CHAPTER IV

DESIGN OF THE STUDY

4.1 PROLOGUE

“Vision without action is merely a dream, action without vision just passes the time and vision with action can change the world.”

- Barker Joel Arthur

Research is a systematic attempt to obtain answers to meaningful questions about phenomena or events through the application of scientific procedures. Research is considered to be the more formal, systematic and intensive process of carrying on a scientific method of analysis. It is directed towards discovery and development of an organized body of knowledge.


According to oxford dictionary, research can be defined as ‘the systematic investigation into and study of material and sources in order to establish facts and reach new conclusions.

“Educational research refers to a systematic attempt to gain better understanding of educational processes, generally with a view of improving its efficiency. It is an application of scientific method to the study of educational problems.”-

Research is thus a systematic and scientific approach to solve a problem. Therefore it is necessary to plan the activities in a systematic manner in advance.

When researchers conduct a study, they proceed through a distinct set of steps given below
Most researches begin with a general statement of the problem. The literature review identifies flaws or gaps in previous research which provides justification for the study undertaken by the researcher. The researcher collects data to test the hypothesis. The researcher then analyzes and interprets the data via variety of statistical methods. The results of confirming or failing to reject the null hypothesis are then tested. At the end researcher may discuss avenues for further research.

4.2 RESEARCH DESIGN AND IT’S NEED

Research design explains the entire plan of the study in detail. It includes a detailed description of the tools used for collecting information, sample, methodology of the study and the methods used for data analysis. Research design refers to the structure of an enquiry planned to show the path for effective completion of the study undertaken. It is the detailed description of a proposed study design to investigate given problem.

The research design is a conceptual structure within which research is conducted. It constitutes a sort of blueprint for the collection, measurement and analysis of data. It is needed because it makes research as efficient as possible yielding maximum result with the minimum of time, efforts and money. Preparation of a research design
becomes important as soon as the research problem has been defined. A careful
design of planning enables the researcher to do work in a systematic manner. It helps
the researcher to organize the ideas in such a way wherein it will be possible for the
researcher to look for flaws and inadequacies. Research design guides the researcher
to keep the right direction.
Thus research design is essential for imparting rational approach to the study. It is a
stepwise, logical and systematic activity. A research design includes following
components:

a. Research Methods
b. Sampling Design
c. Tools for the research
d. Statistical Techniques used for data analysis

There are two major approaches to research.

4.3 Approaches to Research

Two major approaches of Research –

i) Quantitative Approach
ii) Qualitative Approach

Quantitative Approach – In quantitative research, the investigator identifies a
research problem based on the trends in the field or the need to explain why
something occurs. However some quantitative research also explains the effect of one
variable on another variable. In quantitative study data is collected by using
instruments to measure the variable in the study. In quantitative data analysis, data is
analyzed using statistical techniques and conclusions are drawn, generalizations are
made based on the result of the study.
Qualitative Approach – Qualitative research is especially important in behavioral sciences where the aim is to discover the human behavior. It employs a naturalistic approach based on phenomenological paradigm which uses variety of interpretive methodologies that seeks to understand phenomenon as they occur naturally. Qualitative research is best suited to address a research problem in which the investigator need to explore the variable. The verbal data collected through questionnaire, observation and interview are mostly qualitative in nature. No attempts are made to manipulate the situation under study. In qualitative research the data is collected from participants by developed forms, called protocols for recording the data. Interview protocol, observation protocol are used for recording the data. Rather than using statistics, words or pictures are analyzed to describe the central phenomenon under study. (Creswell, J.pg 205)

The selection of research design depends upon the objective of study, the variables taken into consideration and the condition under which research is conducted.

4.4 RESEARCH METHODS

Research methods are utmost importance in a research process. It describes the various steps of the plan to be adopted in order to solve the research problem such as the manner in which the problem is formulated, the choice of subjects for investigation, validation of data gathering tools, the collection, analysis and interpretation of data and the process of inferences and generalization. In order to carry out the research in a scientific and valid manner it is very important to specify the methodology used for the study. The research methods are broadly classified into three categories:

i. Historical method
ii. Descriptive method

iii. Experimental method

4.4.1 Historical Method:

Historical research attempts to establish facts so as to arrive at conclusions concerning past events. This is usually accompanied by an interpretation of past events and it’s relevance to the present circumstances and what might happen to the future. It provides a method of investigation to discover, describe and interprets what existed in the past. This research involves investigating, recording, analyzing and interpreting the events of the past for the purpose to discover generalization that are helpful in understanding the past and present and to limited extent in anticipating the future. The main purpose of historical research, therefore, is to arrive at an accurate account of the past so as to gain clearer perspective of the present.

4.4.2 Descriptive Method:

The descriptive research method has undoubtedly been the most popular and the most widely used research method in the field of education. Descriptive research studies are designed to obtain pertinent and precise information concerning the current status of phenomena and to draw valid general conclusions from the facts discovered. They are restricted not only to fact finding but may often result in formulation of important principles of knowledge and solutions of significant problems. Descriptive studies are more than just a collection of data; they involve measurement, classification, analysis, comparison and interpretation. Descriptive studies investigate the phenomena in its natural settings. This method can be applied to obtain the present information of current events. It helps to explain educational phenomena in terms of the conditions or relationships that exist, opinions that are held by the students, teachers, parents and
experts, processes that are going on, effects that are evident or trends that are developing. At times, descriptive survey is the only means through which opinion, attitude, suggestion for improvement of educational practices and instructions and other data can be obtained.

4.4.3 Experimental Method:

Experimental research provides a systematic and logical method for answering question, “If this is done under controlled conditions, what will happen?” In an experimental method researcher /experimenter manipulates certain stimuli, treatments, or environmental conditions and observe how the condition or behavior of the subject is affected or changed. In this method, the researcher has to deliberately manipulate certain aspects of experiments. The manipulation is deliberate and systematic. The researcher has to control the variables involved in the study and accordingly observe the cause and effect.

