CHAPTER 3
METHODOLOGY

The aim of this study is to explore the effects of creativity training upon concept mapping performance of secondary school students. This chapter outlines the procedures adopted to achieve this aim. In order to fulfill the objectives mentioned in chapter-1, scientific methods and procedures were followed. This chapter contains relevant information pertaining to materials and techniques used and other methodological aspects of study. The methodological aspects of the study are:

- Sample
- Research Design
- Tools used
- Treatment Employed
- Identification of variables
- Experimental Controls used
- Procedure of Experimentation
- Data Collection
- Statistical Analysis

3.1.0 Sample

The present study covered the target population of ninth and tenth grade students of an urban area from one district of Haryana state. The sample in the present experimental study was selected with three considerations in view. Firstly, the groups in the sample should match to their school environment; general home environment, physical conditions, etc. Secondly, the students who formed the particular group in the experiment should belong to different levels of independent variables. Thirdly, the extraneous variables which were concomitant to the dependent variable and correlated with that, may not introduce systematic bias in the results. Such variables could be those, the specification of which might not have entered the purview of the experiment.

Keeping these conditions in view, only two schools within the same campus were selected from the urban area of Shahabad (Markanda), district Kurukshetra (Haryana).
Both the schools are present in the same vicinity and are managed by same management members. Moreover, both schools follow CBSE pattern of syllabus and examination. Therefore, school environment of both schools is almost similar. Each school had two sections (with 30-32 students in each section) in each grade level. There were about 128-138 students in each grade level. From both of these schools, two grade levels were selected i.e. ninth and tenth grade level.

The students were matched on socio-economic status test and the scores proposed that majority of student belonged to the same i.e. average socio-economic status. After that the sample students were administered General Mental Ability Test prepared by Jalota. On the basis of mean and standard deviation, students were divided in three parallel groups; high intelligence, middle and low intelligence randomly, making for 120 students in total. These students were further divided into two groups randomly in such a way that there were 20 students of each intelligence level in all the categories. As the number of students relating to three different intelligence levels were same in both the groups, so the groups were homogenous with respect to intelligence and socio economic status. The students who were non-serious unable to be present throughout the experiment and could not take all the tests were labeled under sample death. Initially the number of students was kept 120 for the fear of sample death; only 102 were retained in each grade for data analysis. Therefore, for the analysis there were 17 students in each category in each grade level. The number of students belonging to different categories has been shown in figure 3.1
Figure 3.1

SCHEMATIC PRESENTATION OF DISTRIBUTION OF STUDENTS IN DIFFERENT GROUPS IN EACH GRADE LEVEL

Sample (102 Students)

Control Group (51 students)

Experimental Group (51 students)

High Intelligence Group (17 students)

Average Intelligence Group (17 students)

Low Intelligence Group (17 students)
3.2.0 Research Design

In order to study the effectiveness of creativity training program on concept map performance of secondary school students, nesting-cum-crossing design was followed. It was nested in the sense that two different groups were taken i.e. the experimental group and the control group. The treatments were assigned to these groups randomly. Further, in each of the sections, students belonging to three levels of intelligence viz. high, middle and low, were present. In this way, different levels of intelligence were nested in different treatments. All these categories of the students were different from each other which is the characteristics of the nesting design. The design was crossing because all the groups of the students were pre-tested as well as post tested for the dependent variable (concept map performance). Here the same students were pre tested and post tested, which is one of the characteristics of crossing design. In this way, the experimental design was nesting-cum-crossing (as per Lewis, 1968).

The experiment resembled four way factorial (2x2x3x2) nesting-cum-crossing designs. Here two grade levels were involved viz. IX and X; two treatments i.e. traditional method and creativity training program method were involved and three levels of intelligence i.e. high, middle, low intelligence were included. There were two occasions of testing viz. pre-test and post-test for the dependent variable. There were, thus 2X2X3X2=24 (twenty four) combinations. The notations for the treatment combinations are illustrated in table 3.1.

