Chapter – III

METHODS AND PROCEDURES
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3.0 Introduction

The present chapter deals with the plan and procedure of the study which covers the population, Sample, Design of the study, tools used and their description and development, procedure of data collection and data analysis. The details in respect of each one of them are given here in different captions.

The heart and soul of the research plan is the accumulation of pertinent data. The quality of research depends upon the appropriateness of the methods adopted and the suitability of tools and techniques. The tool should be valid and reliable so as to draw definite conclusions. Therefore, every investigator in the field of research has to adopt certain methods, and select appropriate tools and techniques for successful completion of his investigation.

Research methods are of utmost importance in research process. They describe various steps of the plan to be adopted in solving a research problem, such as the manner in which the problems are formulated, the definition of the terms, the choice of the subjects for investigation, the validation of data-gathering tools, the collection, analysis and interpretation of data and the process of inferences and generalization.

In the words of John W. Best (1981), “the primary purpose of research is to discover principles that have universal applications, but to study the whole population in order to arrive at generalization would be impracticable if not impossible. The process of sampling makes it possible to draw valid inferences, observations of variables in relative small proportion of the population.”

3.1 Method

A method is a systematic approach towards a particular phenomenon. Methodology used in any investigation in fact, determines its density.
Methods describe various steps of the plan of attack to be adopted in solving research problem.

There are following methods of conducting research.

**Historical Method:**

Historical method is a method of investigation to discover, describe and interpret. Historical research attempt to establish facts so as to arrive at conclusions concerning past events. This is usually accompanied by an interpretation of these events and of their relevance to present circumstances and what might happen in future.

The main purpose of the Historical research therefore, is to arrive at an accurate account of past so as to gain a clearer perspective of the present. This knowledge enables us at least partially to predict and control our future existence.

**Philosophical Method**

Philosophical methodology is the study of how to do philosophy. A method of doing some activity is a systematic or patterned way of doing that activity. So a method of doing philosophy, or a philosophical method, is a systematic or patterned way of answering philosophical questions. A common view among philosophers is that philosophy is distinguished by the methods that philosophers follow in tackling philosophical questions. Of course, there is not just one method that philosophers use to answer philosophical questions. But it is possible to draw some valid generalizations about philosophical research methods.

**Descriptive Method:**

Descriptive method of research, describes, records, analyze and interpret conditions that exist. Descriptive research is designed to obtain pertinent and precise information concerning current status of phenomenon and, whenever possible, to draw valid general conclusions from the facts discovered. They are restricted not only to fact findings but may often result of significant problems concerning local, state, national and international issues.
Descriptive studies are more than just a collection of data; involve measurement, classification, analyses, comparisons, contrast, interpretation and attempts to discover relationship in existing non-manipulated variables.

**Experimental Method:**

Experimental method is a systematic and scientific approach to research in which the researcher manipulates one or more variables, and controls and measures any change in other variables.

Weiner (1977) has rightly remarked that experimental method which is suitable for testing hypotheses is the strongest available method for developing understanding of psychological concept. Any experimental problem has two interrelated aspects, the design of the experiment and statistical analysis of the data. The later aspect is directly dependent upon the former aspect. Statistical methods can greatly increase the efficiency and also strengthen the conclusions so obtained. A good experimental design should provide same information with respect to all the objectives of experiment (Weiner, 1971) and be kept as simple as possible.

The experimental method is usually taken to be the most scientific of all methods, the 'method of choice'. The main problem with all the non-experimental methods is lack of control over the situation. The experimental method is a means of trying to overcome this problem. The experiment is sometimes described as the cornerstone of psychology: This is partly due to the central role experiments play in many of the physical sciences and also to psychology's historical view of itself as a science. A considerable amount of psychological research uses the experimental method.

Gay, L.R. (1992)" The experimental method is the only method of research that can truly test hypotheses concerning cause-and-effect relationships. It represents the most valid approach to the solution of educational problems, both practical and theoretical, and to the advancement of education as a science"

An experiment is a study of cause and effect. It differs from non-experimental methods in that it involves the deliberate manipulation of one variable, while trying to keep all other variables constant.
Moore, D. and McCabe, D. (1993) “The best method—indeed the only fully compelling method—of establishing causation is to conduct a carefully designed experiment in which the effects of possible lurking variables are controlled. To experiment means to actively change ‘X’ to observe the response in ‘Y’.

Any educational research is described as ‘experimental’ when the researchers has, firstly specified the finite set of researchable hypotheses and secondly, has establish a systematic programme of data gathering, under precisely defined conditions and has an effort to test those hypotheses. The hypotheses provide a network of statements relating the impact of on independent variable or a set of independent variables on same outcome variable or dependent variable (s) (Ingersoll, 1984).

In the Present study the investigator had used the experimental method; the main objectives of the study were to find out the effects of Constructivist Approach (Independent variable) on the Achievement (Dependent variable) of 6th grade students in relation to their gender, locality, Socio Economic Status and type of institute in science subject. The investigator had tried to control the extraneous variables under strict conditions.

3.2 Population

Any group of people or observations which include all possible members to that category is called population.

In the words of John W. Best and Khan (1993) “a population is any group of individuals that have one or more characteristics in common that are of interest to the researcher. The population may be of all the individuals of a particular type, or a more restricted part of a group.”

In the present study all the students of 6th grade studying in the Govt. and Public schools in Himachal Pradesh constituted the population of the study.
3.3 Sampling Procedure

The quality of a piece of research stands or fall not only by the appropriateness of methodology and instrumentation but also by the suitability of sampling strategy that has been adopted.

There are two methods of sampling (Cohen and Holliday 1979, 1982, 1996; Schofield 1996). The researcher must decide whether to opt for a probability (Random Sample) or a non-probability sampling (Purpose Sampling). A probability sample because it draws randomly from the wider population, will be useful if the researcher wishes to and will be able to make generalization, because it seeks representativeness of the wider population. This sampling is popular in randomized controlled trials. In random sampling, each member of the population under study has an equal chance of being selected and the probability of a member of the population being selected is unaffected by the selection of other members of the population i.e. each selection is entirely independent of the next.

Best and Khan (1993) hold that the primary purpose of the research is to discover the principles that have universal application, but to study a whole population to arrive at generalization would be impracticable; if not impossible. Some populations are so large that their characteristics cannot be measured before the measurement could be completed the populations would have changed.

Sampling is considered often desirable to reduce expenditure, save time and energy, permit measurement to greater scope or produce precision and accuracy.

After deciding about the field of constructivism the investigator selected multi-stage random sampling technique to select the sample out of its population. Out of 12 districts of the State of Himachal Pradesh District Solan, was selected on the basis of random sampling.

Further out of Five educational blocks in the District Solan the Investigator has selected one Educational Block i.e. Nalagarh Educational Block on the basis of random sampling.
After that in Nalagarh Educational Block, the investigator had selected two schools (one Govt. Sr Sec School and one Public Sr Sec School) for conducting experiment on the basis of random sampling out of 15 Govt. Sr Sec School and 13 Public Sr Sec Schools.

Two groups were constituted in each school namely Experimental and Control group consisting of 35 students in each group in both the Institutions. Hence Experimental and Control group has total 70 students. The total number of students in Experimental and control groups were 70 \((35+35=70)\) and in Public Sr Sec School were also 70 \((35+35=70)\) and the total number of students in both the groups were 140.

