CHAPTER: 3.0
RESEARCH DESIGN OF THE STUDY

3.1 Introduction
This chapter contains detail information about universe, sample, research method, experimental design, development of teaching material, tool, implementation of the experiment, details of internal and external validity, technique of data analysis, etc. In other words methodology of the research – working plan is presented in this chapter.

Desai and Desai (2010)¹ say that, "For understanding the extract of any research, the study about its planning is essential". The reader should clearly understand and can carry out the research in future to check the exactness of results. So this chapter is written in such a way that a reader gets complete information about the work.

3.2 Population
The only one aim of the investigator is to find conclusions which are applicable universally. The main group of students from which the sample in selected is called population. Uchat (2004)² says that with the aim to collect information the small group representing the whole is taken and conclusions are drawn for whole group this whole group is called population.

From the whole universe through scientific method sample is selected. So the universe should be specified.

In the recent study investigator selected the students studying in the English medium schools following state board syllabus at secondary level in Mumbai city for the academic year 2013-14.

² D.A.Uchat, Research Applications on data, Rajkot: University Book Production Board, Saurashtra University, 2004, p.56.
3.3 Sample Selection Techniques

With reference to the objectives of the study the small representative group from the universe is chosen by appropriate method. This process is called sampling. This small group is called sample. Uchat (2005)\(^3\) says that for getting information about universe and deriving conclusions about the same a selection of the small representative group is done such a small group is called sample. There are various techniques of sampling. Uchat (2004)\(^4\) indicates different methods of sample selection. Its pictorial representation is as below;

\[\textbf{Methods of Sampling}\]

- Probability Sampling
- Non-Probability Sampling
- Specific Sampling

- Random Sampling
- Stratified Random Sampling
- Systematic Sampling
- Cluster Sampling

- Incidental Sampling
- Purposive Sampling
- Quota Sampling
- Double Sampling
- Sequential Sampling
- Matched Pair Sampling
- Snow-ball Sampling

\[\text{Figure 3.1 Methods of Sampling}\]

- **Probability Sampling**: In these techniques probability of sample selection is equal. Chance of selection of every sample from the population is known. Four different techniques of probability sampling are – Random Sampling, Stratified Random Sampling, Systematic Sampling and Cluster Sampling.

Random sampling technique is very simple and is mostly used in research as the sample is selected without any bias or prejudice. In Stratified Random Sampling, the population is divided into various strata of variables like standard of education, gender, age etc. This technique is used to overcome the limitations of random sampling and is generally used in non homogeneous group. In Systematic sampling,


sample selection is done at fixed intervals. Here the first item is selected randomly and then every $i^{th}$ item is selected. Cluster Sampling is used if the area of interest is very big. Conveniently the area is divided into smaller non-overlapping areas. Here sample consists of clusters selected randomly.

In the present study the techniques of probability sampling is not used.

- **Non-Probability Sampling**: This technique does not have probability for selection of item in a sample. In this technique selection of sample is as per choice of investigator. Here the chance of selection of every sample is unknown. There are three techniques of Non-Probability sampling. They are Incidental Sampling, Purposive Sampling and Quota Sampling.

  Incidental Sampling is generally used by the investigator when he selects easily readily available sample. This technique is used for ease and comfort in sample selection process. In Purposive Sampling as the name suggest there is some purpose behind selecting sample. This technique works without bias if the investigator is sound in judgment. Quota sampling is very convenient and relatively inexpensive. This method is generally used while taking interview. Here the sample so selected certainly does not possess the characteristics of random samples.

  The present research is an experimental research. The school selected for experimentation was selected purposefully keeping in mind objectives and requirements of the research study. Investigator selected Indian education society high school for the purpose of experiment, reasons behind selection of this school are mentioned below in next heading.

- **Specific Sampling**: This technique is used in some specific situations as per its name. When research work is not carried out in normal circumstances than this type of sampling technique is required. The techniques included in Specific sampling are- Double Sampling, Sequential Sampling, Matched Pair Sampling and Snow-ball Sampling.