<table>
<thead>
<tr>
<th>C1M1I1O1</th>
<th>C2M2I1O2</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1M1I2O1</td>
<td>C2M2I2O2</td>
</tr>
<tr>
<td>C1M1I3O1</td>
<td>C2M2I3O2</td>
</tr>
</tbody>
</table>

Where,
C1 - Grade IX
M1 – Experimental Group
I1 – High intelligence
O1 – Pre-test
C2 – Grade X
M2 – Control Group
I2 – Middle intelligence
I3 – Low intelligence
O2 – Post test
Where,

$A_1 = \text{Grade IX}$  \hspace{1cm} $A_2 = \text{Grade X}$

$B_1 = \text{Treatment I}$  \hspace{1cm} $B_2 = \text{Treatment II}$

$C_1 = \text{High Intelligence}$  \hspace{1cm} $C_2 = \text{Middle Intelligence}$  \hspace{1cm} $C_3 = \text{Low Intelligence}$

$D_1 = \text{Pre-Test}$  \hspace{1cm} $D_2 = \text{Post Test}$
3.3.0 Tools used

In the present study two types of tools were used:

- Instructional Tools and
- Measuring Tools

3.3.1 Instructional Tools

These were the tools used to impart instructions to the students. The instructions varied in two ways i.e. creativity training method and expositional method. For both instructional variations, tools consisted of lesson plans prepared on specified lesson plan formats and worksheets which were prepared according to assumptions, objectives and syntax of the instructional procedure. The detailed description of lesson plan formats and worksheets has been given in chapter 4.

(a) Creativity Training Programme (The CoRT Thinking Lessons)

This is the tool used to impart creativity training to develop creative thinking in the students. For the training in creativity program, De Bono’s CoRT Thinking Lessons were followed. In the present study, the investigator has modified and prepared lesson plans for creativity training of experimental group. The modifications have been done in the lessons for the purpose of Indian adaptation (such as in the context of syllabus, examples and practice activities). Based on the outline and directions provided by Edward de Bono in his program, the researcher prepared lesson plans in the subject of science from the selected content matter. The activities and examples were modified as per the Indian context.

The lesson plan format for the creativity training has been divided in to four parts. In the first part, personal information such as teacher’s name, grade for which lesson plans have been made, subject and thinking tool to be taught are there. Second part of the format was having two sub headings viz., educational objectives and behavioural objectives.

Subsequent parts involved the sections of material required, rationale for clustering the tools, procedure required for the Introduction about the tools (one by one), practice Items, process, principles Involved and Follow-up Exercises. The lesson plans made generous use of illustrations and examples in the form of activities to bring more
clarity in the content matter. The practice items were followed by exercise questions based on the thinking tool employed. The follow up exercise questions helped in follow up of students by the teacher.

The Thinking tools were clustered in a meaningful manner. The clustering of these tools served two goals: to make thinking tools easily learnt by students and to increase the possibility of transfer of these tools to concept map performance test. The students were given training in CoRT –I (all lessons), CoRT-IV (selected lessons) and CoRT-VI (selected lessons).

(b) Expositional Method

Lesson plan format for expositional method also included four sections. In the first part, personal information such as teacher’s name, date, subject, class, and topic was covered. The subsequent sections included educational objectives, working exercise, exposition to the present conditions and re-evaluation of original activity. Educational objectives were further divided in to two sections: General Objectives as well as Specific Objectives in behavioural Terms.

It was kept in mind that the examples and exercises should be the same and evaluation should be in the form of designing a concept map for the answer. Only the way, the treatment was provided, has to be differed.

3.3.2 Measuring Tools

The measuring tools included the Concept Map Performance Test (for quantitative assessment as well as qualitative assessment), General Mental Ability Test, Socio-Economic Status Scale, Scientific Creativity Test and Semi-structured Interview and case studies.

(a) Concept Map Performance Test (Criterion Concept Map)

The concept map performance test has been devised for IX and X grade separately to measure the meaningful learning and misconceptions held by secondary school students. The test is actually worksheet comprised of general instructions for the students, focus question and the list of ‘concepts’ to be used by the students to answer the
focus question in the form of concept map. The test permits freedom to the students about using ‘concepts’ from the given list of ‘concepts’. The subjects were supposed to answer the focus question (in the form of concept map) on the worksheet provided by using ‘concepts’ from list as per their understanding of the concepts and content matter. The scoring of the concept map has been entered on following four factors: Proposition, hierarchy, cross-links, example as per the scheme proposed by Novak and Gowin (1984). Assessment of concept map prepared in concept map performance test was done qualitatively as well as quantitatively. Quantitative assessment of concept maps in this study followed Novak’s (1984) scoring keys (appendix B). For the purpose of qualitative assessment of concept maps content analysis technique (Table 6.2) was followed along with semi-structured interview (Attached in appendix D). The scores of the students and observation of their maps (pre/post) were recorded as per the criteria followed. For the purpose of reliability of concept map performance tests for both grade levels, the inter-rater reliability of the criterion concept maps of both grade levels were taken in to consideration. It was done as the concept map performance test itself has been developed from criterion concept map for both grade levels. In other words, concept map performance test depends upon criterion concept map for its list of concepts and focus question and hence, for reliability and validity too. The reliability of the criterion concept map was found to be 0.92 for IX grade and 0.93 for grade X. For the validity purpose face validity of the criterion concept maps of both grade levels were taken in to account and was found to be sufficiently valid. So, concept map performance test for both grade levels were also considered to be fairly valid. The detailed description of preparation of criterion concept maps of both grade levels has been discussed in chapter 4.

