CHAPTER III
METHOD AND PROCEDURE

The present chapter utilizing the experiment method of research endeavors to assess the effect of socio-constructivist approach of teaching on achievement, scientific creativity and responsible environmental behaviour of class VII science students. The present chapter has been developed to discuss the method of study which covers

3.1 Variables
3.2 Design of the Study
3.3 Sample
3.4 The Tool Used
3.5 Procedure
3.6 The Statistical Techniques used for analysis of data
3.7 Precautions Observed
3.8 Difficulties faced during the experiment

3.1 Variables

3.1.1 Independent variables
1. Teaching approach was independent or treatment variable. Treatment variable was performed in two ways:
   (i) Socio-Constructivist approach and
   (ii) Traditional Teaching approach
2. Intelligence was used as classifying variables.

3.1.2 Dependent Variables

   Dependent Variables were Achievement, Scientific Creativity and Responsible Environmental Behaviour.
3.2 Design of the Study

Research design can be thought of as the structure of research -- it is the "glue" that holds all of the elements in a research project together. We often describe a design using a concise notation that enables us to summarize a complex design structure efficiently. According to Lindquist (1956) “A research design is the plan, structure and strategy of investigation to obtain answers to research problem and to control variance.”

Experimental method is the most sophisticated way of research particularly in sciences. The term ‘Experimental Design’ is used in Fisher Tradition; to state statistical principles underlying experimental designs and their analysis. It contain activities like procedure for selection of factors and their levels of manipulation, identification of extraneous variables that need to be controlled, procedures for handling experimental units, selection of criterion measure, selection of specific design and analysis of data (Broota, 2010). A good experimental design should provide some information with respect to all the objectives of experiment (Winner, 1971) and be kept as simple as possible (Montgomery, 1984). The design is the general structure of experiment, not its specific content.

The present study employed an experimental method with pre test - post test design. It employed 2x3 factorial designs. The first 2x3 factorial design was computed by ANOVA for the mean gain scores on Achievement in Science. Here, instructional treatment and intelligence were the independent variables. Gain on achievement in science scores was the dependent variable which was calculated as the differences in post test scores and pre test scores for science subject. The variable of instructional treatment was studied at two levels namely experimental group (T1) which was taught by Socio-Constructivist Approach and control group (T2) which was taught by traditional learning method. The variable intelligence was studied at three levels viz. High (I1), Average (I2), and Low (I3) levels. The schematic lay out has been presented in Figure 3.1.
Second, 2x3 factorial design was employed for analyzing scores on gains in Scientific Creativity. The two independent variables were instructional treatment and intelligence. Instructional treatment was studied at two levels viz. socio-constructivist approach ($T_1$) and traditional teaching ($T_2$). The variable intelligence was studied at three levels viz. High ($I_1$), Average ($I_2$), and Low ($I_3$) levels. The schematic layout has been presented in Figure 3.2.

Figure 3.1 Schematic layout of 2x3 factorial design for mean gain scores on Achievement in Science

Figure 3.2 Schematic layout of 2x3 factorial design for mean gain scores on Scientific Creativity
Finally, 2x3 factorial design was employed for mean gain scores on Responsible Environmental Behaviour. The schematic layout has been presented in Figure 3.3.

![Diagram of 2x3 factorial design](image)

**Figure 3.3 Schematic layout of 2x3 factorial design for mean gain scores on Responsible Environmental Behaviour**

### 3.3 Sample

Sampling is a technique by which a relatively small number of individuals or measures of individual objects, or event is selected and analyzed in order to find out something about the entire population from which it was selected. Sampling technique reduces the expenditure, saves time and energy, permits measurement of greater scope, or produces greater precision and accuracy. It is an important aspect of life in general and enquiry in particular. The adequacy of a sample i.e. its lack of bias, depends upon our knowledge of population as well as method used in drawing the sample.