**Equalization**

Since the present research is an experimental in nature study the participants in both groups namely the members of experimental and control groups were attempted to equalize in terms of some features. The intelligence scores, pre achievement test scores and participants' demographic features were used to form the groups.

In order to form two matched groups of the students, Ojha and Choudhury verbal Intelligence test was administered to all the 140 students of grade 6. After arranging the students in an ascending order of their intelligence scores, they were randomly allotted into two groups namely experimental group and control group. The students were allotted in each group on the basis of high and low intelligence scores in equal proportion.

The students were also examined through pre achievement test, the results of which showed more or less similar scores of both groups in both institutions. The investigator did not find any significant difference in the achievement scores of the experimental control and groups at the pre test level. Along with this both schools share the Demographic features such as:

1. Both schools follow the Himachal Pradesh Board of School Education syllabus and the text books prepared on the guidelines of National Council of Education Research and Training
2. Both schools have same pattern of examinations
Both schools have almost same infrastructure.

Both schools have Hindi as the medium for instructions in their institutions.

Both the schools have similar criteria for admission.

Both schools have the trained graduate teachers for teaching Science.

In the present study 6th class students were selected for the experimentation in Science subject, because the 6th class is the entry level to the elementary classes and students come from the different schools with different environments. Beside this it was easy to get permission and cooperation from the principals and teachers to the students for experiment higher classes especially 8th or 10th classes. Most of the teacher were not agreed to conduct the experiment. Hence in 7th to 10th classes the 6th class was considered to be most suitable from academically and administratively points of view for conducting the experiment.

3.4. Sample

A 'sample' is a group selected from a larger population with an aim of yielding information about this population as a whole. The process of drawing the sample from a large population is referred to as sampling.

After meeting the school authorities concerned and the Principals regarding the permission to conduct the instructional programme, after getting the permission, the science teachers of the both the schools were also taken into confidence. They were consulted about the syllabus taught in the class and learning levels of the students. Both the teachers were very happy and they gladly assumed their full cooperation to conduct experiment in their classes.

The group of 140 6th grade students including experimental and control groups were taken as the sample for the study. The detailed distribution of subjects under various heads is given as below in table-3.1
Table 3.1
Head Wise Distribution of Sample Pool

<table>
<thead>
<tr>
<th>Variables</th>
<th>Total sample</th>
<th>Gender</th>
<th>Locality</th>
<th>Socio Economic Status</th>
<th>Type of Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>Experimental Group</td>
<td>70</td>
<td>34</td>
<td>36</td>
<td>33</td>
<td>37</td>
</tr>
<tr>
<td>Control Group</td>
<td>70</td>
<td>38</td>
<td>32</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td>Total</td>
<td>140</td>
<td>72</td>
<td>68</td>
<td>73</td>
<td>67</td>
</tr>
</tbody>
</table>
A number of 35 students in Experimental and Control groups respectively were allotted in both the institutions who were the subjects for the purpose. The experimental groups in both the schools were taught with a specially designed methodology based on Constructivist Approach whenever the students belonging to Control groups in both the schools were taught with the Conventional Methods adopted in the schools as per routine work based on the past practice.

The sampling was done with the assumption that the after thing being equal, the larger the sample, the greater the precision and accuracy of the data (Mouly, 1964).

3.5. Selection of content

At the first step investigator analyzed the text books of science for class 6th Grade prescribed by Himachal Pradesh Board of School, Education in terms of its content, exercise and aids. After this the investigator visited to some selected schools in District Solan of Himachal Pradesh and carefully observed the patter of examinations, the type of question asked in the examinations held in the previous years and the questions given for home assignment and the types of errors committed by the students. The most important questions raised by the investigator before the teachers were what they expected from the students of a particular class to achieve minimum level of learning. The teachers put forth their view points which were noted down by the investigator. The investigator then procured the question –papers used by the schools in their terminal and annual examinations for observing the types of questions contained in them.

For conducting experiment based on Constructivist Approach the Science subject of 6th Grade students were taken. The Science text-book contains Sixteen units pertaining to Physical Sciences and Life Sciences out of which ten units in all i.e. Six units of Physical Sciences and Four units of Life Sciences were selected to teaching in both the groups in both the Institutions respectively Keeping in mind the duration of conducting the experiment.
All the units selected have interrelated concepts, which enhanced students learning in new principles, processes, concepts and new ideas of Science. At this stage, subject matter to be programmed and its division into units and sub units, formulation of objectives, types of items to be included in Achievement Test and weightage to be given for each item, were thoroughly analyzed with the help of subject experts and consultation with supervisor.

On the basis of the analysis of students note books, question papers used in various examinations and discussions with the subject teacher, the investigator prepared Achievement Test for 6th grade students on science subject out of ten selected units. The test items were discussed with science teachers, fellow research scholars and eminent teachers of the Department of Education H.P.University, Shimla in terms of their adequacy, difficulty level, content and methods of presentation.

The units selected for the purpose were as follows:

1. Food; Where Does It Come From?
2. Components of Food
3. Fibre to Fabric
4. Sorting Material In to Groups
5. Separation of Substances
6. Getting to Know Plants
7. The Living Organism and their Surroundings
8. Motion and Measurement of Distance
9. Water
10. Air Around Us.

3.6. Design of the Study

Design is a blueprint of the procedure that enables the researcher to test his hypotheses by reaching at valid conclusions about relationships between independent and dependent variables. It refers to the conceptual framework within which the experiment is conducted. The chosen research
design is based on range of factors such as feasibility, time, cost, ethics, measurement problems, and the objectives of the study. The design of the experiment is critical for the validity of the results.

The present study was experimental in nature. Quasi experimental research design was used to achieve the purpose of the present study. The study was designed on the basis of Non equivalent pretest-posttest control group design. By keeping in view the nature of the study pretest-posttest control group design was preferred to compare the participants of both groups and measure the degree of change as a result of treatments or interventions.

The study was conducted in Government Senior Secondary School, Manpura, and Nav Jyoti Senior Secondary public School, Kharuni, in District Solan of Himachal Pradesh. Completing all the formalities, the Investigator had started experiment right from 6th December, 2010 and it was binded up on 4th March, 2011 with the successful completion of the task.

The sample of the study was divided into two groups termed as ‘Experimental Group’ and this group was given treatment through new methodology based on constructivist Approach while the other group continued with the routine and conventional activities of the school and termed as ‘control group’. The layout of the design followed in due present study is given below.

3.6.1 Non –Equivalent Pretest-Posttest Control group design

![Diagram](Figure-3.1)

In this study the prepared Achievement test in Science was given to all the subjects selected for the purpose who completed it with the time frame. This Achievement test in Science was constructed on the beginning of various
researches conducted experimental studies while consulting review of the related literature.