(b) Intelligence Test Scale (General Mental Ability Test):

In order to measure the intelligence of the students, General Mental Ability Test designed and standardized by Jalota revised edition (1972) was employed. This test consists of 100 items. It has five separate categories of twenty tasks each, (i) vocabulary, (ii) classification, (iii) number series, (iv) analogies and (v) reasoning. Reliability coefficient of the test was found to be fairly high. Validity of the test was found to be .81.
The general key was the key for finding out the examinee’s scores of general mental abilities or intelligence from his answers given to the items of the test.

This test was selected in comparison due to the following reason:

- It is a test that can be administered with ease on subjects.
- The questions are so interesting and absorbing that these provide necessary motivation to students.
- It does not require separate instructions and time for sub-tests or sub-groups.
- The test does not require any elaborate arrangements be made and can be administered under normal classroom conditions. The instructions are simple and easy.
- It is a powerful test aimed at testing ability rather than efficiency.

(c) Adapted Version of Kulshreshtha’s Socio-economic Status Scale

In order to record the information about socio-economic status of students, adapted version of Kulshreshtha’s Socio-Economic Status Scale (Urban Form A- 1970) designed and standardized by Sucheeta and Sharma (2009) was employed. Many scales have been developed by various researchers to measure socio-economic status of the people. However many variables like membership of voluntary organizations, the art of living, the type of school in which children studied, caste, savings, etc. have been left in these scales. In this scale, almost all the variables of socio-economic status have been covered. The test has reliability of 0.87 and the validity of the scale was found to be 0.89.

(d) Scientific creativity Test:

The investigator employed the test of scientific creativity developed and standardized by Sucheta and Sharma (2009) to identify students’ scientific creativity bent. The claim that all individuals possess some degree of scientific creative thinking was the basis on which this test has been designed and developed. This test provides subjects with the opportunity to release their creativity through divergent ideas and the assessor to assess the following mental characteristics: fluency, flexibility, originality, elaboration. There are twenty seven items in this test which are divided into 12 task activities, namely: Consequence test, unusual uses test, analogy test, pictorial test, create
new figure test, find alternate test, design new machine test, give suggestion test, vision-2030 test, effect of temperature test, making a scientific story test and measurement test. This test has test-retest reliability of 0.84. Inter factor correlates were computed that show fairly high validity.

(e) Scheduled Semi-structured Interview

As already mentioned to study the effect of the creativity training program, qualitative analysis of data was done by conducting the interviews of two students who scored highest and two students who scored lowest along with two students who gained maximum on test after the exposure to creativity training program (see appendix D).

In this research the use of the interview was limited to its use as the primary tool for collecting information which provides access to what is inside the learners’ heads as regards to what they know, feel and value. It was a kind of the semi-structured interview. The advantages of the semi-structured interview over other means, including the structured interview, is mainly that it allows both the interviewer and the interviewee to ask and answer freely without being constrained in some way by the nature of the question. The goal is to have a face to face direct interaction with respondents and to understand and explore their perspectives.

The interview helped in face to face, verbal interaction with them to know the reactions of the students. Before the interview personal information about the candidates were collected through reliable sources like official records, class-mates and teachers. The interview was started with a general introduction of the candidate. This information given by the candidate was matched with the information collected from other sources to check the seriousness of the candidate. The general introduction round was followed by a set of ten questions presented in a framed manner. Same questions were repeated twice at different intervals so as to check the reliability of the answers. Ultimately a case study of each candidate was prepared keeping in view not only the change in the structure of concept maps found during content analysis but also considering the behavioral changes observed in them after the exposure of training program.
The reliability or the consistency of the response was evaluated by restating a question in slightly different form at a later time in the interview. The questions of the interview were found to be sufficiently reliable and valid.