  In Double Sampling technique sampling is done twice. Here first sample is selected from population and information is collected from it and then again a sample is selected from previously selected large sample. Sequences are followed in sequential sampling. Here the samples are selected subsequently till the required result for taking certain decisions is not obtained. In Matched pair sampling technique the investigator forms a pair of two identical subjects in terms of dependent variables
and controlled variables. Then one of the subjects from the pair is placed in experimental group while other is placed in controlled group. In this way effect of the treatment can be measured by finding difference between final scores of the individuals of the pair. In Snow-ball sampling the subjects of small sample plays a role in increasing size of sample. Selected sample guides the investigator in selecting other identical samples.

In the present study there was no specific situation so Specific Sampling technique was not used at any stage of sample selection process.

3.4 Sample Selection

Selection of sample and its size depends on the research method. The sample should be selected in such a way that its result should be applicable to the population. There should be equal probability for each subject to be selected as sample. The selection of school was done objectively. The reasons were as below:

1. This research is of experimental type. The investigator was supposed to teach unit 'Sets' of Std. 9 in Mathematics. Thus it was essential to select such a school where the content teaching was not done.
2. English medium Secondary Schools following Maharashtra State Board Syllabus were needed.
3. The investigator was to study the effect of teaching through Concept Attainment Model of Instruction on achievement among learners with different achievement levels. Thus it was desirable to have a school with greater number of classes so that pupils with different achievement levels can be obtained.
4. Attendance of nearly equal amount of boys and girls was needed. It was desirable to work upon co-education schools.
5. One of the motives of the research study was to assess the effect of teaching through Concept Attainment Model of Instruction on Socio economic status. So it was decided to select a school where in pupils belonging to different socio economic status come to learn.

While selecting Schools purposive sampling technique was used. But all the students from all the classes were included in the experiment so that generalizations made from the experiment would be applicable to population. Detailed information about sample is given as:
**Sample for the Experiment.** For the experiment Indian Education Society (IES) High School and Sardar Vallabhbai Patel High School (SVP) were selected and procedure followed is as follows:

1. **Selection of the class.** All the classes of the schools were selected.
2. **Group formation.** Students from all the classes formed experimental group as there was no control group.
3. **Implementation of teaching method.** As explained above that all the classes were included in experimental group. These groups were taught through Concept Attainment Model of Instruction. The table 3.1 gives information about the sample students.
4. **Schedule of experiment.** The teaching experiment took place in two phases. Phase-I was in morning shift and in IES school and phase-II was in afternoon shift that included SVP school

The table 3.1 gives information about the sample students.

**TABLE 3.1**

<table>
<thead>
<tr>
<th>School</th>
<th>Std</th>
<th>Group</th>
<th>Treatment</th>
<th>No. of Students before experiment</th>
<th>No. of Students after experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>IES School</td>
<td>9</td>
<td>Experimental Group</td>
<td>Concept Attainment Model of Instruction</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>SVP School</td>
<td>9</td>
<td>Experimental Group</td>
<td>Concept Attainment Model of Instruction</td>
<td>238</td>
<td>238</td>
</tr>
</tbody>
</table>

The table 3.1 reveals that for the experiment IES High School and SVP High School were selected and the number of students before starting the experiment was same as at the end. IES School contained five divisions of class 9 as A, B, C, D and E. The investigator has included students of all the sections in the group. This group studied through Concept Attainment Model of Instruction. In SVP School there were six divisions and all of them were also taught using Concept Attainment Model of Instruction. The detailed time table of teaching schedule is given in Table 3.2
### TABLE 3.2