After problem is defined, the experimenter proposes a tentative answer or hypothesis. Researcher tests the hypothesis and accepts or rejects it in the context of controlled variable relationship which researcher has controlled. Although the experimental method finds it’s greatest utility in the laboratory, it has been effectively applied within non laboratory settings such as classroom, where significant factors or variables are controlled to some degrees. The purpose of such experimentation is to predict events in experimental settings. The ultimate aim is to is to generalize the variable relationship so that they may be applied outside the setting also.

The selection of method depends upon the aim of the study. The present study is aimed at development of an Intervention Programme on Brain Based Learning
Strategies. The researcher has manipulated teaching approach to observe how the subject is affected. So the methodology used for phase I is the experimental one.

4.4.3.1 Experimental Designs

There are various types of experimental designs. They vary in complexity and adequacy. The selection of particular design depends upon nature and purpose of experiment, the type of variables to be manipulated, the nature of the data, the condition for carrying out experiment, how subjects are to be assigned to experimental and control groups, the way variables are controlled, the type of statistical method to be employed. The appropriateness of experimental design is judged by the degree to which they eliminate or minimize threats to experimental validity.

The experimental designs are broadly classified as under.

1. Pre experimental research design
2. True experimental research design
3. Quasi experimental research design
4. Time series experimental research design
5. Factorial experimental research design

(Koul, L. Methods of Educational Research, pg 484)

Each of the designs caters to different types of samples. Each design has its own merits and demerits. The degree of accuracy depends upon and differs along the line of control of observation, manipulation and replication. No design solves all the problems. The nature of the problem determines which type of design is most appropriate and applicable for the experiment.
In the present investigation True experimental design has been used.

4.5 Mixed Method Design

When quantitative and qualitative, both the approaches are used in any study it is known as mixed method design.

A mixed method research design is a procedure for collecting, analyzing, and ‘mixing’ both quantitative and qualitative methods in a single study or series of studies to understand the research problem. (Creswell J, pg. 535)

The basic assumption is that the use of both quantitative and qualitative methods, in combination, provides a better understanding of the research problem than either method by itself. Mixed method research is not simply collecting two distinct “strands” of research-quantitative and qualitative. It consists of merging, integrating, embedding the two “strands”. In short data are mixed in mixed method study.

In mixed methods, the researcher

- Collects and analyzes both quantitative and qualitative data.
- Mixes the two forms of data by combining them (or merging them), sequentially by having one build on the other, or embedding one within the other;
- Uses these procedure in a single study or in multiple phases of a programme of study;
- Combines the procedure into specific research designs that directs the plan for conducting the study.
4.5.1 The Major Mixed method Designs

In mixed methods the researcher selects the design that reflects interaction, priority, timing and mixing. Researcher carefully selects the design that best matches the research problem and reasons for mixing. There are six mixed method designs, with the first four as basic mixed method designs and the last two as complex designs. The designs are:

- the convergent parallel design,
- the explanatory sequential design,
- the exploratory sequential design and the
- the embedded design.
- the transformative design
- the multiphase design.

(Creswell, pg 540)

The Convergent Parallel Design

The purpose of a convergent parallel design is to simultaneously collect both quantitative and qualitative data, analyze both datasets separately, compare the result of both the datasets and make an interpretation as to whether the result supports or contradicts each other. The direct comparison of the two datasets by the researcher provides a “convergence” of data sources. The basic rationale for this design is that one data collection form supplies strengths to offset the weaknesses of the other form and that a more complete understanding of a research problem results from collecting both quantitative and qualitative data. For example, quantitative scores on an instrument from many individuals provide strength to offset the weakness of qualitative documents from few people. Alternatively, qualitative interview of few
people offers strength to quantitative data that does not adequately provide detailed information about the context in which individuals provide information. The diagrammatic representation is given in fig 4.1.

**fig.4.1**
The Convergent Parallel Design

![Diagram of Convergent Parallel Design](image)

**The Explanatory Sequential design**

In this mixed method, researcher instead of collecting data at the same time and then merging the results, first collects quantitative data and then collects qualitative data to explain or elaborate quantitative results. As the data is collected in two phases this is also called a two-phase model. The rationale for this approach is that quantitative data and results provide a general picture of research problem: more analysis specifically through qualitative data collection is needed to refine, extend or explain the general picture. The diagrammatic representation is given in fig 4.2.

**Fig. 4.2.**
The Explanatory Sequential design

![Diagram of Explanatory Sequential Design](image)
The Exploratory Sequential design

In this mixed method design, researcher rather than collecting quantitative data, as is done in explanatory design, begins with qualitative data and then collects quantitative information. The purpose of this design involves the procedure of first gathering qualitative data to explore a phenomenon, and then collecting quantitative data to explain relationship found in the qualitative data. A popular application of this design is to explore a phenomenon, identify themes, design an instrument, and subsequently test it. The design is represented diagrammatically in fig. 4.3.

Fig. 4.3.

The Exploratory Sequential design

The Embedded design

In this method quantitative and qualitative data are collected simultaneously or sequentially but one form of data play a supportive role to other form of data. The reason for collecting second form of data is that it supports the primary form of data. The supportive data may be either qualitative or quantitative. For example, during a quantitative experiment, the researcher may collect qualitative data to examine how participants are experiencing in the intervention. Also researcher may collect qualitative data at the end of the experiment to support the experimental study. The diagrammatic representation is given in fig 4.4.