3.4.0 Treatment employed

There were two groups of students in the present study in each of the two grade levels. These two different types of groups in each grade level were given two different types of treatment that lasted for two months for one grade level and four months in total for both grade levels (as one grade level was given at a time in the school as per their time table for experimental purpose). One of the groups was given training in creativity with the help of Edward de Bono’s CoRT Thinking Lessons and its exercises. This group was designated as experimental group. The second group was designated as control group and was taught through expositional method. This group was not given creativity training but was taught through expositional method.

As the objective of the study was to see the effectiveness of creativity training programme on secondary school students, the experimental group students were given training with the help of a creativity training program. Following are the details of the treatment given to both groups:

3.4.1 Treatment -I

The experimental group was given creativity training with the help of CoRT Thinking Lessons. De Bono has provided a sequence of model lesson for how to run it in the class. The sequence is as follows:

- Do not mention the subject of the lesson, but start with a story or an exercise which illustrates the aspect of thinking that is the subject of the lesson.
- Introduce the TOOL or SUBJECT of the lesson and explain simply what it does. You can use the introduction in the student’s notes (provided in the CD).
- Carry out an open class example by setting a task and asking for individual responses. Repeat the letters of the tool or the subject as often as you can.
- Divide the class into groups of 4, 5 or 6. Set a practice item from the student’s notes. Allow about three minutes or the time specified.
➢ Get feedback from the groups, for example by getting one suggestion from each of the groups.

➢ Repeat the thinking with another item. Repeat practice items in this manner. Allow time to discuss the process of the lesson.

➢ Use the principles given in the student’s notes to have a discussion around the tool or subject of the lesson. If this discussion is weak, plug in a final practice item.

➢ If it is customary to give homework, use one of the project items for this purpose.

De Bono (2000) recommends that CoRT lessons should be taught directly by the teacher. Thus, the investigator herself taught the thinking tools to the experimental group. Following are the steps of treatment-I:

a) The treatment started with the introduction of the tool in the form of story that the students were going to learn about. The investigator did not tell them directly about the name of thinking tool so as to create a curiosity and understanding of the situation in which that tool could be employed by the students in the later stages of development of lesson. The teacher briefly explained the basic theme of the tool that centered on an example. Some more examples have been added as per the environment of the class.

b) After this, practice items were provided to the students collectively. These items provided a direct opportunity to the students for practicing the thinking tool which was the base of lesson. At this time, the output from the students is usually verbal. It was done to know the direction in which students were thinking and also to make students know where they were wrong.

c) In the step of ‘process’ the students were discussed about when, why and how of the tool presented in the lesson. This was done to emphasize the importance of tool to be practiced by the students because it was ‘the tool’ which was the main focus of lesson plan and not the practice items. Practice items were just to tell that how a tool was to be used.

d) In ‘principle’ step the students were made to look at the list of principles of thinking tools and were encouraged if they wanted to add new principle.
e) After this, ‘follow-up’ items were followed to make students work individually and clear their doubts, if any.

The Thinking tools were clustered and each cluster was taught in three 40 minute sessions. These thinking tools were meaningfully clustered in groups of three excluding the last tool which was taught separately in one session. Every session provided the explanation of each tool separately and then the way these tools were clustered. Therefore, only training period lasted for one month in each class. Otherwise, whole treatment, including orientation of concept mapping & creativity training program, administering of pre and post test of concept map and scientific creativity test and follow up in the form of interview if selected students along with training period took more than two months in each class.

The concept map performance test and scientific creativity test was given to this group of students two times, one before the beginning of the treatment i.e. pre- test and one in the end after the completion of creativity training i.e. post- test.

3.4.2 Treatment-II (Expositional Method)

The control group was taught through the expositional method. However, the treatment-II differed to treatment-II in the aspect that the teaching points were presented by the teacher in regular classroom through expositional method unlike the training of creative thinking skills in treatment-I. The exercise given in between and in the end of the treatment was same in both the groups. Following is the detailed description of the treatment given to the control group:

- **Phase 1:** In the first phase, the students were explained the subject matter. All the pros and cons of the particular topic were detailed out.
- **Phase 2:** In the second phase, all the main points were written on the chalk board in the form of concept map. The students tried to explain every point collectively.
- **Phase 3:** In the third phase, students copied the same concept maps in their notebooks and were asked to prepare the concept map on their own without copying it from the earlier one. Later on, they were provided feedback about constructing a concept map.
The concept map performance test and scientific creativity test was given to this group of students also for two times, one before the beginning of the treatment i.e. pre-test and one in the end after the completion of creativity training i.e. post-test.