**Time Table of the Experiment**

<table>
<thead>
<tr>
<th>Lecture No.</th>
<th>Lecture Timings</th>
<th>MON</th>
<th>TUES</th>
<th>WED</th>
<th>THU</th>
<th>FRI</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Socio-economic status scale and Intelligence test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>8:00 am</td>
<td>A</td>
<td>B</td>
<td>E</td>
<td>D</td>
<td>C</td>
<td>E</td>
</tr>
<tr>
<td>3.</td>
<td>8:30 am</td>
<td>D</td>
<td>E</td>
<td>B</td>
<td>C</td>
<td>B</td>
<td>A</td>
</tr>
<tr>
<td>4.</td>
<td>9:00 am</td>
<td>E</td>
<td>A</td>
<td>C</td>
<td>A</td>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td>5.</td>
<td>9:30 am</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
<td>A</td>
<td>D</td>
</tr>
<tr>
<td>6.</td>
<td>10:15 am</td>
<td>C</td>
<td>D</td>
<td>A</td>
<td>B</td>
<td>E</td>
<td>C</td>
</tr>
</tbody>
</table>

**AFTERNOON SHIFT – SVP HIGH SCHOOL (Divisions of class 9 – A,B,C,D,E,F)**

<table>
<thead>
<tr>
<th>Lecture No.</th>
<th>Lecture Timings</th>
<th>MON</th>
<th>TUES</th>
<th>WED</th>
<th>THU</th>
<th>FRI</th>
<th>SAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Socio-economic status scale and Intelligence test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>1:00 pm</td>
<td>F</td>
<td>B</td>
<td>F</td>
<td>A</td>
<td>C</td>
<td>D</td>
</tr>
<tr>
<td>3.</td>
<td>1:30 pm</td>
<td>A</td>
<td>F</td>
<td>D</td>
<td>E</td>
<td>E</td>
<td>A</td>
</tr>
<tr>
<td>4.</td>
<td>2:00 pm</td>
<td>D</td>
<td>A</td>
<td>C</td>
<td>C</td>
<td>D</td>
<td>B</td>
</tr>
<tr>
<td>5.</td>
<td>2:30 pm</td>
<td>B</td>
<td>D</td>
<td>E</td>
<td>D</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>6.</td>
<td>3:15 pm</td>
<td>C</td>
<td>C</td>
<td>A</td>
<td>B</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>7.</td>
<td>3:45 pm</td>
<td>E</td>
<td>E</td>
<td>B</td>
<td>F</td>
<td>A</td>
<td>F</td>
</tr>
</tbody>
</table>

In the study firstly all the students were given intelligence test and socio-economic status scale. Socio-economic status scale was given to know the socio-economic status of the students. Socio-economic status was an independent variable. It gives answer that what type of SES students get benefit if the selected model of teaching is implemented. Secondly, test of intelligence was administered. On the basis of the scores obtained on test of intelligence and marks obtained by pupils in final examination of Mathematics were considered. Using regression equation learners with various achievement levels were found. The students were identified as over achievers, normal achievers and under achievers based on their score of intelligence test and marks in mathematics of final examination. On the basis of the intelligence scores and their achievement scores were predicted using regression equation. The
scores obtained on the basis of prediction are known as predicted scores. If this predicted score were less than their actual achievement then these pupils were considered as over achievers. If the predicted scores were same as their achievement scores then the pupils were termed as normal achievers. If predicted scores of pupils are more than achievement scores than pupils are considered as under achievers. Here meaning of achievement scores is marks obtained by pupils in final examination of mathematics in class 8. The details about this analysis are provided in Chapter – 5. All these sample students were taught using Concept Attainment Model of Instruction.

3.5 Research Method

Every research has its own method. Selection of appropriate method in context to the problem is essential. Borg, Gall and Borg (2001)\(^5\) divided the research methods into three categories.

1. Historical Research Method.
2. Descriptive Research Method
3. Experimental Research Method

If the study pertains to past, if some monuments are to be studied or some historical past events are to be studied then Historical Research Method is used. In researches were in present is studied and certain conclusions about present status are made Descriptive Research Method is used. While in researches where in some conditions are altered in present to find that what would be its results it is an experimental research. In this method some variables are introduced and under certain controlled conditions its effect is studied. These effects can be used in future to improvise certain conditions. In the present study the effectiveness of Concept Attainment Model of Instruction is to be checked in reference to achievement among learners with different achievement levels, so Experimental Research Method was used.