166
**The Transformative design**

This is the more complex mixed method design as compare to the previous designs. The intent of the transformative mixed method design is to use one of the four designs (convergent, explanatory, exploratory and embedded) but to encase the design within a transformative framework. This framework informs the overall purpose of the study, the research question, the data collection, and the outcome of the study. The intent of the framework is to address a social issue and engage in research that brings about change. Thus, strength of this design is that it is value based and ideological. The design is represented diagrammatically in fig. 4.5.

**The Multiphase design**

Like the transformative design, the multiphase design is a complex design that builds on the basic convergent, explanatory, exploratory, embedded designs. It occurs when researcher or team of researchers examine a problem through a series of phases or stages. The intent of the design is to address a set of incremental research questions.
This approach is often used in programme evaluation where quantitative and qualitative approaches are used over time to support the development, adaptation, and evaluation of specific programme. The design is represented diagrammatically in fig. 4.6.

Fig. 4.6.

The Multiphase design

4.6 Methodology of the present study

The selection of methodology of the study depends upon the aim of the study. The present study aimed at development of an intervention programme based on BBL and to study effectiveness of the programme. In order to develop a more in-depth understanding of how the experimental intervention actually worked, for the present study researcher used mixed method design. Both the quantitative as well as qualitative approaches were used. Quantitative data such as scores on Achievement test, Self esteem, Attitude towards learning, and Academic stress were collected, statistically analyzed and inferences were drawn. For collecting qualitative data interview were conducted. In order to get participants views/perspectives interviews were conducted.

From the mix method designs researcher had made use of explanatory sequential design. Under which researcher collected quantitative and qualitative information sequentially in two phases. In the first phase of the study quantitative data was collected and in the second phase qualitative data was collected.
4.6.1 Rationale for selecting Mixed Method design

Researcher was interested in studying effectiveness of an intervention programme based on BBL on student achievement, self esteem, attitude towards learning and academic stress. For which data was collected in numerical form and analyzed. The result showed that there is increase in achievement, self esteem of the students. The attitude towards learning was also found to be favourable and academic stress of the students was reduced after implementation of the intervention programme. This way the quantitative data was collected and conclusions were drawn, but quantitative analysis in itself was not enough to support the result. So it was necessary to integrate quantitative and qualitative data. The rationale for mixing both types of data is to support the quantitative result with qualitative. The researcher was also interested in understanding the reasons for making the BBL strategies effective. The researcher collected qualitative data from low, moderate and high achievers so as to get the complete picture of the study. When used in combination, quantitative and qualitative methods complement each other and provide a more complete picture of research problem.

For collecting quantitative data of phase one, experimental methodology was used. The selection of method and the specific design within that method appropriate to investigate the research problem depends upon the nature of the study. The present study aimed at developing an intervention programme based on brain based learning and to study its effectiveness in which the researcher has to deliberately manipulate certain aspects of experiment so Experimental method was used. All the factors that influence the outcome of high scores were controlled. Cognitive abilities and test conditions were same for both the groups .Same tests were given to both the group. All variables that might influence the outcome were controlled except for the
difference in type of instruction (BBL or traditional method). Effect of history, maturation, testing, measuring instruments; statistical regression, selection and mortality were controlled.

Under experimental method, the researcher used *True experimental design*. It is the most rigorous and strong design because of equating the groups through random assignment. In a true experimental the equivalence of the experimental and control group is provided by random assignment of subjects to experimental and control treatments. The researcher randomly assigns participants to different conditions of the experimental variable. Following procedures are commonly used to minimize inter subject differences so as to increase equivalence among groups that are to be subjected to various experimental conditions.

- Subject to subject matching
- Matching for mean and standard deviation
- Ranking of subject on matching variable
- Random assignment on the basis of homogeneous selection
- Technique of analysis of covariance

(Koul, L. Methods of Educational Research)

In the present study the groups were equated by *matching for mean and Standard Deviation*. Sometimes it is worthwhile to match groups rather than individuals on the relevant variable. The researcher seeks to show that the two groups do not differ significantly in terms of mean and standard deviation on the matching variable. In the present study the groups were equated by matching for mean and Standard Deviation on achievement in science. The test on achievement in science based on syllabus of std V was given to four divisions of std VI. Mean and SD were calculated. The two
classes with equal mean and SD were matched for the experiment. Class ‘Tulip’ was selected as experimental group and class ‘Lily’ was selected as control group. These classes were selected randomly as experimental and control group.

Although it is difficult to arrange a true experimental design, particularly in school classroom research, it is the strongest type of design and should be used whenever possible. True Experimental design is further classified into-

- Post – test only Equivalent Group design.
- Pre-test,Post-test Equivalent Group design
- The Solomon Four groups design

For the present study researcher has used Pre-test,Post-test Equivalent Group design. Pre test were administered before the application of the experimental and control treatment and post test at the end of the treatment. Pre test and post test scores were compared and subjected to test of significance of the difference between the means of two tests and groups. This design is often used in classroom experiments when experimental and control groups are matched on certain criteria.

The pretest posttest equivalent group design is denoted as follows –

\[
\begin{array}{ccc}
R & O1 & X & O2 \\
R & O3 & C & O4 \\
\end{array}
\]

Where,

- R- Randomization
- X – treatment
- O1 O3 - pretest
- C – Control
- O3 O4 - posttest
Experimental group was exposed to the intervention programme whereas control group was not provided any treatment. Pretest was administered to both the groups before the implementation of the programme. Self esteem inventory, Academic stress scale and Attitude towards learning scale and achievement test (Pre test) were administered before the treatment. Same tests were administered at the end of the programme as post test to both the groups. Pre test and post test scores were compared and subjected to test of significance. In this way researcher collected the quantitative data for the first phase.

The present study adopted mixed method design of explanatory type therefore in the second phase the data in the qualitative form has been collected.