3.5.0 Identification of variables

In the present study, three types of variables were worked upon; these variables were independent variables, dependent variables and intervening variables. Different variables in each of these categories have been detailed out:

3.5.1 Independent Variables

There were the variables which were manipulated in order to see their effect on the concept mapping ability and creative outcome of the students. These variables were independent variables. These included (a) Different grade levels (IX & X) (b) Two methods of Teaching (c) Three levels of intelligence (high, medium and low) and (d) Two testing occasions (pre-test) and (post-test).

a) Grade levels: As has been explained, there were two different grade levels viz., ninth and tenth which were selected for the treatment. Each grade level was further divided in to two parallel groups of students called sections.

b) Method of Teaching: Method of teaching was an independent variable wherein the students were classified into two treatment groups. One group was provided creativity training. This group was termed as the experimental group. The other group was taught the subject matter in a traditional manner and was termed as the control group.

c) Levels of Intelligence: Osten and Fiven (1961) suggested for the need of systematic variation of instructions for different levels of ability. Keeping this in view and to experimentally control the effect of their prominent variables, students were classified on the basis of their scores on intelligence test.
Intelligence of the students was an independent variable where in students were classified as per high, medium and low on the basis of their intelligence scores. The variables existed in the students prior to the conduct of the experiment and did not come in the course of its manipulation.

d) Testing Occasions: The effect of treatment was assessed on two different occasions. One was before giving treatment called pre-test and the other was after giving treatment called post-test. In this way each of the students of each treatment group and each grade level was tested on two occasions’ viz., pre test and post test for different criterion variables.

3.5.2 Dependent Variables

These were the variables which acted as a criterion to the test effect of different independent variables. The change in the level of these variables was attributed to the effect of independent variables. In the present study scores on concept map performance test, scientific creativity test and the scores on different components of concept map i.e. propositions, hierarchy, cross-links, examples were the dependent variables. These have been enumerated as follows:

1) Scores of students on concept map performance test: In order to see the effect of the treatment-1, the main factor which was taken into consideration was the scores of the student on concept map performance test. These were measured on two occasions as follows – (a) before the experiment started, the students were administered Concept Map Performance Test; the scores on this test were termed as pre-test scores. (b) The test was again administered after the treatment; the scores on this test were termed as post-test scores.

2) Scores of students on different factors of Concept Map Performance Test: - In order to see the effect of treatment, different components of concept map were considered as the dependent variable. For the same, the scores for all these four components were measured on two occasions as follows: - (a) the scores of
students for all the four components on concept map test conducted on them before the experiment started i.e. pre-test scores (b) Concept Map Performance test was again administered after the treatment; the scores on each factor of concept map performance test were termed as post-test scores.

3) **Scores of students on scientific creativity test:** In order to see the effect of the treatment-1, the main factor which was taken into consideration was the scores of the student on scientific creativity test. These were measured on two occasions as follows – (a) before the experiment started, the students were administered scientific creativity Test; the scores on this test were termed as pre-test scores. (b) The test was again administered after the treatment; the scores on this test were termed as post-test scores.

### 3.5.3 Intervening variables

There is another category of variables which cannot be measured directly but may have an effect on the outcome of the treatment. This category of variables is called intervening variables. In this experimental study, there were many intervening variables that should be considered e.g. socio-economic status, existing abilities, teacher behavior, other pupil variables, school variable, physical environment of the classroom, contamination effect, study effect etc. All these variables were either controlled experimentally, statistically or equalized by the ways of controlling them. The steps taken to control the effect of these variables have been given below.

### 3.6.0 Steps taken to control Intervening Variables

Before conducting the experiment, it was considered necessary to identify as well as control all these variables that can affect the dependent variables. The intervening variables and the controls employed on them have been discussed in the proceeding paragraphs:

- **Socio-economic status:** it is one of the important variables that affect the activities of the learners. All the students were also administered adapted version of Kulshreshtha SES scale designed and standardized by Sucheta and Sharma
(2009). The mean of SES scale of the total sample students was computed on the basis of mean most of the student belonged to middle level on SES.

- **Qualification:** As all the participants of study include grade IX and X students so we can take this variable also as constant.

- **Existing Abilities:** The result may be affected by already existing abilities. If some students with high or low mental abilities enter into the sample of the study, the treatment may project falsifying effects. In order to control the variables, all the sample subjects were pre-tested and post-tested for all the criterion variables. While analyzing the data, pre-test and post-test scores were taken in to consideration.