Best (1963)\(^6\) says that "Experimentation is the classic method of Mathematics laboratory, where elements are manipulated and effects observed can be controlled. It is the most sophisticated, exacting and powerful method for discovering and developing an organized body of knowledge".


Thus to find the effectiveness of the Concept Attainment Model of Instruction the experimental method was used. Here in after the treatment is explained.

3.6 Selection of Experimental Design

There are various types of designs available. It is important to select appropriate method. Dave (1994)\(^7\) says "Experimental method is a scientific pre decided tool to test the hypothesis and collecting data".

According to Shah (2004)\(^8\) experimental design is blue print prepared to evaluate hypotheses that are made for developing relations between independent and dependent variables. There are mainly three types of experimental designs which can be classified as follows:

1. **Pre Experimental Design.** Pre experimental designs are very less effective as they have minimal control. No control group is present in such designs. There is no method for equalizing groups.

2. **True Experimental Design.** These designs are mostly used in scientific laboratory study. Randomization is used for equalizing groups. These types of designs have equalized groups.

3. **Quasi Experimental design.** Quasi experimental design provides a less degree of control. Randomization is not possible. This design is mostly used in educational experiment. The investigator used Quasi-experimental design.

The investigator used ‘Three groups only post test design’. The logical thinking of this study provides strong basis for it.

1. This design is according to the objectives/process of experiment of the study.
2. This is the best design when randomization of subjects is not possible.
3. Number of subjects in the groups is unequal.
4. This method has internal and external validity. Its discussion is done later in the same chapter.

The form of design is given in tables 3.3.

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TABLE 3.3

Three groups only post test experimental design of the study

<table>
<thead>
<tr>
<th>Group</th>
<th>pretest</th>
<th>Independent variable</th>
<th>post test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group 1</td>
<td>-</td>
<td>X</td>
<td>T₂</td>
</tr>
<tr>
<td>Experimental Group 2</td>
<td>-</td>
<td>X</td>
<td>T₂</td>
</tr>
<tr>
<td>Experimental Group 3</td>
<td>-</td>
<td>X</td>
<td>T₂</td>
</tr>
</tbody>
</table>

Where

Experimental Group 1 = Over achiever students
Experimental Group 2 = Normal achiever students
Experimental Group 3 = Under achiever students
X = Teaching through Concept Attainment Model of Instruction
T₂ = Standardized Unit Achievement Test

3.7 Characteristics of Experimental Design

In this section the characteristics of the experimental design is presented. Donga (1998)⁹ says that the investigator should specify the characteristics with the help of following references.

1. Control of Variables
2. Implementation of Independent Variable
3. Observation of Dependent Variable
4. Replication of Experiment

With reference to above following care is taken by the investigator.

1. Control of Variables. During the experiment the independent variable affects the dependent variable. Some of the variable affect on their own on the dependent variable which can spoil the results. So in order to maintain validity of results the investigator identifies such variables and controls them.

In this research "Students Educational Achievement" was dependent variable and various variables like number of lectures, subject, topic, grade etc. were taken under control. Gender and Socio-economic status of pupils were taken as moderator variables during the study, as the investigator wanted to find the effect of gender and socio-economic status on achievement.

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2. Implementation of Independent Variable. Independent variable can be implemented only after proper planning. Teaching through Concept Attainment Model of Instruction is independent variable. Proper lesson transcripts based on it were prepared with due care as discussed in chapter-4.

3. Observation of Dependent Variable. In the experimental research after the implementation of the independent variable a standardized achievement test in Mathematics was given to the students to check their effectiveness. The usage of standardized test while assessing achievement gives more authentic results. Details about test construction and its process of standardization are mentioned in chapter-4.