To understand the phenomena, researcher had collected the data by conducting interviews. The qualitative data had been collected after the analysis of quantitative data, therefore sequential explanatory design has been used. Further the transcripts are prepared for further analysis of data in qualitative form.

4.7 SAMPLE

Data collection is the next and most important part of the study. It is practically impossible to collect all the necessary and valid information from each and every individual in the population related to the study for data collection. Hence, it is necessary to select a finite number of individuals from the population for a study. The representative proportion of the population is called sample. By studying the sample, certain inferences about the population could be made. Sample consists of a number of selected individuals, objects, events which represents the total population. The systematic process of selecting a limited number of individual, institution or objects from the population for the study is called Sampling. A carefully, well planned
selected sample helps in saving time, money and efforts of the researcher. The adequacy of a sample will depend upon knowledge of the population as well as upon the methods use in drawing the sample.

### 4.7.1 Methods and Techniques of Sampling

The nature of population and the information required for study determine the type of sampling. Sampling is broadly classified into two broad categories-

1. **Probability sampling**
2. **Non-probability sampling.**

**Probability Sampling:** In probability sampling the units of the population are not selected at the discretion of the researcher but by means of certain procedures which ensure that every unit of the population has one fixed probability of being included in the sample.

Following are different methods of selecting a probability sample.

**a. Simple random sample**

A simple random sample is obtained by choosing units of the population in such a way that each unit in the population has an equal chance of being selected. A simple random sample is free from sampling bias. A researcher may use lottery method or the table of random numbers or toss a coin to draw such type of sample.

**b. Systematic random sample**

This method is a modified form of simple random sampling. It involves selecting subjects from the population list in a systematic rather than a random fashion. In systematic sampling, a researcher generally starts with all N units of the population
listed in alphabetic or some other order. Instead of using a list of simple random numbers, data collection can be simplified by selecting say every 10\textsuperscript{th} or 100\textsuperscript{th} unit after the first unit has been chosen randomly. Such a procedure is called systematic random sampling. For example, from a population of 5000, a researcher wants a sample of 500 then every tenth person could be selected.

c. **Stratified Sample**

A stratified sample is obtained by independently selecting a separate simple random sample from each population stratum. When the units in the sample are selected in proportion to their presence in the population, the sample is said to be stratified random sampling. When a researcher divides the population into different strata on the basis of some characteristics and selects a sample, the technique is known as ‘stratified random sampling’. The usual stratification factors are gender, age, socio-economic status, educational background, residence, occupation, religion, cast and so on.

d. **Cluster sample**

In ‘cluster sampling’, the unit of sampling is not the individual but rather a naturally occurring group of individuals. It is used when it is more feasible or convenient to select groups of individuals than it is to select individuals from a defined population.

A cluster sample is obtained by selecting clusters from the population on the basis of simple random sampling. It involves grouping the population and then selecting the groups or the clusters rather than individual elements for inclusion in the sample.
e. Multi stage sample

This is further development of an idea of cluster sampling. This technique is meant for big entities extending to a considerably large geographical area. The researcher may have to use two, three or four stage sampling.

Non probability sampling: In non-probability sampling, the units are selected at the discretion of the researcher. Such samples use human judgments in selecting units and have no theoretical basis for estimating population characteristics. The selection of the subject is arbitrary or subjective, since the researcher relies on his/her judgment and experience.

There are different methods of non probability sampling

a. Incidental Sample

It is also called as accidental sampling. It is a term which is applied when easily available groups are taken as sample. The researcher collects information from samples that are conveniently available and willing to cooperate for providing information.

b. Quota sample

In quota sampling, the population is first segmented into mutually exclusive sub-groups, just as in stratified sampling. Then judgment is used to select the subject or units from each segment based on a specified proportion. It is this second step which makes the technique one of non probability sampling.
c. Purposive sample

In purposive sampling the researcher uses his/her judgment in selecting the unit from population for study based on the population’s parameters. The researcher may exercise his own judgment based on experience for selecting sample.

Sampling technique used for the present study

The nature of population and the type of information required for the study determines the type of sampling technique to be used.

For collecting data for the first phase of quantitative analysis, researcher has made use of following sampling techniques. Sample was selected in the following manner.

School selection - One of the English medium schools of CBSE board located in Navi Mumbai was selected by incidental sampling technique as it agreed to cooperate for conducting the experiment.

Class selection - Four intact classes of std VI of the same school were chosen randomly for equating the groups. From those four classes, two classes with equal Mean and SD were selected as control group and experimental group with random assignment of equated group.

Following table shows the mean and SD values of the four divisions of standard VI.
Table 4.1

Mean and SD values of the four divisions of standard VI

<table>
<thead>
<tr>
<th></th>
<th>Aster</th>
<th>Lily</th>
<th>Rose</th>
<th>Tulip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>25.72</td>
<td>24.92</td>
<td>22.38</td>
<td>24.39</td>
</tr>
<tr>
<td>SD</td>
<td>5.51</td>
<td>5.48</td>
<td>5.51</td>
<td>5.11</td>
</tr>
</tbody>
</table>

|       | Control Group | Expt. Group |

From the above table it can be seen that the two classes i.e Lily and Tulip has near about equal mean and SD so these two classes were selected as control and experimental group respectively.

To decide the control and experimental group random selection technique has been used.

**Student selection** – From the two intact classes, all the students were considered for the study. Students were selected by **cluster sampling technique**. Those students who were present for pre and post test and all the sessions were considered as final sample.

