N= 34

Group II
N= 36

Group III
N= 35

Pre test
(On topic A, B and

Treatment I

Post test for topic

Treatment II

Post test for topic

Treatment II on topic

Treatment III

Post test topic B

Treatment III on topic

Group I
N= 34

Group II
N= 36

Group III
N= 35

Pre test
(On topic A, B and

Treatments

Post test for topic

Treatment I

Post test for topic

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Treatmen
The researcher administered the science achievement test on VII grade students of a public school situated in Muzaffarnagar District. After the completion of each experiment post-test were conducted in the presence of teachers to maintain the discipline during the test. The students were told that the part of present achievement test is on the content which they have been taught. Every time test was administrated on next day after the completion of the topic. The students were given 20 minutes for every part i.e. A, B and C separately for taking the test. Students were told that they have to write the correct response of questions on the answer sheet according to the instructions given and they have to write nothing on the test paper. They were told to read the instruction carefully and to follow the same. The answer sheets with the test were collected after the expiry of allotted time of 20 minutes each and then researcher thanked the students. After the completion of experiment and data collection the researcher thanked to the students, teachers and Principal of the institutions.

3.10 SCORING

The researcher scored the answer sheets of science achievement test with the help of scoring key developed by herself. The tables of pre-test and post-test for the science achievement scores were prepared for all the three groups, 1st,
2\textsuperscript{nd}, 3\textsuperscript{rd}. Answer script of only those students were scored who were present in the classroom during the teaching and test period continuously. Thus numbers of students were 34 for 1st group, 36 for IIInd and 35 for IIIrd group. Hence total 105 students from the three different institutions were taken in the sample of the study. The scoring tables were separately prepared for all the three parts i.e. A, B and C of science achievement test for all the three groups.

3.11 STATISTICAL TECHNIQUES USED

This is certainly true that statistical techniques are used in the analysis of data for interpretation. Certain statistical techniques have to be used in connection with the estimation of responses received on science achievement test, formation of groups, analysis of data and hypothesis testing. Analysis of data includes comparison of outcome of the treatment upon all the three groups and the making of a decision as to the achievement of the goals of the research.

After administering and scoring the research tool answer script, data collected and organized. The collected data is called as “raw data”. The raw data are meaningless unless certain statistical treatment is given to them. Analysis of data means to make the raw data meaningful or to draw some results from the data after the proper treatment. The null hypotheses were tested with the help of analysis of data so to obtain some significant results.
3.11.1 CONSIDERATION FOR STATISTICAL ANALYSIS

There are various statistical techniques for analyzing data. To choose an appropriate technique of statistical analysis is the challenging task to a research worker. It has two main functions:

5) Interpretation of results
6) Presentation of data

The major types of tests are employed for analyzing data so as to interpret the results. These are:

1. Parametric statistics or tests
2. Non-Parametric statistics or tests

The present study consists the well defined population as well as the sample was representative. So, parametric statistical techniques were used for analysis of data. The data were on interval scale. Hence the following parametric statistical techniques have been used in the present study.

1. Mean and standard deviation
2. “F” test for measuring the significance of the difference among the three groups pre-test and post-test.
3. “t” test for measuring the significance of the difference between the two main scores.