4. Replication of Experiment. The experiment was done with utmost authenticity. Procedure followed during carrying out an experiment was systematic. The experiment was done in two phases on two different schools and in two different shifts to overcome the limitation of replication of experiment.

3.8 Validity of the Research Design

It is very important for the experiment to be valid. According to Campbell and Stanley there are two types of validity as mentioned in Shah (2004)\(^{10}\) are (1) Internal Validity and (2) External Validity.

The internal validity is discussed hereafter.

3.8.1 Internal Validity: Internal validity means to find out that does independent variable have any effect on dependent variable? It is must to find that whether the result obtained from the study is affected by unwanted variables?

Internal validity of the program depends upon ‘control’. In this study investigator checked internal validity of the experiment with reference to the following controls.

1. Current events. During implementation of the instructional design any events like changes in weather, events like war and earth-quake or other such circumstances which affects dependent variable are called current events.

During this experiment no such events occurred. If at all it might have occurred it could affect all the three experimental groups.

\(^{10}\) Dipika Shah, Educational Research, Ahmadabad: University Book Production Board, 2004, pp.212
2. **Maturity.** Due to the longer duration of time there occur changes in physical and mental development of the sample. This affects the dependent variable and this effect was controlled.

In the given study the experiment continued for fifteen days and on the sixteenth day post test was taken to know the effect of the experiment, so in this duration there was no question in change in attitude, intelligence or talent.

3. **Pre testing.** The process and content of the pre-test provides experience to sample for giving post-test. May be due to practice the students can perform well in post test. In this study no pretest was taken so experience of pre-test did not affected the results of post-test.

4. **Instrumentation decay.** During the experiment certain measurement and observations are done. If the measurement is done by a test then there are chances that there may be voice of instrumentation. May be the post test can be more easy or hard, which effects the test results and in turn dependent variable.

This research contained only one Standardized Achievement Test as a post test so there was no question of instrumental decay.

5. **Statistical regression.** If the sample is selected from the ending scores then mean of sample score is found nearer to the mean of the scores of population. This is called statistical regression. In this study ending scores are not taken.

6. **Experimental mortality.** During the experiment there may be decrease in the number of students. Some students might have left the school during the experiment which leads to experimental mortality.

Throughout the experiment number of students was maintained so there was no question of experimental mortality.

7. **Consistency of results.** The investigator did experiment in two different schools and in different shifts and their combined result was obtained. So result can be considered consistent. Moreover the scores were converted to standard scores and the tools used for measurement were also standardized. So consistency in results was obvious.

8. **Expectation.** Due to implementing new instructional design on certain group investigator may expect better results from experimental group compared to control group. As a result automatically the program is proven successful which provides misleading conclusions. Here in the present study all the three groups were treated as experimental groups and same instructional design was used for them.
9. **Extension of experimental care.** When experimental group and control groups are kept together then experimental care is extended to control group which affects the dependent variable and hence alters the results. In the present study all the three groups were given experimental care so there was no question of extension.

10. **John Henry effect.** When sample of control group come to know that they are in competition with the experimental group then they try to work better which affects the results. Here in the present study samples were unaware of the groups means they were given same treatment. So this effect was not possible.

3.8.2 **External Validity:** It is essential for the investigator to know how much generalization of the experiment can be done. External validity means, to check the generalization, representation and extension of results obtained from the experiment in reference to population. Following factors were affecting external validity.

1. **Interaction between pretesting and independent variable.** Due to the pretest students’ gets experience for the post test, this is known as interaction between pretest and independent variable. In this study no pretest was taken so there was no interaction between pretest and independent variable.

2. **Interaction between selection of students and independent variable.** If selected sample does not represent the whole universe then the result generalized may not be applicable to the whole population. The investigator has not claimed for result. The school was selected purposefully and sample was selected purposefully.