It was decided to continue the treatment for 40-working days at the rate of 40 minutes per day. When experimental groups were busy in doing the exercises in both the schools, at the same part of time the students of control groups were also busy in their routine and conventional activities of classroom transactions in both the schools. At the end of instructions both experimental groups and Control groups were assessed with the help of Science achievement test developed and standardized by the guide and investigator.
Figure: 3.2
Non equivalent control group design

Groups of participants

Experimental Group
(70 Students)

Control Group
(70 Students)

Measurement of the Achievement (Dependent variables)

Pre-Test

Experimental condition
(Use of Constructivist Approach)
Unit wise Test-I

Unit Test-I

Feedback session
Remedial teaching
Unit Test II-X
Feedback session
Remedial teaching
Measurement of achievement
(Post-Test)
(Delayed Post-Test)

After 15 days

Control condition
(Use of Traditional Approach)
Unit wise Test-I

Unit Test-X
Feedback session
Remedial teaching
Measurement of achievement
(Post-Test)
(Delayed Post-Test)
3.7. Variables Structure

Variables are those which vary or change from person to person or from situation to situation. According to Kerlinger (1978), a variable symbol to which numerals of values are assigned. In the opinion of Matheson et al. (1978), variable is any factor that can be measured and can change. The various examples of variables are Achievement, Teaching methods, Locality, Curriculum and Weight etc.

According to Mouly (1964), the important purpose of an experiment is to establish a functional relationship among phenomena by constructing the occurrence of certain outcomes under controlled conditions designed to prevent the confusing effects of the operation of extraneous factors.

The variables can be classified into various ways. Some important types of variables are as follows:

**Independent Variable**

This variable operates either within a person or within the environment of a person to influence his behavior. It is also known as 'stimulus' or input variable. The independent variable is the antecedent or dependent or criterion variable. It is the factor which is measured or selected by the investigator to determine its relationship to an observed phenomenon. It is the factor from which the dependent variable is predicted.

**Dependent Variable**

It is also known as the 'response', output the presumed effect of the 'consequent' or criterion variable. It is the factor which is observed to determine the effect of the independent variable. The dependent variable, of course, is the variable predicted to. It is the variable that is not manipulated by the investigator. Rather it is observed for variations presumed result of variation in the independent variable.

**Moderator Variable**

It is the special category of the independent variable which is identified and selected for studying the extent of moderation its effects in respect of...
relationship between main independent variable to the observed phenomenon denoted by the dependent variable.

**Control Variables**

It is a kind of extraneous factor or condition which is placed under control by the experimenter to cancel out or neutralize any effect it might otherwise have on observed phenomenon.

**Intervening Variable**

It is that factor which is theoretically affects the observed phenomenon but cannot be seen, measured or manipulated. Its effects must be inferred from the effect of independent or moderator variables on the observed phenomenon.

**Dichotomous or Categorical Variable**

The variables which are used in the behavioral or educational research are dichotomies that is, they are characterized by the presence or absence of a property: alive-dead, employed-unemployed, male-female, and arts-science and rural-urban. Most variables however are theoretically capable of taking on continuous values. It has been common practice in behavioral research to convert continuous variable to dichotomics.

**Continuous variable**

A continuous variable is capable of taking on an ordered set of values within a certain range. This definition means, first, that the value of a continuous variable reflect at least a rank order, a large value of the variable meaning more of the property in question than a smaller value. The values yielded by a sale of measure some construct. For instance dogmatism, express differing amount of dogmatism for high through medium to low. A scale to measure dogmatism may have the range 1 through 7. It is worth mentioning here that the designation of the variable from one class to another may change from research to research. For instance, a variable identified as independent variable in one type of research study, may be differently designated as (moderator, dependent or control Variable) in another research.

In the present study the variables are as below:-
• Achievement
• Group
• Gender
• Locality
• Socio-Economic Status
• Type of institution i.e. Government and Public school
• Methodology of teaching - Constructivist and Conventional Approaches

The teaching method i.e. Constructivist Approach and Conventional Approach were the independent variables, while the Achievement in Science at different levels of testing i.e. Pretest, Posttest and Delayed Posttest level was the dependent variables.

3.8 Tool Used and Developed in the Study

For studying the effect of the methodology used in classroom teaching (Constructivist/Traditional) on the dependent variables (Achievement), various tools were used. A Science achievement test was developed to test and compare the achievement in Science of experimental and Control groups students at pretest, posttest and delayed posttest levels. Keeping in the view, aims and objectives of the study the following tools were considered suitable for the problem under study. The following table gives the details of the tools and the purposes for which they were meant.
### Table-3.2
**Tools Used and Developed**

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of the Tool used</th>
<th>Author</th>
<th>Purpose/Variable measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verbal Intelligence test</td>
<td>R.K Ojha and K Ray Choudhury</td>
<td>To measure the mental ability of students to form the groups.</td>
</tr>
<tr>
<td>2</td>
<td>Socio-economic status scale</td>
<td>R. L Bharadwaj</td>
<td>To measure the Socio-Economic Status of an Individual in the society.</td>
</tr>
<tr>
<td>3</td>
<td>Science Achievement test</td>
<td>Guide and Investigator</td>
<td>To measure Academic achievement of the students in Science at different levels of testing i.e. pretest, posttest and delayed posttest</td>
</tr>
<tr>
<td>4</td>
<td>Lesson Plans based on Constructivist Paradigm</td>
<td>Investigator</td>
<td>To achieve the objectives of Constructivist teaching based on Constructivist principles of teaching and learning</td>
</tr>
</tbody>
</table>

#### 3.8.1 Construction and Validation of Tools

Every research study requires relevant data from many sources, direct or indirect. This data should be in adequate quantity and quality and it should be reliable and valid. For collecting desirable data for the study of any problem, the researcher may be used various devices and instruments. These instruments are called tools. The selection of relevant tools is of vital importance for the success of the study. The investigator may use one or more variable tools for the research.

**Bennett (1973)** has suggested that at least five factors should be taken into account when selecting the tool for data collection. These are as follows:

1. **Reliability**
2. **Validity**
3. **Time to administer**
4. **Expertise required**
5. **Administration procedure**
The Constructivist Approach is based on the Principle that the students should be allowed to learn by performing various activities within his neighboring environment. As the science is the subject which involves a systematic approach and based on certain facts and observation to acquire the desired knowledge and experience.

Cronbach (1964) stated that a test, which helps in making one decision in a particular research situation, may have no value at all for another.

3.8.2. Description of Tools Used

3.8.2.1 Intelligence test

In the present study the verbal intelligence test was used to measure the intelligence or mental level of the students to form the groups. A verbal test has been developed by the various researchers for different age groups. Some of them are listed in the table-5.

### Table-3.3

**Intelligence Tests: Author, Age, Language and Reliability**

<table>
<thead>
<tr>
<th>S. No</th>
<th>Name of the test</th>
<th>Author</th>
<th>Age</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Verbal Intelligence Test</td>
<td>R.K.Ojha</td>
<td>13-20 years</td>
<td>Hindi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>K R Chaudhy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>A Group Intelligence Test</td>
<td>Prayag Mehta</td>
<td>7 and above</td>
<td>Hindi</td>
</tr>
<tr>
<td>3</td>
<td>Group Test of General Mental Ability</td>
<td>S Jalota</td>
<td>11 to 16 years</td>
<td>Hindi</td>
</tr>
<tr>
<td>4</td>
<td>General Mental Ability Test for Children</td>
<td>R P Srivastva &amp;</td>
<td>7-11 years</td>
<td>Hindi/ English</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kiran saxena</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Group Test of Intelligence</td>
<td>R.K. Tandon</td>
<td>10-16 year</td>
<td>Hindi</td>
</tr>
<tr>
<td>6</td>
<td>Group Test of Intelligence</td>
<td>G C Ahuja</td>
<td>13-17 year</td>
<td>English</td>
</tr>
<tr>
<td>7</td>
<td>Group Test of Intelligence</td>
<td>Pramila Ahuja</td>
<td>9-13 year</td>
<td>English</td>
</tr>
</tbody>
</table>
The students in the present study belong to the 6th grade and having an average age ranged from 12-13 years. For this age group the test were available to measure mental ability were as per list given table 3.5. It is clear from the table 3.5 that considering the age and language of the students for the present study, the verbal intelligence could be assessed by the Verbal intelligence test by Ohja and Choudhary as the language, reliability coefficients and age range of this test was the most appropriate for the present study. Hence, verbal intelligence was measured with the help of Intelligence Test (Hindi Version) Constructed and Standardized by Ohja and Choudhary. This test measures the abilities related to classifications, analogies, synonyms, number test, completion test, paragraph test, best reasons and simple reasons. This test was standardized on the population on an age group ranging from 13 to 20 years However, It is the But most suitable for the age group of 13-16 years. This test contains questions which are classified in eight parts. Partwise total number of questions and time required to complete the part are given in table - 3.6 below:

The total time required for completing the test apart from the instructions is 40 minutes. The reliability of the test was established with the help of Split - half method and Kuder - Richardson formula. The split half coefficients for different parts ranged from 0.64 -0.86 and for the whole test it was 0.87. The Kuder-Richardson reliability for different parts ranged from 0.68-0.89 and for the whole test it was 0.91. The validity of the test was established with the help of concurrent validity.

The scoring of the test was done with the help of scoring key. One mark was awarded to right answer and zero mark to each wrong answer. Sum of the scores was done with respect to each sub test in the respective column. T -scores were calculated with the help of tables hence according to probability error (PE) with the help of T scores students were classified in the groups. Appendix-I
### Table-3.4

**Classification based on the Range of Raw Scores**

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Range of Raw scores</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>107 and above</td>
<td>Very Superior</td>
</tr>
<tr>
<td>2</td>
<td>99-106</td>
<td>Superior</td>
</tr>
<tr>
<td>3</td>
<td>91-98</td>
<td>Bright-Normal</td>
</tr>
<tr>
<td>4</td>
<td>73-90</td>
<td>Normal</td>
</tr>
<tr>
<td>5</td>
<td>65-72</td>
<td>Dull-Normal</td>
</tr>
<tr>
<td>6</td>
<td>57-64</td>
<td>Borderline</td>
</tr>
<tr>
<td>7</td>
<td>56 and below</td>
<td>Defectives</td>
</tr>
</tbody>
</table>

### Table-3.5

**Part wise Number of items and time for completion**

<table>
<thead>
<tr>
<th>Part</th>
<th>Sub test</th>
<th>No of items</th>
<th>Time of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Classification</td>
<td>15</td>
<td>3 minutes</td>
</tr>
<tr>
<td>2</td>
<td>Analogies</td>
<td>15</td>
<td>4 minutes</td>
</tr>
<tr>
<td>3</td>
<td>Synonyms</td>
<td>20</td>
<td>4 minutes</td>
</tr>
<tr>
<td>4</td>
<td>Number test</td>
<td>12</td>
<td>5 minutes</td>
</tr>
<tr>
<td>5</td>
<td>Completion test</td>
<td>13</td>
<td>5 minutes</td>
</tr>
<tr>
<td>6</td>
<td>Paragraph test</td>
<td>10</td>
<td>3 minutes</td>
</tr>
<tr>
<td>7</td>
<td>Best reasons</td>
<td>10</td>
<td>4 minutes</td>
</tr>
<tr>
<td>8</td>
<td>Simple reasons</td>
<td>17</td>
<td>12 minutes</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>112</strong></td>
<td><strong>40 minutes</strong></td>
</tr>
</tbody>
</table>

### 3.8.2.2 Socio-Economic Status

Socio-Economic Status is an economic and sociological combined total measure of a person's work experience and of an individual's or family economic and social position relative to others, based on income, education and occupation.
Socio-Economic Status is typically broken into three categories, High, Average or Middle and Low Socio Economic Status to describe the three areas of a family or an individual may fall into.

Socio-economic Status is therefore, a ranking of an individual by the society he lives in, in terms of his material belongings and cultural possessions along with the degree of respect, power and influence he wields.

Socio-Economic status -scales have been developed by the various researchers; some of them are listed in table 3.7 below:

**Table 3.6**

*List of tools Developed on Socio-Economic -Status*

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Name of the Scale</th>
<th>Author</th>
<th>Target group</th>
<th>Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Socio-Economic Status(urban)</td>
<td>B. Kuppuswamy</td>
<td>Urban</td>
<td>English</td>
</tr>
<tr>
<td>2</td>
<td>Socio-Economic Schedule</td>
<td>R.M. Verma</td>
<td>Rural And Urban</td>
<td>Hindi</td>
</tr>
<tr>
<td>3</td>
<td>Socio-Economic Status Scale from A and B</td>
<td>SP Kulshrestha</td>
<td>Rural And Urban</td>
<td>Hindi</td>
</tr>
<tr>
<td>4</td>
<td>Socio-Economic Status(Rural)</td>
<td>U.Pareek and G.Trivedi</td>
<td>Rural</td>
<td>English</td>
</tr>
<tr>
<td>5</td>
<td>Socio-Economic Status(Rural urban)</td>
<td>Singh&amp; Saxena</td>
<td>Rural And Urban</td>
<td>Hindi/English</td>
</tr>
<tr>
<td>6</td>
<td>Socio-Economic Status Scale</td>
<td>R.L. Bharadwaj</td>
<td>Rural And Urban</td>
<td>Hindi/ English</td>
</tr>
</tbody>
</table>

In the present study, students were from both the areas i.e. Urban and rural. Hence it is clear from the table 3.7 that Socio Economic Status scale developed and standardized by Bharadwaj (Rural and Urban), Singh and saxena (Rural and Urban), Kulshrestha, R.M. Verma were the most appropriate for assessing the Socio Economic Status of students. The Investigator found the SES scale developed and standardized by Bharadwaj most appropriate tool for his study, because it was applicable to the age group 13 and above. The students studying in the 6th class who were the subjects of the present study belonged to age group 13 and above approximately.

The present Socio-economic Status scale has been constructed with a view to seek clarity of distinct aspects of social and economic status of an individual separately and integrally. The Hurlock (1964) ‘that the economic status of family frequently determines what the family social status will be’.
The present scale is equally good in both urban rural and areas and is applicable to measure any status above 13 years of age. This scale of 'Socio-Economic Status has been developed for literate people. It can be administered on illiterate peoples also, but only by personal interviews. At preliminary state fifteen areas of 'Socio-Economic Status' were selected with careful study of the relevant literature and from some popular tests in the field. The list of fifteen areas were submitted to twenty judges to know the most important areas which can measures the 'Socio-Economic status' of the individual in society. Opinion of the twenty judges pointed only seven areas to provide the desired information.