Students of std VI were selected as sample for the study because according to Piaget children belonging to this age group starts developing abstract thinking at this age. Upto age 12 the brain is like a super-sponge. It is during this period that the foundations for thinking, language, vision, attitudes, aptitudes, and other characteristics are laid down. After this stage of development, the windows close; the fundamental architecture of the brain is complete (Kotulak, 1996). It is easier to learn in these vital years. Therefore, the std VI were selected for the present study.
4.7.3 Sample- Its size and nature

The total sample of seventy two students was selected through Incidental sampling technique. There were thirty five students in experimental group and thirty seven students in the control group. The following table depicts the nature and composition of sample for the present study.

**Table 4.2**

Sample Size

<table>
<thead>
<tr>
<th>Groups</th>
<th>Class</th>
<th>Initial Sample</th>
<th>Final Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>Std VI, ‘Tulip’ group</td>
<td>47</td>
<td>35</td>
</tr>
<tr>
<td>Control</td>
<td>Std VI, ‘Lily’ group</td>
<td>45</td>
<td>37</td>
</tr>
</tbody>
</table>

Table 4.2 indicates the distribution of the total sample for the study. The researcher selected students from two classes one as experimental group and other as control group. The students of class VI ‘Tulip’ was selected as experimental group and of class VI ‘Lily’ was selected as control group.

The following table shows the Gender wise distribution of Sample for the present study.

**Table 4.3**

Gender wise distribution of the Sample

<table>
<thead>
<tr>
<th>Group</th>
<th>Boys</th>
<th>Girls</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>11</td>
<td>24</td>
<td>35</td>
</tr>
<tr>
<td>Control</td>
<td>15</td>
<td>22</td>
<td>37</td>
</tr>
</tbody>
</table>

From the above table it can be seen that there were eleven boys and twenty four girls in the experimental group whereas fifteen boys and twenty two girls were there in control group.
For collecting qualitative data for second phase of the study, thirteen students of class VI were selected by **purposive sampling technique**. While selecting the sample care was taken that it represents the class so low average and high achievers were purposefully selected for conducting the interview. The following table depicts the nature and composition of sample.

**Table 4.4**

**Sample for second phase**

<table>
<thead>
<tr>
<th>Gender</th>
<th>High Achievers</th>
<th>Average Achievers</th>
<th>Low Achievers</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>02</td>
<td>02</td>
<td>02</td>
<td>06</td>
</tr>
<tr>
<td>Girls</td>
<td>03</td>
<td>02</td>
<td>02</td>
<td>07</td>
</tr>
<tr>
<td>Total</td>
<td>05</td>
<td>04</td>
<td>04</td>
<td>13</td>
</tr>
</tbody>
</table>

From the above table it can be seen that amongst thirteen students, two high achiever boys, three high achiever girls, two low achiever boys and two low achiever girls, whereas two average achiever boys and two average achiever girls were selected as sample.

**4.8 TOOLS USED OF THE RESEARCH**

To carry out research, data must be gathered to test the hypothesis. There are different methods and procedures developed for collection of data. In order to collect data from the sample, the researcher may require many data gathering tools which may vary in their complexity, design, administration and interpretation. Many tools are easily available and accessible that could be used in collecting the data. Every tool has its own advantage and limitations. It is the task of the researcher to find out and select an appropriate tool according to the study.
The major data gathering tools of research may be broadly classified into the following categories

i. Questionnaire

ii. Psychological test

iii. Interest inventories

iv. Personality inventories

v. Rating scales

vi. Attitude scales

vii. Aptitude tests

viii. Achievement tests

ix. Observation schedules

x. Interview schedules

xi. Socio metric techniques

### 4.8.1 Tools used for the present study

For the purpose of collecting data for quantitative analysis, following tools were used by the researcher. These tools are prepared by the researcher.

1. Achievement test
2. Self esteem Scale
3. Academic stress Scale
4. Attitude towards learning scale
5. Reaction towards brain based learning scale
6. Evaluation Rubric
7. Interview schedule
8. Worksheets
9. Reflection sheets

For the present study, the researcher used rating scales along with achievement test. As the researcher was interested in gathering information regarding Self esteem, Academic Stress, Attitude towards learning and Reaction towards brain based learning of the students, the rating scale was thought to be the most appropriate tool. For collecting qualitative data interview schedule, worksheets and reflection sheets were used.

4.8.1.1. Achievement test

Achievement test measure the present proficiency, mastery and understanding of general and specific areas of knowledge. For the most it is measure of effectiveness of instruction and learning. It attempts to measure what an individual has learnt, his/her present level of performance. It is particularly helpful in in determining individual or group status in learning.

Achievement test was prepared by researcher to evaluate the performance of students in environment education. The test was prepared as a pre-test to know the initial level of the learners and a post test to verify the result of effect of an intervention programme on achievement of learners. The test consisted of multiple choice questions as well as situation based questions. The test was prepared by using reference materials such as environmental education text books (from std IV to VI) and internet resources. It has eight questions carrying 60 marks. The time allotted for the test was two hrs. The main concern for designing the test was to evaluate student’s knowledge, understanding and awareness about the topic ‘waste management’. The specification of the topic was decided according to the need and level of the class.
After deciding the content, content analysis was done. Objectives were written for the content. Blue print was developed for preparing the test. Questions were framed considering the weightage given to content and type of question. The test was prepared keeping in view the objectives of revised bloom’s taxonomy. The achievement test is attached in appendix A.

**Validity of the test**

The content validity of the test was established by seeking the opinion of five experts including teachers working in the field of environment education as well as teacher educators. After collecting all experts’ opinion the test was modified.

**4.8.1.2. The Rating Scale**

The rating scale is a type of tool which attempts to measure the quality, judgment or opinion and indicate its degree or amount. It involves qualitative description of a limited number of aspects or traits of a person, situation or object. Opinion is usually expressed on a scale of values. It has set of points which describe varying degrees of the dimension of an attribute being observed. The classification may be set up in five to seven categories.