3. **Interference of various teaching methods.** During the experiment some times more than one method are applicable on the group. Under such conditions the resistance of one method is seen on the other. Here as an independent variable teaching method was used but three groups were individually taught with same method. No groups were taught with different methods so this factor may not affect to the results.

4. **Measurement of dependent variable.** From pretest and posttest the measurement of dependent variable is done. The tools used may be Observatory, Inventory, test, etc. The measurement varies if different tool are taken. But in this research only one Standardized unit achievement test was constructed and used as post test.

5. **Mutual interaction of experiment.** Any specialized program affects the results compared to formal teaching. Here all the students were taught using Concept
Attainment Model of Instruction so even if the effect occurs in results it occurs to all the groups. Hence this factor is controlled.

6. **Explanation of experimental care.** In many of the researches full details about the program are not provided clearly so it becomes difficult for other investigators or teachers to use it in future. This leads to decrease in validity of experiment. In the present study complete details about the instructional design is provided from root till top. The details are mentioned in chapter-4. Thus there is no question of this effect.

7. **Hawthorne effect.** “Hawthorne effect” means awareness of the samples about we are under experiment gives high result as subjects starve to perform better. In the present study specialized instructional design was prepared but that design was implemented on all the groups hence this effect was controlled.

8. **Placebo effect.** When subjects of experimental group and control group come in contact with each other, the subjects of control group tries to find what work is carried out for the experimental group and this affects the results. In the present study all the groups were provided same situations including instructional design so this effect was controlled.

9. **Innovation and interruption effect.** Due to novelty of the experiment the samples try to perform better than regular this affects the results. In this study the instructional design was new but it was used in all the groups so even if the newness of teaching method has affected results it must be in all the groups. Hence this factor is also controlled.

10. **Interaction between history and independent variable.** The results of any experiment cannot be generalized for ever as time passes certain modifications are inevitable. In the present study investigator prepared Concept Attainment Model of Instruction to assess its effect on achievement among learners with different achievement levels.

11. **Interaction between measurement time schedule and independent variable.** If two tests are taken simultaneously or posttest is taken twice or even if posttest is taken soon after the experiment it affects results. Here soon after the completion of experiment posttest was taken. So this factor might have affected results but on all groups.

12. **Effects of experimental person.** Individual differences among the experimental persons affect the behavior of sample. Here investigator only taught in
all the groups so if at all it affected it affected to all the groups hence this effect can be neglected.

3.9 Variables of the Present Study

The present research was an Experimental research. The certain variables are involved in the study. Variables are conditions or characteristics that experimenter manipulates, control or observes. According to Kothari (2011)\textsuperscript{11} Variables are concepts that take different quantitative values. In the present study effect of manipulated independent variable is to be studied on dependent variables under certain controlled and moderator variables details are as below:

3.9.1 Independent Variable

In present study independent variable was Concept Attainment Model of Instruction. IndependentVariable are those conditions or characteristics that experimenter manipulates or controls. Here teaching method was independent variable. Since only one method of teaching was used independent variable had only one level.

3.9.2 Dependent Variable

In Present study dependent variable was academic achievement. It had three levels over achiever, normal achiever, under achiever students of secondary school. These variables are those which changes as the experimenter introduces, changes or removes independent variable.

3.9.3 Controlled Variables

During the experiment the researcher checks the effects of independent variable on dependent variable and controls some non selected variables to see that, they might not have any effect on dependent variable during study. Such variables are called controlled variables. Controlled variables were the grade, selection of unit and subject. These types of variables are characteristics which were controlled by investigator during experiment.

3.9.4 Intervening Variables

In the present study interest in mathematics, attitude towards study, study habits were intervening variables. These types of variables are difficult to observe but

their presence may be confused with the effect of independent variable on dependent variable.

3.9.5 Moderator variables

It is secondary independent variable, which is selected to check whether it affects the relation between main independent variable and dependent variable. The study included gender and Socio-Economic status as moderator variables. These are the variables whose effect investigator wants to find on dependent variable. Levels of moderator variable “Gender” were boys and girls. Levels of moderator variable “Socio-economic status” were high, medium and low.