Population refers to all cases under investigation and a sample is an actual subset of observations drawn at random from a population. A population is the theoretical set of all possible observations for a particular experiment (Calfee, 1981). If the observations are numbers, then the population is described by the distribution function of the observations, which gives the probability of the occurrence for each possible numerical value. In statistical terminology, the items that make up a test constitute a sample from a much larger collection, or population of items that might have been used in that test (Ebel, 1996).
A sampling procedure is representative if every sub class eventually occurs with the same proportion in the sample as in the general population (Garrett, 1966). In probability sampling, statistical inference about the population can be made from respondents of samples. It is therefore, referred to as representative sampling where the sample is taken as a representative of population (Robson, 2002).

Various techniques have been devised for obtaining a sample, which are representative of its population. Most commonly used sampling techniques are:

- Random Sampling
- Stratified or Quota sampling
- Incidental Sampling
- Purposive Sampling

The sample in the present investigation was drawn at two levels:

- The School Sample
- The Student Sample

The School Sample

The selection of schools in present study was primarily purposive in nature with respect of medium of instruction; secondly with respects to the willingness of the schools to cooperate and tryout a new approach and thirdly with respect to availability of computers and LCD projectors in the schools. Principals of various representative schools of Chandigarh wherein the medium of instruction was English were approached by the investigator. Principals of two schools namely Government Model Senior Secondary school, Sector – 16, Chandigarh and Government Model High School, Sector- 25, Chandigarh showed interest and promised to co-operate. The names of schools along with number of students selected for the experiment have been listed in the table.

**TABLE 3.1: Schools for Experimental Treatment**

<table>
<thead>
<tr>
<th>S.No</th>
<th>NAME OF THE SCHOOL</th>
<th>INITIAL SAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Government Model Senior Secondary school, Sector – 16</td>
<td>193</td>
</tr>
<tr>
<td>2.</td>
<td>Government Model High School, Sector- 25</td>
<td>168</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td><strong>N = 361</strong></td>
</tr>
</tbody>
</table>

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These two schools were assessed on matching criteria with respect to the type of schools mainly Government public schools; infrastructure and general background of the students.

The Student Sample

The initial student sample comprised of 361 students chosen from two above mentioned schools of Chandigarh. 193 students were from Government Model Senior Secondary school, sector -16 and 168 students were from Government Model High School, Sector-25 as shown in table 3.1. Intelligence test (Coloured Progressive Matrices, 1995) was administered to all 361 students of two schools. In accordance with the manual given below in figure 3.4 students were divided into three groups, High Intelligence, Average Intelligence and Low Intelligence. Students whose scores on intelligence test lie at or above the 75th percentile were placed in high intelligence group, students whose scores on intelligence test lie between the 25th and 75th percentile were placed in average intelligence group, and students whose score lie at or below 25th percentile were placed in low intelligence group. After scoring it was found 67 students were in high intelligent group, 73 students were in low intelligent group and 221 were in average intelligent group.

![Figure 3.4 Schematic Layout of Sample of Study](image)
Thus, 24 students with High intelligence, 24 students with low intelligence and 72 students with average intelligence were selected randomly. Each of three groups of students was randomly allocated to two sub groups i.e. experimental and control group. So, the final sample comprised of 120 students which were selected through proportionate stratified random sampling technique. The breakup of total sample (school wise) is given in table 3.2.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Name of the school</th>
<th>High Intelligence</th>
<th>Average Intelligence</th>
<th>Low intelligence</th>
<th>total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Government Model Senior Secondary school, sector – 16, Chandigarh</td>
<td>12</td>
<td>36</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>2.</td>
<td>Government Model High School, Sector-25, Chandigarh</td>
<td>12</td>
<td>36</td>
<td>12</td>
<td>60</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>26</td>
<td>72</td>
<td>26</td>
<td>120</td>
</tr>
</tbody>
</table>

No doubt, the sample is small for the result of the study to be generalized but availability of a large sample and feasibility of carrying out such an experimental study on large sample is beyond the control of the investigator. Even earlier investigators conducting such studies through experimental design have used small samples.