- **Teacher Behavior:** Inter-teacher variations were eliminated because the experiment was controlled by the investigator herself. All the treatment groups were exposed to creativity exercises by the investigator herself. So the teacher was same for all the treatment variations. Further the administration of various tests was also done by investigator. In this way, there was similar familiarity with all the treatments for all the groups of students. Therefore the possibility of variation due to teacher-competence could be assumed to be negligible. Again the investigator tried to keep the level of motivation, mental and physical alertness same throughout the experiment. In this way, by performing the experimental herself, the investigator tried to control the effect due to teacher variation.

- **Other pupil Variable:** There could be many other pupil variables which could interfere therefore with the treatment effect like pupil caste, home environment etc. this way controlled by randomization. The groups were randomly selected and treatment was randomly assigned to the various groups.

- **School Variable:** The schools selected for experimentation were private schools managed by the same managing committee. These schools were having more or less same physical environment. Thus the students’ environment taken as an intervening variable was also controlled.

- **Physical Environment of all grade levels:** The investigator was able to complete the experiment in the same room during the stay in school. The experiment was conducted in the months of April and May. The primary variation due to seasonal
conditions, physical environment of the classroom, ventilation, and light arrangement etc. was more or less same the school.

- **Contamination Effect:** This effect occurs due to exchange of ideas by the students in the different treatment groups about the content learnt. The other reason for the contamination effect may be due to receiving tuition beyond instructions in the classroom. It occurs if the pupils of the treatment group exchange ideas about the content learnt and the manner in which the content was presented. An attempt was made to control this effect. The students were asked not to talk to their fellow-students or exchange their class notes. The students did follow these instructions.

- **Study Habits:** Other variable closely connected with the experiment is the study habits of the students. The hours of study put in by a student may bring a change in the ability level of the student. This factor was controlled by requesting the student-teachers no to go for extra study hours on the topics related to the study.

### 3.7.0 Experimental Control Used

Every possible attempt was made to control those factors, which could create bias. Firstly, the investigator herself provided treatment to all the groups. It was generally believed that the competence and attitude of the investigator may alter the treatment effects. In order to control the inter-group variation in different treatment groups, the investigator herself provided treatment to all the groups. Secondly, the investigator tried to maintain the sympathetic and encouraging attitude towards all the groups in order to have a constant socio-cultural climate during the experimentation. Thirdly, every effort was made to maintain the experimental conditions similar in all experimental groups. Fourthly, the experimental process was controlled by keeping experimental situation, classroom environment, and duration of experiment and mode of testing same for all the treatment groups. Fifthly the students of all the treatment groups were requested to maintain a good attendance for experimental period. The students who were irregular or non-serious in any of the teaching groups were kept out of sample.
3.8.0 Procedure of Experimentation

The procedure of this study involves selection of students for treatment groups and experimentation.

3.8.1 Selection of students for Treatment groups

As has already been mentioned, only two schools from the urban area were selected. The students of IX & X grade level of these schools formed the population for the present study. Each school had two sections (with 32-35 students in each section) in each grade level. There were about 128-138 students in each grade level. Out of this, 120 students for each of the grade levels were taken from which treatment groups were formed. The formation of the groups was as under:

a) **Administration of intelligence test:** All the students were administered General Mental Ability Test by Jalota. On the basis of the common mean and SD, three different groups were identified as high intelligence, medium intelligence and low intelligence groups.

b) **Administration of SES Scale:** All the students were also administered adapted version of Kulshreshtha SES scale designed and standardized by Sucheta and Sharma (2009). The mean of SES scale of the total sample students was computed but as all the students belonged to nearly the same socio-economic status. So, the categorization on the basis of SES was dropped by the investigator.

c) **Random selection of the subjects from the groups:** From each of the intelligent level, 34 students were randomly selected in each grade level. In this way, there were 34 high intelligent, 34 middle intelligent and 34 low intelligent students in each grade level. Now, 17 students from each of the intelligence level were selected to form two different treatment groups, and thus two sections were formed in IX grade level. In this way each section consisted of 17 high intelligent, 17 middle intelligent and 17 low intelligent students. As each section contained 51 students, so the total students for two sections were 51x2=102 and for two grades levels it was computed to be 102x2=204 that constituted the total sample for the experiment. The treatments were randomly assigned to the groups.
So the students from each category in both the groups are illustrated below in table 3.2

<table>
<thead>
<tr>
<th>Total Students (102)</th>
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<tbody>
<tr>
<td>High intelligence (HI-34)</td>
</tr>
<tr>
<td>Experimental Group</td>
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<tr>
<td>17</td>
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</table>

(d) **Assigning treatment to groups**: Each of the grade level was having two parallel groups. These groups were assigned the treatments randomly. Each group in the both grades was assigned to one particular treatment. The group which was assigned creativity training was called experimental group and the group which was assigned to expository teaching method was called control group.