3.10 Construction of Tools and Materials used in the Study

1. The investigator constructed and standardized a test on the unit 'Sets' for the subject Mathematics of std. 9 for the testing achievement of students. The test was used as posttest. Detail about test construction and its standardization is provided in next chapter.

2. To find various achievement levels among learners investigator used an intelligent test. According to the suitability of the research work and as per the necessity of the objectives of study investigator used Ravens Standard Progressive Matrices.

3. In order to assess the Socio-economic Status of pupils the investigator used the adapted version of Socio-economic Status scale prepared by Kuppuswamy. Details about Socio-economic Status scale and Ravens Standard Progressive Matrices are provided.

4. The investigator developed lesson plans using Concept Attainment Model of Instruction details of it are given in the next Chapter.

3.10.1 Measurement of Intelligence

Intelligence tests are available in verbal and non-verbal forms. While using verbal tests the language ability also plays active role and affects the process of assessing intelligence. Mumbai is a mixed city where in pupils come from different varied background with versatility in languages they speak. Thus it was not desirable to use verbal test for measuring intelligence. Hence investigator decided to use non verbal intelligence test that can be applicable to pupils in general without biasness of the region to which they originally belong.
Non verbal tests are of two types - individual tests and group tests. Individual tests are mostly used for clinical purpose and are difficult to administer on school students’ sample. It is also found that there is very high correlation between individual tests and group tests and they measure the same ability. Investigator decided to use group intelligence test. Thus it was finalized to use non-verbal group test of intelligence in order to measure intelligence of sample students studying in class 9. By considering the qualities of all the available intelligence test and as per the demand of the present study the investigator decided to use Raven’s Standard Progressive Matrices with sets A, B, C, D and E.

Raven designed the test as a measure of spearman ‘g’ factor that is ability to understand relations among abstract items. This test consists of sixty problems divided into five sets of twelve. In each set first problem is self evident. The problems gradually increase in level of difficulty. The Problems are in form of patterns with missing answer. There are six alternatives in sets A and B. In sets C, D and E there are eight alternatives. All of the alternatives appear to be correct, pupils have to put “X” mark in the box of correct response in the answer sheet provided to them. The individual’s total score provides an idea of his intellectual ability whatever his nationality or education.

Thampuratti (1969) concluded that twenty minutes is sufficient time span to complete test when it is intended to find intelligence of pupils of secondary schools. From the original studies on Standard Progressive matrices, the test reliabilities were ranging from 0.83 to 0.93. The test correlation with Terman-Meril Scale was 0.86. This test is a popular measure of intelligence in Indian Secondary Schools. Nair (1967) while implementing this test on Indian students found split half reliability 0.79 to 0.86. Test-Retest reliability varied from 0.89 to 0.91. This test is adapted by Indian Psychologists and they have standardized the test on Indian Students. The detailed booklet is published by Manasayan, Delhi.

**3.10.2 Measurement of Socio Economic Status**

Education, Occupation and income are three essential variables that determine the socio-economic status of any family. To assess the Socio economic status of the pupil investigator used adapted version of Socio economic status scale by Kuppuswamy (1962) published by Manasayan, Delhi. The scale used by the investigator is the adapted version that is modified as per the need of the modern society. This scale is redeveloped by Aggarwal, Bhasin, Chhabra and Rajoura and it is
published in Indian Journal of Community Medicine in the year 2004. Reliability, Validity and utility are found on nuclear as well as joint families of urban society. Pattern of weightage given is described in the table 3.4.

