CHAPTER III - DESIGN AND PROCEDURE OF THE STUDY

After formulating the problem theoretically and reviewing related literature, it is worked out empirically so that valid and reliable solution to the questions that the research poses can be obtained. Fred N. Kerlinger (1974) described “Research design as the plan, structure and Model of investigation conceived so as to obtain answers to research questions and control variance”. Design in any research project, provides a blue print of research to the investigator, it dictates the boundaries of project and helps in controlling the experimental and error variances of the problem under investigation. This necessitates in the first place to decide about the design of the study.

The present study is related with Concept Attainment Model (CAM) and Concept Mapping Model (CMM). The main aim was to know the comparative effectiveness of the Concept Attainment Model and Concept Mapping Model. The comparative effectiveness of the Concept Attainment Model and Concept Mapping Model was judged on the basis of achievement scores of the students which they secured on the achievement test.

The design of the study has been given in Table 3.1.

**TABLE 3.1.**

DESIGN OF THE STUDY

| 3.1.0. Mastery of model | 3.2.0. Studying the effectiveness of CAM. | And CMM |
3.1.1. Theoretical Understanding of CAM And CMM

3.1.2. Developing lesson plan

3.2.1. Design

3.2.2. Population

3.2.3. Sample

3.2.4. Tools

3.2.5. Treatment

3.2.6. Statistical Analysis

3.1.0. Mastery of model

In order to acquire mastery of the models the investigator had followed training strategy as developed by Bruce Joyce and Weil Marsha. This training strategy comprises of four components:

a) Describing and understanding the model
b) Viewing the model
c) Planning of lessons
d) Adopting the model
Out of these four components, fourth one was not included as apart of training taken by the investigator because it concerned with the reformulation of curriculum according to the model. The first three components of training strategy can be grouped into two main classes –

a) Theoretical understanding of CAM and CMM
b) Application of theory in practice

3.1.1 Theoretical understanding of CAM and CMM:

Prior to the actual preparation of lesson plans, the investigator had thoroughly read the theoretical part of the model.

Concept attainment model was designed by Bruce Joyce and Weil Marsha on the basis of the work of J. S. Bruner. It is meant for teaching different levels and types of concepts. The CAM facilitates the conceptual type of learning in contrast with rote learning. There are three variations of CAM, the first one is Reception CAM which is more direct in teaching students the elements of a concept. A second variation is the selection CAM which permits students to apply the conceptual activity more actively by using their own initiation and control. The third variation is unorganized CAM, where the learner transfers concept theory and attainment activity to a real life setting.

Bruner’s view about concept learning:

Bruner has described the processes by which people acquire concept on the basis of researcher in his book “a Study of Thinking”. All types of concept learning depend upon nature of concepts which Bruner has given as “Theory of concepts” and also described the thinking strategies used by learners in order to acquire concepts.

Theory of Concept –
Bruner sees any concept as having five elements-

a) Name  

b) Example (positive and negative)  

c) Attributes (essential and non essential)  

d) Attributes value  and  e) Rule  

Name –

The name is a term given to a category for example fruit, plant and chair are all name given to category.

Example –

The second element ‘example’ referred to instances of a given concept. These instances which posses a concept are called positive examples and others are called negative examples.

Attributes and Attribute Value –

Third and fourth elements of the theory of concept are attribute and attribute value. Attributes are the common characteristics that cause to place example in the same category.

Bruner differentiated attributes of the concept in the following types –

Those attributes are essential ones which play a role in distinguishing examples from non- examples. The attributes that are often associated with the concept but does not play a role in distinguishing example from non – example are called non- essential attributes.

The acceptable value range of an essential attribute of a concept is called attribute value. For example purple is out of the acceptable value range of color of ‘apple’. There are of course, certain concept whose attributes does not have arrange are called criterical attributes. If criterical attribute is missing from an object then the given object is an example of a different concept. These non-essential attributes in the examples which
creates difficulty in finding out the common essential attributes of concept Noisy Attributes.

Rule –

The sixth important element of a concept is a rule. It is a definition or a statement specifying the essential attribute of concept. A rule normally evolves at the end of the concept attainment process.

3.1 Objectives of CAM-

The CAM produces two types of effects, the instructional effects and nurturing effects. The major instructional objectives of CAM are –

a) to teach specific concept
b) to understand the nature of concept
c) to create awareness about thinking strategy and improve concept building strategies    d) to provide practice in inductive reasoning.