Passi and Sansanwal (1991) while reviewing research teaching in Buch’s fourth survey of research in education had justified the use of small sample in such experimental researches due to deeper inquest of these studies and available methodological facilities. Mcmanus and Gettinger (1996) had taken sample of 76 third graders for their experimental study in which 38 students were in experimental group and 38 students were in control group. Kumari (1996) had taken a sample of 136 students from class VI and VII for her study. Gill (2004) worked on a sample of 180 students of class IX. Thakur (2006) studied the effect of co-operative learning on

3.4 The Tool Used

For the present investigation following tools were used.

1. Instructional material based on socio-constructivist approach (Developed by investigator).
2. Criterion Reference test in Science (Developed by investigator).
4. Responsible Environmental Behaviour test (Developed by investigator).

All of these tools have been discussed in chapter II

3.5 Procedure

Two main stages were adopted as procedure of experiment

Stage I Selection of the Sample

Stage II Conducting the experiment

Stage I Selection of the Sample

The present study was conducted on VII class students from the Government Model Senior Secondary school, sector – 16, Chandigarh and Government Model High School, Sector- 25, Chandigarh. After administering test to 361 students, students were selected and allocated to 3 groups’ viz. high intelligence, Average intelligence and low intelligence as explained under the subheading sample in the present chapter. Each of three groups of students was randomly allocated to two sub groups i.e. experimental and control group. So the final sample comprised of 120 students.
Stage II: Conducting the Experiment

The experiment was conducted in three phases as given below:

Phase I: Administration of Pre test: This phase involved the administration of the following tests to the students of experimental group and control group i.e.

i. Criterion Reference Test
ii. Scientific Creativity Test
iii. Responsible Environmental Behaviour Test

Separate response sheets were provided. The answer sheets were scored with the help of scoring key. The scores indicate the previous knowledge possessed by the students, their scientific creativity and responsible behaviour towards environment.

Phase II: Conducting the instructional programme

To find out the efficacy of instructional treatment, it was executed for about 36 days which included 18 teaching episodes to the experimental group whereas the control group was taught by the conventional method. Same content was taught to both the groups. Students were motivated to learn through the novel method of instruction and were encouraged to participate in the experiment by explaining the objectives. For experimental group each lesson follows the 5-E model where students encounter phenomena experimentally (Engage, Explore) prior to having general rules stated that help them articulate underlying principles (explain). Then the skill and new knowledge are transferred to new situations (Expand) and/or have their understanding enriched through additional experience. Student readiness to make meaning of additional experience is assessed (Evaluation) before the cycle begins again. Students were explained the steps of instructional treatment. Grouping of students was done.

Formation of the Groups: Six groups were formed. Each group comprised of five students, one of high intelligence, one of low intelligence and three of average intelligence. Selection of these students was done randomly.

Instructions to the students for working in group

1. Group members were asked to move their desks together
2. Each student in a group should perform the task given at the desk and help his or her partners. If anyone missed then it is the responsibility of other group members to explain it.

3. If there is a disagreement among team members on them, they are to present their arguments and resolve problem themselves. Only when they are unable to resolve the problem, they should ask the teacher for help.

4. Students should give their final answer only when they are certain that everyone in their group has performed the task.

5. When you have a question, first ask a group member before asking the teacher.

6. Encourage and praise your group members and clear your doubts.

7. If any of your group members indulges the group in gossiping then stops him/her sternly. If need be, tell the teacher.

8. Have patience in explaining the task or skill to a weaker student.

9. After explaining the skill or task to one of your group member, check it weather he is able to do the similar task independently or not.

10. If you have a group member who is weak, encourage him that he can also do well and can reach up to the level of others.