All the selected students were given scientific creativity test and concept map performance test termed as pre-test. All the control group students were taught the concept in conventional manner where as the experimental groups were taught with the help of creativity training program i.e. CoRT Thinking Lessons. In the end both the groups were given the post test.

**3.8.2 Experimentation**

The experimentation was conducted under three phases. In the first phase (introduction phase), the students of each of experimental and control group were provided orientation about concept mapping technique and administered Scientific creativity test and Concept map performance test. As concept mapping was a new technique for the students, that’s why orientation about concept mapping took some time to make them familiar with the fundamentals of concept mapping. After the administration of the test, the students were provided orientation and instructions about the treatment to be given to them. All the procedures followed took two weeks. The
purposes for giving such an orientation program was to get over the anxiety and curiosity of the students which may create hindrance to the final outcome of the results. It was thought that such an orientation will help in normalization of the students. The students were also made familiar with the objectives etc., so that they may not feel total novelty in the experimental set up.

In the second phase (treatment phase) of the experiment, each of the treatment group was taught with one particular method of teaching. In the experimental group, lesson plans prepared by investigator herself were taught. The investigator tried to encourage the students to write their ideas in the form of concept map as much as possible.

Each lesson plan was having a logical cluster of two- three thinking tools from CoRT Thinking Lessons e.g. thinking tools namely PMI, CAF and Rules were clustered together and taught in the class simultaneously. In this way total 10 lesson plans were developed. First three lesson plans were developed from CoRT- I having cluster of three thinking tools. Fourth lesson plan contained single tool as it was the last tool of CoRT I and could be taught independently. In the same way Fifth and sixth lesson plans were having cluster of two thinking tools in each from CoRT IV and seventh lesson plan was again having single thinking tool from CoRT IV and could be taught independently. Eighth and ninth lesson plans were having cluster of two thinking tools each from CoRT VI and tenth lesson plan was having single thinking tool as it could be taught independently. This was done because the thinking tools somehow were overlapping in their meaning and still were different from each other. It was also done to make it clear to the students that the tools somehow have the similar meaning, still these thinking tools differ from each other. The clustering of the tools was logical in the sense so as to make it differentiable, easy and understandable by the students.

All the students of the experimental groups were mentally prepared by giving preliminary briefing of each tool in the form of a story. This helped in introducing the specific thinking tool easily. The students were asked to listen carefully to what the investigator is telling about the thinking tool. The students were then given ‘situation’ (common to all students) so that the students might be able to understand a particular thinking tool. A ‘situation’ means example from the natural surrounding having any sort
of problem in it. For example for the thinking tool ‘APO’ the teacher may ask from the students about the possibilities for the ceiling fan that has stopped working by chance. The teacher gave one or two ideas by herself and then asked about the other possibilities from the students. In this way the students were told a part of the example and in other part they collectively have to give ideas about the solution to the problem in a particular situation by using the particular tool. As this process leads to a storm of ideas in the brains of students, this session could be considered as brain storming session. The students were advised to concentrate upon how to use a particular tool. The situations provided were based on the syllabus for that particular class in the subject of environmental science.

After this, the students were grouped having 4-5 students in each group. They were given two more ‘situations’ and were asked to discuss the ideas related to solution of problem collectively in their group and write the ideas in the worksheets provided to them. This session could be considered as buzz session as one student from each group was given the chance to stand and answer the problem given in a situation.

After this ‘What’ ‘When’ and ‘Why’ of the particular tool was discussed with the students. This step was called as ‘process’ because the main emphasis of the creativity training program i.e. CoRT Thinking Lessons was to tell about a specific tool and how and when to use it rather than to find out solution to a problem. After this the principles of the tool studied were discussed. This step was called as ‘principle’. This step was essential so as to make the students know that a specific tool can be used in a specific situation not in all situations. After that, they were given home assignment. The same procedure was followed in each lesson plan. The duration taken by one lesson plan to complete was three to five days. The lesson plan having three thinking tools together was developed in five days. The distribution of the days is as follows:

On first day introduction of the each tool was given in a story form. On second, third and fourth day single thinking tool from the same cluster was discussed by using different ‘situations’. On fifth day all the three tools were discussed together by using the same situations.
Same was done in the lesson plans where two thinking tools were clustered together. The duration taken by such lesson plan was three to four days almost. In this way experimentation lasted for about one and half month.