With abstract type of concept certain nurturing effects are also produced by the model. These are –

a) an awareness of alternative perspectives
b) a sensitivity to logical reasoning in communication and
c) tolerance of ambiguity.

TABLE 3.2
Syntax of CAM –

The syntax of this model describes the model in action, it describes the sequence of the activities (phases) which teachers have to do by using the model.

1. Phase one - Presentation of data and identification of concept
   It involves presenting data to the learner each unit of data is a separate example or non-example of the concept.

   The examples are presented in a pre-arranged order and labeled ‘Yes’ or ‘No’. The learners are informed that there is an idea or concept that all the positive examples have in common, learners are asked to compare and justify the attributes of the different example. Their task is to develop a hypothesis about the concept.

2. Phase two – Testing Attainment of Concept
   The students test their attainment of the concept first by correctly identifying additional unlabelled examples of the concept and their by generating their own examples.

3. Phase three – The Analysis of Thinking Strategies
   In this phase students begin to analyze the strategies by which they attain concept. The learners can describes their patterns, whether they focused on attribute or concept, whether they did so one at a time or several at once, and what happened when their hypothesis was not confirmed. Did they change strategy; gradually they can compare the effectiveness of different strategies.

Theoretical Understanding of CMM
According to Novak (1977), the concept mapping tactic is based on the premise that concepts do not exist in isolation but depend upon others for meaning.

Concept mapping technique was first developed to represent learners’ provisions and relevant knowledge and later on it was used to enhance meaningful learning. It represents concepts and their interrelationships graphically. In this technique, concepts are arranged hierarchically in a deductive manner. Broader concepts are placed at the top and less inclusive concepts at the bottom; the mere general ideas are presented first and are then followed by specific instances. Thus giving the whole structure the look of pyramid using various words and phrases as linkages, various concepts are linked. While using the concept mapping model the stress is mostly on linking various concepts are not only with one another but also with the previously acquired knowledge in a meaningful logical way.

**PHASES OF CONCEPT MAPPING MODEL**

Concept mapping as a model

Four well defined phases of Concept Mapping were evolved after rigorous discussions with experts in the subject and technique of drawing concept maps.

**PHASE I - PRESENTATION OF ABSTRACTION**

First, the students are presented with a definition or a generalization. Since a generalization arises from common characteristics of various concepts, the students are asked to identify various concepts and sub-concepts and to enlist them and they are asked to provide new and unique examples to judge their understanding of these concepts.
PHASES II: PROPOSITIONAL PHASE

The teacher guides the learners to arrange the concepts hierarchically in a deductive manner, with the broader concepts placed at the top followed by less inclusive concepts.

These various concepts are linked by lines and these lines are supplemented by words/phrases which indicate meaningful relationship among various concepts. Thus the whole concept map is viewed as a network of concepts.

3.1.2. Developing lesson plan

The investigator had taught ninth grade students through CAM and CMM. For this, the investigator had prepared CAM lesson plans exactly on the lines of lesson plan guide (LPG) available in the package prepared by Weil Marsha and Bruce Joyce (1978, 2000).

The topics for the lesson plans were selected from the ninth grade Biology book. A copy of lesson plan may be seen in Appendix.

3.2.0. Studying the effectiveness of CAM. And CMM

The present study intends to find out the effectiveness of CAM and CMM in terms of achievement scores of students of ninth grade level. For this purpose a simple post test parallel group design was employed. The three groups namely, the experimental groups and control group were formulated in such a way that the three groups belonged to three independent settings. In other words the experimental groups were picked up from two different
schools and the control group was picked up from the other school. The treatment was assigned randomly.

a) Experimental Group- These groups were given the treatment in the form of Concept Attainment Model and Concept Mapping by the investigator.

b) Control Group – This group was taught the same concepts by traditional method. In other words, this group was not given the treatment.

After the completion of the treatment the experimental groups and the control group were given achievement test.

3.2.1. Design

This design is being placed below diagrammatically –

\[ G_1 \quad X \quad O_1 \quad \text{Experimental Group 1} \]

\[ G_2 \quad X \quad O_2 \quad \text{Experimental Group 2} \]

\[ G_3 \quad X \quad O_3 \quad \text{Control Group} \]

Where
- \( X \) - Treatment
- \( O_1 \) - Post test observation of Experimental Group 1
- \( O_2 \) - Post test observation of Experimental Group 2
- \( O_3 \) - Post test observation of Control Group
- \( G_1, G_2 \) - Experimental Groups
- \( G_3 \) - Control Group
3.2.3. Population

The population of the study was Hindi medium students of ninth grade studying in average socio-economic schools of NOIDA during the session 2006-07.