Table-3.7

Areas of the Socio–Economic status

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Area</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Social</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>Family</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Education</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Profession</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Doctors</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>College Principals</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Administrators</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Forces(4)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Officers</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Lawyers</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Teachers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Writers</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Business Personnel's</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Artists</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Engineers</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Leaders</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Managers</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Miscellaneous</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Caste</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>Total Assets</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Monthly income</td>
<td>6</td>
</tr>
</tbody>
</table>
Table-3.8

Reliability and Validity of SES

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Area</th>
<th>Coefficient of Correlation</th>
<th>Original Scale</th>
<th>Revised Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Family</td>
<td>.72</td>
<td>.76</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Social</td>
<td>.68</td>
<td>.69</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Education</td>
<td>.82</td>
<td>.86</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Profession</td>
<td>.70</td>
<td>.74</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Caste</td>
<td>.92</td>
<td>.94</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Total Assets</td>
<td>.67</td>
<td>.69</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Monthly income</td>
<td>.73</td>
<td>.74</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Scale (as a Whole)</td>
<td>.76</td>
<td>.76</td>
<td></td>
</tr>
</tbody>
</table>

The content validity of revised scale, since areas and then item are solely based on research proven items is high and promising.

Scoring of the test is very easy and of a quantitative type. Scoring key provides the weightage score for each item. Appendix-II.

Interpretation of any status or all nine types of status can be made with the help of T-scores. Categories of any status can be ascertained with the help of table-3.10 given as below:

Table-3.9

<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Category</th>
<th>Range of Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Upper Class</td>
<td>70 and above</td>
</tr>
<tr>
<td>2</td>
<td>Upper middle Class</td>
<td>60-69</td>
</tr>
<tr>
<td>3</td>
<td>Middle Class</td>
<td>40-50</td>
</tr>
<tr>
<td>4</td>
<td>Upper Lower Class</td>
<td>30-39</td>
</tr>
<tr>
<td>5</td>
<td>Lower Class</td>
<td>39 and below</td>
</tr>
</tbody>
</table>
3.8.2.3 Construction of Science Achievement Test

The Achievement test was developed with an aim of measuring entering and terminal behavior of the learners. This test can be used at pre test, post test and delayed post test levels to observe the changes brought in the behavior of an individual through the new interventions. During the preparations of the lesson plans, the concepts, teaching points and respective objectives were listed out. Objectives emphasizing Knowledge, Understanding, application and Skill levels were framed for all the selected units of Science. Blooms Taxonomy was made use of while writing the objectives.

A criterion test is different from an achievement test. Pipe (1966) has differentiated these two on the basis of difficulty range and normality conditions. They are different on the basis of objectives as well. The Criterion Test aims at 90/90 standard i.e. 90% of the learner's attempts 90% of items correctly. The achievement test is mainly discriminatory in nature and its emphasis is upon discriminating one student from another.

The Achievement test was planned according to the guidelines and rules given by Standly (1964). These were kept in view, which are as below:

- Adequate provision should be made for evaluating all important outcomes of the instruction.
- The test should reflect the approximate proportion of emphasis of the course.
- The nature of the test must make clear its purpose.
- The nature of the test must clearly indicate the conditions under which it will be administered.

3.8.2.3.1 Item Pooling

The test items were framed from the selected units of 6th grade Science subject to construct and Standardized the Achievement Test to apply the Constructivist Approach in the classroom.

The items were pooled based on the objective framed. Appropriate weightage was given to various types of objectives, content and type of questions. The assessment was objective based and the achievement test
planner included eight types of items such as true false type, multiple choice type, completion type, matching type, classification type, analogy type, master list type and descriptive type questions like short answer type questions.

The items framed were scrutinized and edited by the investigator from the point of view language, ambiguity, suitability and for their correspondence to specific behavioral outcomes and comprehensibility. The content validity of the test was obtained by giving it to a panel of experienced teachers including respected Guide for the present study Subject Experts, Science Teachers working in the State of Himachal Pradesh having 15 to 20 years teaching experience in the Schools. Two educationists of Punjab University, Chandigarh, eminent faculty of Department Educational Measurement and Evaluation, NCERT, New Delhi, and SCERT, Solan of Himachal Pradesh.

They scrutinized and studied the items of the test in terms of their sampling individual units, ensuring coverage of behavioral objectives comprising Knowledge, understanding, application and skill.

On the basis of the suggestions made by the various experts in the field modifications were made accordingly. Finally 105 items were selected to make the preliminary draft of the Achievement test, which was termed as Science Achievement Test (ATS). The preliminary draft prepared was printed with appropriate instructions on the first page. It was prepared in Hindi language as both the Schools follow the Hindi medium for imparting the Instructions to the students.

The test items were arranged in such a way that similar kind of items prepared together and care was taken to see that each set of items was preceded by specific instructions as to how the learner would have to respond to the set of items. No time limit was fixed. The scoring procedure and marking scheme were prepared well in advance.

3.8.2.3.2 Try out of the Preliminary form of the Science Achievement Test

The Preliminary form of the Science Achievement Test was used to collect data to finalize the items of test. Samples of 60 students of 6th grade was
selected from the local School of Nalagarh affiliated to Himachal Pradesh Board of School Education on random basis.

The investigator visited personally to the concerned schools for administration of the Science Achievement Test.

A sincere attempt was made to analyze items of the test in order to identify weak and defective items. The items of the test were also analyzed in order to further improve by identifying ambiguous and intermediate implausible distracters; very difficult and very simple items: determine the difficulty level and discriminating power of each individual test item and lastly to determine the number of test items to be included in the second draft. A schedule was drawn after having consultation with the principals of the selected schools. The purpose of administration of test was also explained before the students. They were given general and specific instructions regarding the test. All precautionary measures were taken to avoid mutual help and any kind of unfair means, no time limit was fixed to complete the test.

The first draft of the achievement test consisted of 105 test items from the selected ten units of 6th grade science subject was administered to the sample selected for the purpose. The objective of which had already been formulated, which acted as the guide lines for the preparation of the first draft of the Achievement Test. The care was taken that no objectives remained untested by the achievement test. The items included in the test were of eight types viz., short answer type, completion type, multiple choice type, true/false type, matching type, classification type, analogy type, and master list type. Test items of each type were grouped separately and were arranged in the increasing order of difficulty i.e. from Simple to complex, concrete to abstract, known to unknown and definite to indefinite on the basis of maxims of the teaching.

3.8.2.3.3 Item Analysis

The process of item analysis was started to check the most important quality of an item i.e., its relevance to the test. Item analysis is needed to indicate the items which were very easy or very difficult and are not serving
the purpose for which they were framed. The immediate purpose of the item analysis is to determine the difficulty and discrimination of each item.

In addition to its relevance, two characteristics usually desired for a test item are discrimination and difficulty, i.e., how hard is the item for a group tested, and how well does it distinguish between the respondents who rank high and those who rank low on the characteristic being measured by them.

Tests are composed of items and test efficiency whatever its purpose depends upon the care taken in selecting the test items. Item analysis can help the test users in their test evaluation. This procedure helps to differentiate between the better and the poor items.

Item analysis is one of the essential parts in the development of a psychological test. According to Guilford, "The major goal of item analysis are the improvement of total score reliability or total score validity (or both) and the achievement of better items sequence and types of score distribution. Both the validity and the reliability of a test depend on the characteristics of its items. Item analysis ensures high reliability and validity into a test in advance." The chapter wise detail of items, their type and total no of items taken from the each chapter is given below in the table 3.11. and table 3.12 respectively.