For the present study, the researcher used rating scales. As the researcher was interested in gathering information regarding the Attitude towards learning, Self esteem, Academic stress and reaction of students towards brain based learning, the rating scale was thought to be the most appropriate tool.

The following table shows the number of statements prepared for above mentioned tools.
Table 4.5

Items prepared for the Rating Scales

<table>
<thead>
<tr>
<th>Rating Scales</th>
<th>Items prepared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self esteem</td>
<td>40</td>
</tr>
<tr>
<td>Attitude towards learning</td>
<td>36</td>
</tr>
<tr>
<td>Academic stress</td>
<td>40</td>
</tr>
<tr>
<td>Reaction towards brain based learning</td>
<td>40</td>
</tr>
</tbody>
</table>

Table 4.5 indicates the number of statements prepared initially by the researcher. For self esteem the researcher had prepared 40 statements. Attitude towards learning initially had 36 statements. Academic stress had 40 statements. Reaction towards brain based learning had 40 statements.

Validity of the scales

If a tool measures what it intends to measure, it can be termed as valid. There are four types of validity namely

i. Construct validity

ii. Criterion related validity

iii. Concurrent validity

iv. Content validity

Construct validity

This validity is concerned with the meaning and interpretation of the test scores obtained in terms of psychological or theoretical constructs. A construct is a trait of ability, temperament, or attitude which is hypothesized to explain certain aspects of behavior.
**Criterion related validity**

This validity refers to the association between present results as indicated by a test and future behavior; and in order to determine the predictive validity of a test the results from it must be compared with the actual performance in future.

**Concurrent validity**

This validity refers to the usefulness of the test in closely relating to other measures. Tests are often validated by comparing their results with a test of known validity.

**Content Validity**

In order to determine the content validity of the scales, the scales were given to five experts in the field of education and environment education and their opinion was obtained about the relevance of each item. The items which were agreed by 85% of the experts were retained and the other items were either discarded or modified. Thus after determining the content validity and item analysis, the valid statements were retained.

**4.9 Pilot Study**

The pilot study was conducted in order to carry out item analysis and establish the validity and reliability of the scale. For the pilot study, all the rating scales i.e. Attitude towards learning, Self esteem, Academic stress and Reaction of students towards brain based learning were administered on 43 students of Harmony International School. After administering the scales the responses were quantified. The pilot study was also conducted in Vishwajyot High school to implement the BBL Intervention programme in order to establish validity of the programme.
4.10 Item Analysis

The main objective of item analysis was to determine the discrimination index of each item. According to the total scores on the rating scales the forms were arranged in an ascending order. This was followed by taking the uppermost 27% and the lowermost 27% forms, i.e. uppermost 13 and the lowermost 13 were taken out. Scores for each item from higher and lower group were written down and the discriminating index was calculated using the formula

\[ D.I = \frac{N_H - N_L}{1/2 N} \]

Where, \( D.I \) = Discrimination Index

\( N_H \) = Number of correct responses in the group high on the rating scale

\( N_L \) = number of correct responses in the group low on the rating scale

\( N \) = sample size

Those items with discriminating index of 0.20 or more were regarded as satisfactory and they were retained. The items with discriminating index lying between 0.18 to 0.20 were modified. Items with discriminating index less than 0.18 were discarded. The details are mentioned in the following table.

**Table 4.6**

<table>
<thead>
<tr>
<th>Rating Scales</th>
<th>Items prepared</th>
<th>Items retained</th>
<th>Items rejected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self esteem</td>
<td>40</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td>Attitude towards learning</td>
<td>36</td>
<td>34</td>
<td>2</td>
</tr>
<tr>
<td>Academic stress</td>
<td>40</td>
<td>34</td>
<td>6</td>
</tr>
<tr>
<td>Reaction towards brain based learning</td>
<td>40</td>
<td>36</td>
<td>4</td>
</tr>
</tbody>
</table>
Table 4.6 indicates that for self esteem the total number of items prepared was 40. Out of which 36 were retained and 4 items were rejected. For Attitude towards learning, out of 36 items initially prepared 34 were retained and 2 were rejected. For Academic stress, out of 40 items prepared, 34 were accepted and 6 were rejected. For Reaction towards brain based learning, out of 44 items prepared, 30 were accepted and 14 items were rejected.

4.11 Reliability of the Scales

Reliability is the consistency with which a tool measures what it measures (Garrett, 1979). The reliability of a tool can be established by

1) The test-retest method
2) Internal consistency reliability
3) The parallel form reliability
4) Internal Consistency Reliability

The researcher established the reliability of the tools through Split Half and Cronbach Internal Reliability. The results of the reliability of the tools are as follows.

Table 4.7
Reliability of the Scales

<table>
<thead>
<tr>
<th>Rating Scales</th>
<th>Split Half</th>
<th>Cronbach Reliability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self esteem</td>
<td>0.85</td>
<td>0.87</td>
</tr>
<tr>
<td>Attitude towards learning</td>
<td>0.91</td>
<td>0.89</td>
</tr>
<tr>
<td>Academic stress</td>
<td>0.84</td>
<td>0.86</td>
</tr>
</tbody>
</table>
Table 4.7 indicates the results of the reliability of the tools using Split Half and Cronbach Internal Consistency Reliability. It was found that Split Half, reliability for self esteem was 0.85, for Attitude towards learning was 0.91, for Academic stress the reliability was 0.84.

On the other hand, with Cronbach alpha internal reliability, self esteem had 0.87, Attitude towards learning had 0.89 and Academic stress had 0.86.

**Interpretation**: Reliability of all the scales was very high and hence the scales are internally consistent.

### 4.12 Final form of rating scales

After establishing the validity and reliability, the final form of the scales were prepared. Following table indicate the final form of rating scales with number of positively and negatively worded statements.