**TABLE 3.4**  
**Weightage Given To Items in Socio-Economic Status Scale**

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Education</th>
<th>Weightage</th>
<th>Occupation</th>
<th>Weightage</th>
<th>Income per month</th>
<th>Weightage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Doctorate or Double Masters</td>
<td>10</td>
<td>Highly Professional (Dr, En., CA, MBA)</td>
<td>10</td>
<td>Above 50,000</td>
<td>10</td>
</tr>
<tr>
<td>2.</td>
<td>Masters or Professional degree</td>
<td>9</td>
<td>Semi-Professional (Govt./Pvt.)</td>
<td>8</td>
<td>20,000 to 49,999</td>
<td>8</td>
</tr>
<tr>
<td>3.</td>
<td>Bachelor's degree</td>
<td>8</td>
<td>Skilled Workers</td>
<td>7</td>
<td>10,000 to 19,999</td>
<td>6</td>
</tr>
<tr>
<td>4.</td>
<td>12th Pass</td>
<td>5</td>
<td>Semi-skilled Works</td>
<td>4</td>
<td>5,000 to 9,999</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>10th Pass</td>
<td>4</td>
<td>Very small scale work</td>
<td>3</td>
<td>2,500 to 4,999</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Pass till 7th</td>
<td>2</td>
<td>Unskilled work</td>
<td>2</td>
<td>Below 2,499</td>
<td>1</td>
</tr>
<tr>
<td>7.</td>
<td>Literate (lower Primary)</td>
<td>1</td>
<td>Unemployed</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Illiterate</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The above scale was especially useful for urban families. Full weightage is given to the head of the family: father or mother. Half credit is given to the other parent. One point credit is also given if elder brother or sister has higher education, income or occupation. Two point credits if both brother and sister are higher in any of the aspect. The sum of composite score obtained by the family is considered for determining the socio-economic status of the family.

3.11 Implementation of Experiment

This is an important step of the experiment. It reveals the whole planning and arrangement. It explains the complete procedure of experiment.

**TABLE 3.5**
Planning of Teaching Points

| Day 1 - Students were given intelligent test and socio-economic status scale |
| [Date : 10/06/2013 – Monday] |
| **Single concept was taught on each day**---[11/06/2013 to 27/06/2013] |
| 1. Sets | 2. Elements of set | 3. Cardinality of sets |
| 15. Intersection of sets |

Day 17- Standardized Unit Achievement Test on the topic “Sets” in Mathematics was taken. [ 28/06/2013 - Friday]

3.12 Data Collected

The aim of the investigator was to check the effectiveness of teaching method on students with varied levels of achievement and Socio-economic status. The information obtained during the study and during replication is as under.

1. Before the experiment previous year final exam marks (scores) in Mathematics subject were obtained. The raw score were converted into standardized score.
2. Pupil’s responses on intelligence test in terms of intelligence score were collected.
3. The socio-economic status scale was administered and on the bases of its manual students was grouped according to their level of Socio-economic status.

4. Pupils were tested on standardized achievement test in mathematics after the completion of experiment.

3.13 Techniques for Data Analysis

The data were analyzed by following steps:

1. The Intelligence-quoutient was derived from the scores obtained by each student on Ravens Standard Progressive Matrices.

2. The Annual examination marks of standard eight of Mathematics of the sample, were collected from their schools, were converted into T-scores.

3. The above said scores were considered as the pre-achievement of the samples.

4. The underachiever, normal achiever and over achiever students were identified from the sample with the help of intelligence-quoutient and pre-achievement quoutient of the sample by using regression equation method.

5. The Marks obtained by the underachiever, normal achiever and over achiever students on the post-tests were converted in to T-scores.

6. The above said scores were considered as the post achievement of the students.

7. The level of significance of every hypothesis was measured by finding t-values of the mean differences of selected variables, and by this, the effectiveness of the Concept Attainment Model of Instruction was checked on under achiever, normal achiever and over achiever students.

Hypotheses were tested using SPSS software to check the effectiveness of Concept Attainment Model of Instruction on achievement in Mathematics of students with various achievement levels.

The next chapter contains explanation about Construction of lesson transcripts using Concept Attainment Model of Instruction and Construction and standardization of unit achievement test in mathematics for class 9 on the topic “Sets”.