Table-3.10
Distribution of Test Items

<table>
<thead>
<tr>
<th>Chapter No</th>
<th>Name of the Chapter</th>
<th>No of test items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Food Where Does It Come From?</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Components of Food</td>
<td>12</td>
</tr>
<tr>
<td>3</td>
<td>Fibre to Fabric</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>Sorting Material In to Groups</td>
<td>9</td>
</tr>
<tr>
<td>5</td>
<td>Separation of Substances</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>Getting to Know Plants</td>
<td>14</td>
</tr>
<tr>
<td>9</td>
<td>The Living Organism and their Surroundings</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>Motion and Measurement of Distance</td>
<td>9</td>
</tr>
<tr>
<td>14</td>
<td>Water</td>
<td>11</td>
</tr>
<tr>
<td>15</td>
<td>Air Around Us</td>
<td>9</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>105</td>
</tr>
</tbody>
</table>
Table-3.11
Type wise Distribution of Test Items

<table>
<thead>
<tr>
<th>SR NO</th>
<th>TYPE OF ITEM</th>
<th>TOTAL NO OF ITEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>short answer type,</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>completion type,</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>multiple choice type</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>true /false type</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>classification type,</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>analogy type,</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>master list type,</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>matching type,</td>
<td>10</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>105</td>
</tr>
</tbody>
</table>

There are the various procedures of item analysis but In the present study Kelly’s (1939) method of item analysis was employed to compute the difficulty value and discriminating power of the items after forming the top 27 percent and bottom 27 percent groups from the total subjects by arranging the answer sheets in ascending or descending order, the frequency of each possible response to each item was found out for each group. The results of the item analysis of the items in Science achievement test is as follows:

A preliminary pool of 105 items was framed on the basis of the content given in the above mentioned Chapters in various types. Statements were written in Hindi language. Around six rounds of checking or reframing. The statements were made to ensure the appropriateness and uniqueness in their nature. A panel of experienced teachers and experts reviewed the items of Achievement Test. The opinion given by experienced experts in the concerned field led to modification of some items. The table 3.13 shows the D.P. of the test items in the first draft.
Table -3.12

Distribution discriminating power for the test items of preliminary form of Achievement test

<table>
<thead>
<tr>
<th>Discriminating Power</th>
<th>Frequency</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>60 and above</td>
<td>39</td>
<td>Very good items</td>
</tr>
<tr>
<td>40 and above</td>
<td>18</td>
<td>Good items</td>
</tr>
<tr>
<td>between 30 and 39</td>
<td>07</td>
<td>Average items</td>
</tr>
<tr>
<td>Between 20 and 29</td>
<td>06</td>
<td>Needs improvement</td>
</tr>
<tr>
<td>Below 19</td>
<td>36</td>
<td>Poor items</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td></td>
</tr>
</tbody>
</table>

The discriminating power below which an item was rejected was taken to be 20 (Garrett 1971). 36 items were deleted for the first draft of the first test on the basis of the criteria of Discriminating power. The scores of the on discriminating power of these deleted items were below 20.

A scoring key was prepared in advance and one mark was assigned to each correct response and zero mark was awarded to every incorrect response.

The first draft thus prepared was administered on a representative sample of 60 students of class 6' at Nalagarh who had already gone through the content. Among the 60 (35 boys and 25 Girls)

The total number of 69 items were remained for the second draft on the basis of the item analysis.

3.8.2.3.4 The Second Draft of the Science Achievement Test

The second draft of the Achievement Test was prepared after revising modifying and reflecting the items of the first draft on the basis of Discriminating power. At this stage there were 69 items. The second draft of Achievement Test consisted of same 8 types of items as in the first draft arrangement of items within their groups was however slightly changed. The Second draft test was administered on representative sample of 50 students (29 boys and 21 girls) drawn randomly from 6' class of Govt. school at Nalagarh Distt solan Himachal Pradesh.

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The Discriminating power of index of items of second draft of Achievement Test ranged from .15 to .93. 9 items were dropped from the Second draft according to the criteria of Discriminating power. However, the items with Difficulty Value ranging from .20 to .25 were modified and improved in sentence construction and language etc. The number of items having different ranges of discriminating power is represented in the table 3.14.

Table-3.13

Distribution discriminating power for the test items of second Draft of Achievement test

<table>
<thead>
<tr>
<th>Discriminating Power</th>
<th>Frequency</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>.60 and above</td>
<td>46</td>
<td>Very good items</td>
</tr>
<tr>
<td>.40 and above</td>
<td>05</td>
<td>Good items</td>
</tr>
<tr>
<td>between .30 and .39</td>
<td>04</td>
<td>Average items</td>
</tr>
<tr>
<td>Between .20 and .29</td>
<td>05</td>
<td>Needs improvement</td>
</tr>
<tr>
<td>Below .19</td>
<td>09</td>
<td>Poor items</td>
</tr>
<tr>
<td>Total</td>
<td>69</td>
<td></td>
</tr>
</tbody>
</table>

The second draft of Achievement Test was also shown to the subject expert and some teachers, teaching science at school level and the Measurement and Evaluation Departments of NCERT, New Delhi. The teachers were requested to indicate ambiguity of any in the items of Achievement Test and point out of any item of the test was beyond students mental level or comprehension. The investigator noted down the suggestions and comments forwards by the various teachers, subject experts and research scholars.

The achievement test was again revised and modified as per the suggestion, comments views of the subject experts and students performance Comments for final draft at this stage and the modification were minor in nature.
3.8.2.3.5 Preparation of Final Draft of Science achievement Test.

After carrying out item analysis of second draft Science achievement Test of its final draft was prepared. The 9 items vide Sr. No 8,23,34,38,43, 49, 55, 61, 67 were deleted as Their discriminating power was less than 0.20. In case of item analysis since out of 69 items, 60 items were selected for the final draft of the Science achievement test. T The booklets were prepared of the final draft. The final draft of Achievement test was consists of 60 items. The items were distributed unit wise and the allocations of test items were done by keeping in view the length of the unit and content matter of that unit. Proportional weightage was given to each behavioral objective. The objective wise and total number of items under each specific objective is given in table 3.15.

<table>
<thead>
<tr>
<th>Specific objectives</th>
<th>Knowledge</th>
<th>Understanding</th>
<th>Application</th>
<th>Skill</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weightage</td>
<td>25%</td>
<td>35%</td>
<td>20%</td>
<td>20%</td>
<td>100%</td>
</tr>
<tr>
<td>No of test items</td>
<td>15</td>
<td>21</td>
<td>12</td>
<td>12</td>
<td>60</td>
</tr>
</tbody>
</table>

The item in the final draft of the Science Achievement Test assessed through the method given by Kelly’s (1939).

<table>
<thead>
<tr>
<th>Discriminating Power</th>
<th>Frequency</th>
<th>remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>.60 and above</td>
<td>06</td>
<td>Very good items</td>
</tr>
<tr>
<td>.40 and above</td>
<td>51</td>
<td>Good items</td>
</tr>
<tr>
<td>between .30 and .39</td>
<td>03</td>
<td>Average items</td>
</tr>
<tr>
<td>Between .20 and .29</td>
<td>Nil</td>
<td>Needs improvement</td>
</tr>
<tr>
<td>Below .19</td>
<td>Nil</td>
<td>Poor items</td>
</tr>
<tr>
<td>Total</td>
<td>60</td>
<td></td>
</tr>
</tbody>
</table>

129
In the final draft of Science achievement test same procedure was followed as in the Preliminary and a Second draft of the Achievement test. At this stage total items were 60. It is evident table 3.16, that 6 items gave the Discriminating Power above 0.60 and 51 items fall in the range of .40-.60. whereas 3 items has D.P. 30-.39 The total number of items in the final draft ranged from .30 to .60 and above. Open and closed ended items were also included in the final draft of the Science Achievement Test.