<table>
<thead>
<tr>
<th>Rating Scales</th>
<th>Total no. of items</th>
<th>Positively Worded</th>
<th>Negatively Worded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self esteem</td>
<td>36</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>Attitude towards learning</td>
<td>34</td>
<td>21</td>
<td>13</td>
</tr>
<tr>
<td>Academic stress</td>
<td>34</td>
<td>34</td>
<td>Nil</td>
</tr>
<tr>
<td>Reaction towards brain based learning</td>
<td>36</td>
<td>36</td>
<td>Nil</td>
</tr>
</tbody>
</table>

Table No.4.8 shows the number of positively and negatively worded statement for each of the rating scales. Self esteem has 18 positively and 18 negatively worded
statements. Attitude towards learning has 21 positively and 13 negatively worded statements. Academic stress has all 34 negatively worded statements. Reaction towards brain based learning scale has positively and negatively worded statements.

4.13 Quantification of Scales

Quantification of response is necessary in order to use statistical techniques, for analyzing the data. A four point rating scale has been used for

a. Self esteem
b. Attitude towards learning
c. Academic stress and
d. Reaction towards brain based learning

The Self esteem, Attitude towards learning and Reaction towards brain based learning has the following rating and scoring

i. Strongly Agree (SA) 4
ii. Agree (A) 3
iii. Strongly disagree (SD) 2
iv. Disagree (D) 1

The other scale i.e Academic stress is also four point rating and its scoring is as follows

i. Always 1
ii. Frequently 2
iii. Sometimes 3
iv. Never 4
The scoring for positively and negatively worded items was given in such a way that higher the score more is the Self Esteem, more favourable is the attitude towards learning and lower the academic stress. The above scales are attached in Appendix B.

For qualitative data collection Interview schedule was prepared.

4.14 Interview and interview schedule

The interview is a psychological and sociological measuring instrument. The interview is a face to face interpersonal role situation in which one person, the interviewer asks a person being interviewed, the respondent.

The planning and writing of interview schedule is a skill. Three kind of information are included in most interview schedules, one identification information, second sociological information and third problem information.

There are number of approaches of interviewing.

- One on one interview
- Focus group interview
- Telephone interview
- Email interviews

Which interview approach to use will ultimately depends upon the accessibility of individuals, the cost, and the amount of time available.

For the present study One on one interview technique was used. In this researcher asked the question to students and recorded answer from only one participant at a time. This type of interview is ideal for interviewing participants who are not hesitant to speak and who can share their ideas comfortably.
This technique was used as the students are of age group 11-12 and generally the children of this age group want to share their feelings and it was possible for the researcher to visit the places of interviewee and conduct their interview. Interview schedule was developed for conducting the interview.

Following procedures was followed for conducting the interview.

In order to make the interview more structured, interview protocols were developed. The interview protocol was designed considering instructions for process of interview, the questions to be asked, and the space to take notes of responses from the interviewee.

Participants were identified for conducting the interview. Thirteen participants out of which five high achievers, four average achievers and four low achievers were chosen purposefully for the interview in order to get true representation of the participants.

Consent was obtained from the interviewee and their parents (as the interviewee are minor) on telephone. The purpose of the interview was conveyed to them. The time of interview was decided. The time it will take to complete was told.

The researcher personally visited the students and conducted the interview. The researcher conducted interview of thirteen students on individual face to face basis. Sub questions under each question were asked to elicit more information. Probes were used to clarify points and to expand the idea of interviewee.

Researcher audio recorded the responses of the participants. Although interview was audio taped, brief notes were taken in order to avoid malfunctioning of the audiotapes in future.
Interview was completed by thanking the participant. Assurance was given to him/her for confidentiality of the responses.

The interview schedule is attached in appendix F.

4.15 Worksheets

As an evidence for assessment of students learning, worksheets for each activity were prepared. While planning the worksheets objectives of the session were considered as well as due care was taken that it should not become monotonous. Variation in the worksheets was brought by changing the nature of each worksheet. Various environmental issues and problems were presented through worksheets. Students were given ample scope for developing their thinking through those worksheets. The solutions provided in the worksheets provided scope for further learning. The worksheets are attached in appendix.

4.16 Evaluation Rubric

Evaluation of level of learner’s mastery in drawing concept maps and graphic organizers was done by scoring their performance on evaluation rubric. The attributes/criteria of concept maps and graphic organizer were classified in evaluation rubric and each criterion was rated giving it scores as per the performance.

The evaluation rubric is attached in appendix H15.

4.17 Reflection sheets

To evaluate metacognitive processes of the learner and to identify the change in their learning process reflection sheets were provided at the end of each activity. Students were also told to write reflective journal entries in their reflective journals.
The reflection sheets are attached in appendix.

4.18 Data Collection

Data collection is an important step in the research process. In the present study the data was collected in two phases. In the first phase quantitative data was collected and in the second phase qualitative data was collected.

For collecting quantitative data, first permissions from the schools were taken. It was necessary to seek the permission from the school principal so researcher personally went to the school to take permission for data collection. As per the demand and to maintain transparency in tools and programme developed was submitted in the Principal’s office. After going through the entire programme the principal clarified her doubts and then permitted to conduct the experiment.

The researcher then went on the appointed day to collect data from students. The four VI\textsuperscript{th} std classes were given a test on Science and then equated groups were formed. The students of experimental and control group was administered the pre test for measuring their attitude towards learning, academic stress, self esteem and their achievement in Environment Education.

Then experimental group was exposed to an intervention programme (i.e. teaching with brain based learning strategies) for about fifty hours. (The detailed programme and time table of activities are given in chapter IV). After completion of the programme same tools were administered as post test to determine the effectiveness of the programme. The above mentioned tools were administered on both the groups to see any difference has occurred or not. The experimental group in addition to above
mentioned tools was also administered reaction towards brain based learning scale in order to know their reaction about Brain Based Learning strategies.