In case of control group, the students were taught the syllabus in expositional method. In the first phase, the students were explained the subject matter. All the pros and cons of the particular topic were detailed out. In the second phase, all the main points were written on the chalk board in the form of concept map. The students tried to explain every point collectively. In the third phase, students copied the same concept maps in their notebooks and were asked to prepare the concept map on their own without copying it from the earlier one. Later on, they were provided feedback about constructing a concept map.

The syllabus was taught in both the groups in parallel manner i.e. the topic which was developed in the experimental group with the help of creativity training program; same topic in control group was developed in expositional manner. The teaching in this manner was also continued for two month in each grade level separately and four months collectively.

The third phase was the evaluative phase. In this phase, students were evaluated for the achievement in the treatments. Both groups were administered scientific creativity test and concept map performance test. After one week, selected students from experimental group were interviewed for follow up.

Detailed description of the experimentation is given in the form of table 3.3 on the next page:
Table 3.3 Detailed description of experimentation

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Phase</th>
<th>Programs undertaken</th>
<th>DURATION</th>
<th>Exp. Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Phase-I (Introduction phase)</td>
<td>Orientation</td>
<td>40 minutes each for two weeks for concept mapping technique as well as creativity training program</td>
<td>General Orientation towards creativity training program and concept mapping</td>
<td>General Orientation Towards concept mapping.</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Pre-test</td>
<td>No time limit</td>
<td>administered concept map performance test and scientific creativity test</td>
<td>administered concept map performance test and scientific creativity test</td>
</tr>
<tr>
<td>3.</td>
<td>Phase-II (Treatment phase)</td>
<td>Creativity Training Program</td>
<td>40 minutes every day for one and half month</td>
<td>Situations were provided from the syllabus prescribed and told to think creatively for the ideas using creativity tool</td>
<td>Same syllabus was taught through expositional teaching</td>
</tr>
<tr>
<td>4.</td>
<td>Phase-III (Evaluation phase)</td>
<td>Post-test</td>
<td>No time limit</td>
<td>administered concept map performance test and scientific creativity test</td>
<td>administered concept map performance test and scientific creativity test</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Follow up</td>
<td>(after one week of experimentation)</td>
<td>Interview of six selected student from All group</td>
<td>------</td>
</tr>
</tbody>
</table>

3.9.0 Data Collection

In this study, the data was collected keeping in view the objectives of the study. The data to study the effectiveness of creativity training program was collected on two occasions. One was pre-test (before the treatment) called as occasion-I and the other after the treatment was called occasions-II. Scheduled Interview technique was also used to know the process that goes on in the mind of children during the exposure to creativity training program.

Occasion I: - The first occasion was the pre-test stage. Before the experiment was conducted, the students of each of the treatment groups were administered
concept map performance test and scientific creativity test. The scores of these tests were termed as pre-test scores.

Occasion II: - Immediately after the treatment the students were administered the same tests. The scores were termed as post-test scores.

3.10 Statistical Techniques Used

Keeping in view the objectives and design of the study, the following statistical techniques were employed to analyze the data. The techniques and the rationale for using these are given below:

1. The measures of central tendency and the measures of dispersion such as mean and standard deviations were worked out to know the nature of the data.

2. Multivariate analysis of variance was used to assess the data in order to find out the effect of different grade levels (IX & X), different groups (i.e. experimental and control), levels of intelligence (high, middle, low) and testing occasions (pre and post test) on concept mapping ability. The concept map performance test was employed and four way analysis of variance (2X2X3X2) factorial designs were used.

3. Multivariate analyses of variance were used to assess the data in order to find out the effect of different grade levels, different groups (i.e. experimental and control), levels of intelligence and testing occasions on different components of concept mapping i.e. propositions, hierarchy, cross links, examples.

4. Multivariate analysis of variance was used to assess the data in order to find out the effect of different grade levels (IX & X), different groups (i.e. experimental and control), levels of intelligence (high, middle, low) and testing occasions (pre and post test) on total scores of scientific creativity. In this way four way analysis of variance (2X2X3X2) factorial designs were used in case of scientific creativity.

5. Pearson’s product-moment correlation was calculated to find out correlation between scientific creativity and concept mapping performance of the students.

6. Qualitative analysis for conceptual richness scores was carried out on gain scores.

7. Whenever F-ratio was significant, it was interpreted through means scores.