(Appendix-III).

3.8.2.3.5.1 Reliability

Reliability concerns the extent to which a test or any measuring procedure yields the same results on repeated trials (Gramines and Zeller, 1979).

Reliability is the estimation of the degree of consistency of measurement. It is related to the problem of measuring the amount of 'Variable error' in measurement. A test is said to be possess reliability to the extent the scores obtained through it are consistent overtime and over samples of the test items.

In the words of Anastasi “Reliability refers to the consistency of scores obtained by some person when reexamined with same test on different occasions, or with different sets of equivalent items, or under other variable examining conditions.” In other words, measurement is intended to be stable over a variety of conditions in which essentially the same results should be obtained.

According to Garrett “The reliability of a test or any measuring instrument depends upon the consistency with which it gauges the ability to whom it is applied.”

Models of reliability:-

The following models of reliability are available:

- Test retest
- Split half
In the present study the reliability coefficient of the Science Achievement Test was computed by using Test retest method of the reliability.

**Test-retest Reliability**

For determine the test retest reliability the Science Achievement Test was administered on a sample of 80 students of 6th class. After one month of time the Science Achievement Test was re-administered to the same sample. The test-retest reliability co-efficient obtained for Achievement Test is shown as the table 3.9.

<table>
<thead>
<tr>
<th>Administration of tool</th>
<th>No of students</th>
<th>Mean</th>
<th>S.D.</th>
<th>R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>100</td>
<td>47.14</td>
<td>10.50</td>
<td>0.86(**)</td>
</tr>
<tr>
<td>Re-test After one month</td>
<td>100</td>
<td>25.12</td>
<td>8.00</td>
<td></td>
</tr>
</tbody>
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**Correlation is significant at 0.01 levels.**

It is event from Table 3.3 that the Test-retest co-efficient of Correlation(r) of Science Achievement Test has come out to be 0.86 which is highly significant at 0.01 level of significance.

Therefore, the Science Achievement Test is a reliable tool for measuring the Achievement of student's achievement in science subject.
3.8.2.3.5.2 Validity of the Test

Validity of a test is one of the important aspects of the test construction. The validity of a test concerned means that it measures what it is claimed/supposed to measure. Validity is a highly relative concept. It is determined with reference to a particular case for which it is being considered. There are various types of validity as face validity, content validity, related validity, construct validity, factorial validity and empirical validity. To validate the present achievement test the content validity was employed.

The final draft of the test shown to three teachers of teaching science at middle school along with the prescribed curriculum for the 6 upper classes. The objective of constructing the test was also explained to them. They were requested to match the content of the test with prescribed curriculum keeping in view the objective of constructing the test. The teachers agreed that the contents of the entire test matched quite satisfactorily with the prescribed curriculum and they were well in accordance with the objective of the study.

The expert opinion came out to be favorable in terms of the relevance of each item in the Science Achievement Test.

The investigator has established content validity while preparing the preliminary draft of Science Achievement Test. Expert opinion of science teachers and language specialists with regard to the relevance of each item in the scale was sought. In addition to this, the help of science teachers from NCERT, New Delhi was solicited to ascertain the content validity of this scale. For this, a copy of the final draft of science achievement test was given to the experts who are directly or indirectly involved in science education.

Hence, the content validity of the test was considered to be satisfactory. At the end, the Science Achievement Test was found fully reliable, valid in all respects.

3.9. Procedural Details of the study:
The study was carried out three main phases:

Phase-I Developmental Phase
Phase-II Try out of lessons
Phase-III Implementation phase
3.9.1. Developmental Phase:

At this stage, the investigator developed instructional material, including lesson plan, activity sheets, unit tests, tools namely Science Achievement test.

3.9.1.1. Development of the lesson Plan based on Constructivist Model:

After selecting the content the investigator carried out the following tasks.

3.9.1.1.1 Content analysis

Content analysis may be defined as a strict and systematic set of procedures for the rigorous analysis, examination and verification of the content of written data Robson (1993) content analysis has several attractions. It is an unobtrusive technique in that one can observe without being observed. Content analysis is a research technique for objective, systematic and quantitative description of manifest content of communication.

In the present study, ten units selected from the 6th grade science text book was analyzed in terms of teaching points, objectives, instructional material, activities, demonstrations, type of questions, time required, science concepts, processes, principles, exercises, home assignment etc. The content matter was reorganized in order to have continuity, logical sequence and integration of learning experiences as per the requirement of specific contents of the unit.

3.9.1.1.2 Planning of the lesson

According to National Science Education standards (NSES, 1996), American Association of Advancement of School Science (AAAS, 1990), National Curriculum framework for school education (NCFSE, 2000) the major objectives of science education include experiencing science inquiry, understanding of interrelationships of science and technology, comprehending the nature of science, using personal and social perspectives to understand science, favorable attitude towards science and achieving scientific literacy.
critical thinking, imaginative power and use of science in various daily life situations

Keeping all the objectives and values of science learning in mind, unr's and the lessons were planned on the basis of 5 E's Model of Constructivist teaching and learning.

3.9.1.1.3 Planning and Learning Model: 5 Es

When making decision concerning instruction, teachers must determine the prior knowledge of the students. The goal of instruction is to build upon what students already know and allow them to gain deeper understanding of reality. Several instructional models for constructivism exist. But the researcher found suitable the model developed by the Roger Bybee of the biological sciences curriculum study the “Five Es”

It was made use of with some modifications in the study. This model follow very open type of planning and it provides the opportunities to explore, build, and demonstrate their learning. The 5 E’s lesson planning model is the most often associated with Constructivist learning design. The 5E’s approach included:

- Engage
- Explore
- Explain
- Elaborate or extension
- Evaluate

Objectives of Five Es Science Lesson Plan:

- To evaluate the conceptual understanding and ability of the students to use skills begins at the engage stage and continuous throughout the model.
- To discover and provide opportunity to the students to what they know or what they think they know
- To provide a common set of experiences as well as broad range of experiences.
• To provide the opportunities for the students to connect their previous experiences and to begin to make conceptual sense of the main ideas with the unit of the study.
• To enable the students to, apply or extend concepts in new situations and relate their previous experiences to new ones.

It shifts the learning environment from one which is very instructor-centered to one that is very learner-centered. Model Lesson plan based on Constructivist 5E’s Model is given in the Appendix-IV

3.9.2. Phase-II Try out of the lessons

Four lessons from the units namely components of food, separation of substances, getting to know plants, and water were selected for pilot study and were tried out in the local school of Nalagarh, Distt Solan, following the HPBSE syllabus. The instructional materials developed were tried out on 60 students belonging to 6th grade at Nalagarh, Distt Solan. The units were taught using the constructivist approach for Three weeks. Units test were conducted after completion of each unit. By getting feedback from the experts and subject teacher the investigator made modifications accordingly.

3.9.3. Phase-III-Implementation

3.9.3.1 Scoring Procedure

The Achievement Test prepared by the investigator was administered to the 6th class under standard conditions after establishing proper rapport with the respondents. Keeping in the view the purpose of the study, the test was administered before final examinations.

The relevant Achievement Test was administered to class 6th in the month of December, 2010 before they appeared in the final examination in March 2011.