Further to understand the students’ understanding about the topic and their feeling during the intervention programme the qualitative data has been collected. In order to collect qualitative data, interview was conducted. First permissions of the parents were taken on telephone for conducting interview of their wards. Researcher explained the purpose of conducting the interview to their parents. Date and time was fixed for conducting the interview. Interview protocols were developed for recording the data. Then on appointed day and time given by the parents, researcher personally visited their places and explains the purpose and procedure to students to obtain their responses. Students were asked to express their true and frank opinion about the programme.

Student’s reflection sheets and worksheets were also analyzed for qualitative data collection.

After the data collection, the responses of the students were quantified and analyzed.

4.19 Data Analysis

Analysis of the data means a study of systematically organized material in order to discover inherent relationship and differences. Statistical analysis acts as a link for communication of results. Statistical techniques have been used extensively in analyzing the data. For the present study descriptive and inferential analysis was carried out for quantifying quantitative data.
4.19.1 **Quantitative data Analysis**

For analyzing quantitative data Descriptive and inferential techniques of data analysis were used.

**Descriptive Analysis**

A descriptive statistical measure studies the characteristics of a particular group. The generalization is limited up to that particular group studied. The conclusions cannot be extended beyond this group. For the present study the statistical measures used for descriptive analysis were as follows:

a. Measures of central tendency: This includes mean, median and mode.

b. Measures of variability: This includes standard deviation, skewness and kurtosis.

c. Graphical method: This includes bar diagrams.

**Inferential Analysis**

To study the nature of the data and find out significant difference in experimental and control group, the researcher made use of inferential statistical technique. Generalizations made by inferential analysis can be extended to infer population characteristics. For the purpose of inferential analysis of the data in the present study, the following techniques have been used.

- Paired t-test
- Two way ANOVA
- $\omega^2$ estimate
- Wolf’s formula
**Paired t-test**

In order to find out significant difference in experimental and control group paired t test was used. The following formula was applied for calculating ‘t’ value.

\[
t = \frac{m_1 - m_2}{SE_{diff}}
\]

\[
SE_{D} = \sqrt{(\sigma^2_{x1} + \sigma^2_{y2}) (1-r_{xy}^2)}
\]

( Garrette, H, Statistics in Psychology and Education, pg 231)

**Two way ANOVA**

In order to find interaction effect of mediating variable and treatment on gain scores of achievement, self esteem, attitude towards learning and academic stress Two way analysis of variance was used.

**$\omega^2$ estimate**

When t ratio is found to be significant for the gain scores, the $\omega^2$ estimate is calculated. It is computed with the help of following formula.

\[
\omega^2 = \frac{t^2 - 1}{n_1 + n_2 + t^2 - 1}
\]

Where t = t ratio of scores of two groups

N1 = Sample size of experimental group

N2 = Sample size of control group
Wolf’s formula

Wolf’s formula is used to measure the extent of effectiveness of treatment on the dependent variable. The formula for computing effect size is as follows.

\[ d = \frac{M_E - M_C}{SD_C} \]

Where \( d \) = Magnitude of effectiveness of the experiment.

\( M_E \) = Mean score of the dependent variable of the experimental group

\( M_C \) = Mean score of the dependent variable of the control group

\( SD_C \) = Standard Deviation of the dependent variable of the control group

4.19.2 Qualitative data analysis

For analyzing the qualitative data, the following six steps were followed.

1. Recorded interviews were listen carefully.

2. Transcribes were prepared.

3. Data was read through to obtain a general sense of data.

4. Themes were identified from the data

5. Data was coded.

6. Themes were coded for the description to be used in research

Preparation and organization of data

In the initial preparation of data analysis, organizing data is important. Organization of data is critical in qualitative analysis because of the large amount of information gathered during the study. The extensive data that an interview yields results in about many pages of transcriptions. For e.g. thirty minute interview will often results in
twenty pages of single spaced transcription. With this sizable amount of data, the transcribing and organization of information requires a system of organization, which could take several forms such as

- Developing a matrix or a table that can be used to help organize the material.
- Organizing the material by type: all interviews, all observations, all documents and all photographs and other visual materials.

In the present study data collected through interviewing participants was converted into transcripts. Data collected was transformed from spoken to written words. To begin the process of analysis the audio tapes were listened again and again. The data collected through audiotape was converted into transcription. Then this text data was coded.

**Coding the data**

Coding is the process of segmenting and labeling text to form descriptions and broad themes in the data. The objective of coding the data was to make sense out of text data. The thematic analysis was carried out for analyzing interview data. Thematic analysis is a way of seeing as well as a process of coding qualitative information.

For the present study descriptive coding and interpretive coding has been done which leads to overarching themes. The stages followed in thematic analysis for coding the data are given below.

**Stage I - Descriptive coding**

1. Read all the transcriptions carefully.

2. Highlight the relevant material
3. Define descriptive codes

4. Repeat the same procedure for each transcript

5. Redefine descriptive codes

Stage II - Interpretive coding

1. Cluster descriptive codes.

2. Interpret meaning of cluster

3. Question and disciplinary position

4. Apply interpretive code to full data set

Stage III - Overarching themes

Derive key themes for whole data set by considering interpretive codes.

(King N and Christine H 2010, pg 159)

In the present study the mixed method design is used to study the effectiveness of the intervention programme based on BBL. The quantitative analysis helps in examining effectiveness in statistical way while qualitative analysis help researcher to understand the phenomenon holistically. This enhanced the researcher's understanding of the of the students, the programmes, the lacunas and look into the phenomena from various facets.