**Phase III: Administration of Post Test**

After the completion of instructional treatment of 36 days, the subjects were assessed by administrating the following post-tests to students of both the experimental and control groups.

i. Criterion Reference Test

ii. Scientific Creativity Test

iii. Responsible Environmental Behaviour Test

**Schedule of Experiment:**

Table 3.3 below depicts the data schedule of the experiment:
### Table 3.3: Date Schedule of Experiment

<table>
<thead>
<tr>
<th>S.no</th>
<th>Activity</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intelligence Test</td>
<td>April 2, 2011 – April 5, 2010</td>
</tr>
<tr>
<td>2</td>
<td>Pre Test</td>
<td>April 8, 2011</td>
</tr>
<tr>
<td></td>
<td>Criterion reference test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Scientific Creativity test</td>
<td>April 9, 2011</td>
</tr>
<tr>
<td></td>
<td>Responsible Environmental</td>
<td>April 11, 2011</td>
</tr>
<tr>
<td></td>
<td>Behaviour Test</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Instructional Programme</td>
<td>April 12, 2011 – May 27, 2011</td>
</tr>
<tr>
<td>4</td>
<td>Post Test</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Criterion reference test</td>
<td>May 28, 2011</td>
</tr>
<tr>
<td></td>
<td>Scientific Creativity test</td>
<td>May 30, 2011</td>
</tr>
<tr>
<td></td>
<td>Responsible Environmental</td>
<td>May 31, 2011</td>
</tr>
<tr>
<td></td>
<td>Behaviour Test</td>
<td></td>
</tr>
</tbody>
</table>

### 3.5 Statistical Techniques Used

- Descriptive statistics such as mean, median, standard deviation, skewness and kurtosis was computed on mean gain scores of Achievement in science (criterion reference test), scientific creativity and responsible environmental behaviour test.
- T-test for finding the significant difference if any in mean scores of group taught through Socio-constructivist Approach and the group taught through Traditional Teaching Approach on the variables of Achievement, Scientific Creativity and Responsible Environmental Behaviour as pre-test given before the treatment. The purpose was to ensure matching of the two groups on these variables.
Factorial design 2x3 analysis of variance for mean gain scores on achievement in science, Scientific Creativity, responsible environmental behavior was employed. For further investigation t-test was employed wherever F-ratio was found significant.

3.6 Steps Taken to Control Extraneous Variables

The following steps were taken to control intervening variable:

Matching of Groups: Matching of the groups was done on the variable like age. In both the groups, students were taken from class VII in the age groups 11-13 years.

Randomization: The procedure of randomization adopted at different stages ensured groups was matched to as many variables as possible.

Holding situational variables constant: Equal number of subjects was taken in the two groups; both the groups were taught by the investigator herself at the same time of the day and in the same environmental conditions such as temperature, presence or absence of distracting noise and like.

Schools selected for the study were government public schools, affiliated to CBSE and medium of instructions was English. The schools had more or less same physical environment.

3.7 Precautions Observed

For ensuring effectiveness in experiment following precautions were observed.

- Investigator herself taught all the subjects to avoid any variation in the teacher variable.
- During the experiment no stress of any kind was imposed on the subjects and experiment was conducted in relaxed natural setting.
- All the teaching episodes were given in harmonious atmosphere.
- The effectiveness of the experimental treatment was ensured by establishing rapport with students and teachers.
It was ensured that the topics on contents of treatment had not been previously taught to the students and not during the course of experiment in both the experiment and control groups.

Care was taken to keep the importance of content matter during the course of treatment and it was not underplayed while fitting into the instructional treatment.

Sufficient time was provided for each and every activity.

While conducting new experiments proper care was taken.

All the groups were provided with sufficient material during experimentation to avoid any kind of disturbance.

Teaching period of 45 minutes duration were utilized fully for treatment and time was not wasted during experimentation.

Care was taken to avoid indiscipline during group discussions.

3.8. 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:

- Efforts were needed to convince teachers and principal of the school about the importance of the experiment and made them agree to cooperate in the experiment.
- In the schools, sometimes few subjects were not present or were irregular. It is an essential requisite for every experiment that the treatment be fully provided to every student.
- During group work of students some difficulties were faced due to indiscipline and noise.
- In the beginning, some students had problem of cooperation with their group members. But with the passage of time and encouragement given by the investigator, students were motivated and began to take interest in teaching learning activities and realize the importance of treatment.
The experiment had to adjust the time accordingly, as the students were pursuing a regular course of studies.

Students with high intelligence were more active in their groups than the students with average or low intelligence. Lots of efforts were made by investigator to make every student participate equally in the class.