The test was marked in the form of correct, incorrect, partially correct, unanswered response of the students for various items. The obtained scores were tabulated separately for control and experimental groups for further analysis.
3.9.4. Experimental Procedure:

3.9.4.1 Procedure of Data Collection

Procedure of the experiment was comprised of two main stages. They are:

i) Selecting the experimental sample or selection of the sample

ii) Conducting the experiment

Stage-I

3.9.4.1.1 Selection of the sample

This stage involved the identification of two HPBSE affiliated schools in the Distt Solan H.P. The present study was conducted on the total sample of 140 students of 6th class, out of which 35 students were selected randomly for experimental group and 35 for control group in each school respectively.

Figure-3.3

Stage -2
3.9.4.2.0  Conduction the Experiment

The experiment was conducted in the 5 phases given below:

- Phase-1  Instructions for classroom climate.
- Phase-2  Administration of pretest.
- Phase-3  Instructional programme or treatment
- Phase-4  Administration of post test.
- Phase-5  Administration of retention test.

3.9.4.2.1  Phase-1 Instructions for Classroom Climate

Before the conducting of the experiment, the subjects were told about the purpose of the study. They were asked to be free, truthful and honest while answering the information asked for in the various test. They were made to understand that the aim of the study was to examine some research issues and not to evaluate them on their performance.

The teacher’s participating in the experiment was also given the instructions regarding the aim of the study and various norms of classroom behavior. As the experimental group was taught by the investigator himself. The investigator was supposed to follow the following instructions in the classroom.

- Encourage students for participating in class work.
- Take cooperative decisions.
- Active involvement.
- Emphasis on learning by doing or activity control approach.
- Opportunity for self learning.
- Accept the views and ideas of the students.
- Democratic and friendly environmental is the classroom.

All these instructions were discussed in detail with the teachers who are to teach the control group respectively. However it is earlier mentioned that the control group was taught with traditional approach or conventional methods. They willingly agreed to comply with the above instructions.
3.9.4.2.2 Phase-2 Administration of Pre-Test

After giving the instructions to the students and concerned teacher, an achievement test was administered uniformly to all the selected control and experimental group students. No time limit was fixed for the test. Separate booklets were provided to each student of the group. The answer sheets were scored with the help of a scoring key. The scores indicated the previous knowledge possessed by the students regarding the specified items from the units of the concerning subject.

3.9.4.2.3 Phase-3 Conducting the Instructional Program

The instructional treatment was manipulated in the form of teacher-directed instruction followed by constructivist approach settings to the experimental group, whereas the control group was taught through conventional methods. Both the groups were taught 10 chapters of science syllabus prescribed by the NCERT/HPBSE. The instructional program lasted for 40 days. For this duration, one period of 30-40 minutes daily allotted to the science subject in each school timetable of class VI was given to instructional treatment. The instructional procedures and measures incorporated in the constant approach have been described below:

The treatment group was taught by the investigator himself via the constructivist methodology a new instructional model, involving number of techniques which are based on activity centered, assumed or proved to be essential for efficient and effective classroom instruction by the researchers in the field of educational technology.

First of all, student's enthusiasm for learning science through novel methods of instruction was exploited for motivating the experimental group. The students were also encouraged to participate in the instructional program actively.

In every instructional unit, appropriate new stimulus material was presented to the students without an overdose of new information. The various daily life activities, demonstration, chart, models were used to make the teaching learning more interesting, effective and goal-oriented.
Students were directed to take the class notes at the beginning of the lesson, the hand out were distributed to the class that served as environment material. New information was presented and was supplemented with the help of examples which were related to their day to day life situations by following the guidelines of the pre-developed 10 lessons. Thus, the principle of application of classroom instruction and learning in actual life was followed. The content was recapitulated and summarized at intervals in the process of imparting classroom instruction. During instructions, students were required to make responses that forced them to demonstrate acquisition of new information. Corrective feedback or confirmations were provided as and when needed.

Developmental questions were used to keep in the program of the lesson from time to time. Towards the completion of each unit, a semi-structured criterion test was taken which consist of 5-10 short answer, objective type items on the content of the unit. Its results were given to the students the following day. It served as a feedback for the students which help to assess as well as to modify their learning experiences towards the terminal behavior.

To prevent the accumulation of deficiencies that may cause serious learning problems toward the end of the lesson, students’ doubts were clarified by remedial teaching instruction. Students were given home assignment which included reading the relevant part of the chapters from their science text book.

On the other hand the control group was taught by regular science teacher in conventional way. The content and the time of instruction for this group were equated with that of treatment group i.e. experimental group.

In the present study following teaching approaches were used:

- Traditional approach to teach Control group
- constructivist approach to teach Experimental group
Following methods were included in above mentioned approaches:

1. **Traditional Or Conventional approach**
   - Direct Speech
   - Dictation method.
   - Lecture method.
   - Question-Answer
   - Recitation method.
   - Home Assignment method.
   - text book Readings

2. **Modern or Constructivist Approach**
   - Peer group learning
   - child to child learning
   - problem solving method
   - Lecture cum demonstration method.
   - Hands on activities or Activity methods
   - Co operating learning
   - Concept mapping
   - Auto learning
   - Project method
   - Active learning where the voice of the learner is important
   - Programmed learning
   - Personalized system of Instruction.
   - Evaluation is done through observation, activity. Exhibitions and portfolios.
   - Inquiry method
   - “Learning by Doing”.

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• Democratic method.
• Story telling method.
• Individual Self engagement approach.

3.9.4.2.4 Phase-4 Administration of the Post-Test

After the instructional treatment on 10 units of 6th grade science for 40 days the achievement test was again administered to the students of both experimental and control groups to know the affect of treatment. No Time limit was fixed. After completion of the test, the students were thanked for their cooperation and were given no indication of the later test. The answer sheets were scored with the help of scoring key.

3.9.4.2.5 Phase-5 Administration of Retention Test

After the administration and evaluation of the post test the same achievement test was again administered to the students to get measures of retention after 15 days of the post test. The Time limit was not fixed. Again obtained responses were scored with the help of scoring key.

The Five phases marked the end of the experiment is one school. Similarly, all the phases were replicated in the other school. Date and schedule of the experiment has been given in the below table:

Table-3.17
EXPERIMENT-SCHEDULE

<table>
<thead>
<tr>
<th>SCHOOL</th>
<th>EXPERIMENTATION-PHASES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PHASE-I</td>
</tr>
<tr>
<td>Govt. School</td>
<td>06-12-2010</td>
</tr>
<tr>
<td>Public School</td>
<td>to 07-02-2010</td>
</tr>
</tbody>
</table>

The data thus obtained was subjected to statistical analysis:
3.10.0 Data Analysis

3.11 Statistical Techniques used

The pretest, Posttest and Delayed Posttest answer sheets obtained from the students of both the Experimental and control groups as per guidelines and scoring keys of each achievement test. SPSS (15.0) version was made use for the statistical analysis of data. The following statistical techniques were employed to analyses the data obtained from the experiment of different groups in order to test the hypotheses.

➢ Descriptive statistics:

Mean, Standard Deviation, Standard Error of Mean, intelligence scores, achievement scores at pretest level, posttest level and delayed post test level.

➢ Independent–Samples T test:

For compare the achievement scores of two groups.

➢ Paired –Samples T test:

The paired samples T test procedures compare the means of two variables for a single group. The procedure computes the differences between values of the two variables for each case and tests whether the average differs from 0.