While keeping the objectives of the study in mind, the researcher chose population on account of the following reasons –

a) This age group forms the foundation of the adolescent period. It heralds the new chapter of individual recognition in child’s life.

b) New methods of teaching are easily applicable to children possessing flexible attitudes.

3.2.4. Sample

The population for the present study represents students of Ninth grade of average schools of noida. Out of these schools, three schools were selected to form the sample. The selection of these schools was made on the basis of the judgment of the investigator e.g. investigator chose those schools which were among the well-established and available at the time of investigation. These schools were –

a) Gandhi Samarak Vidyalaya, Sector 22, Noida

b) Govt. Inter College, Sector 12, Noida

c) Chet Ram School, Sector 44, Noida

3.2.5. Tools Used in the Study

Tools Selected

The following tools were selected for the study –

a) Verbal Intelligence Test by R. K. Tandon

b) Socio- Economic status scale by Gyanendra P. Shrivastava
Tools Developed

The tool developed by the investigator for collecting the requisite data was -

Achievement Test for selected concepts of science (Biology)

Verbal Intelligence Test by R. K. Tandon

It is a group test of intelligence in verbal form. It is named as Samoohik Mansik Yogyata Parikcha (2/70). It is a group scale in omnibus form. It has a total of 91 questions employing seven types of subtests namely – Number series, Vocabulary opposites, Classifications, Best answers, Analogies and Reasoning. All the questions have been framed in selective type providing 4 or 5 alternatives to each. The questions are in simple Hindi to enable the children of Hindi speaking areas to answer them without being influenced by proficiency in language. Thus, it can be used on school going pupils of Hindi speaking areas of India of the age group 10 years to 16 years.

Two methods have been used to find out the reliability of the test, namely split half method and Kuder–Richardson formula number 20 in both the cases reliability coefficients comes to 0.93, which is very high and the test results should be relied upon.

The test items have been found to discriminate well between high and well scores further most of the items reveal positive high correlations with the total test scores. Thus the test seems to consist of homogenous items and can discriminate well between dull and bright children.

Socio- Economic Status Scale by Gyanendra P. Shrivastava

This scale is designed to measure socio-economic status of urban families. It is a verbal scale and can be administered individually as well as in group.

The scale consists of eight items. These includes education, occupation, income, cultural living and social participation of the parents. The
scale has been standardized on one thousand school and college students. Since the description pattern tends to approximate the Normal probability curve the concept of normality was reasonably employed for the purpose of Norm development. The distribution of sample range from -2.5 S.D. to +2.5 S.D. and it was divided in units taking 0.5 S.D. as the unit. Moreover, the variable of socio-economic status was divided into five categories. The total possible scores are 44 following the above method when standard score norms are converted into raw score (with the obtained Mean =20 and S.D. = 8). The following five categories are obtained for the purpose of classifying students-

<table>
<thead>
<tr>
<th>Raw Score</th>
<th>Categories</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 34 and above</td>
<td>Upper Class</td>
<td>Upper Class</td>
</tr>
<tr>
<td>2. 25 – 33</td>
<td>Upper Middle Class</td>
<td></td>
</tr>
<tr>
<td>3. 16 – 24</td>
<td>Lower Middle Class</td>
<td></td>
</tr>
<tr>
<td>4. 9 - 15</td>
<td>Lower Class</td>
<td>Lower Class</td>
</tr>
<tr>
<td>5. 6 and below</td>
<td>Lowest Lower Class</td>
<td></td>
</tr>
</tbody>
</table>

Achievement Test for Selected Concepts of Science (Biology)-

The investigator prepared (ATSCS) teacher made achievement test for the purpose of assessing achievement in Biology of ninth grade students. The test was based on the course content given in the NCERT text book of Biology for ninth grade. The medium of the test was Hindi.

Try Out of the Test

The draft of the test consisted of 160 items in which 60 were multiple choice types, 40 were true-false type, 40 were fill up the blanks type and 20 were one word answer type. It was tried out on a sample of 180 students of grade ninth of a school other than the schools selected for the experiment. Necessary instructions were given to the students. To obtain score of students, each correct answer was given one mark and wrong answer was given zero.
Item Analysis

Item analysis is an essential part of test construction. For this, responses of students about each item were analyzed. Each item is best described by two indices – difficulty value of item and discrimination index. For getting difficulty value, response of top 27% students and bottom 27% students was noted and arranged in descending order. Difficulty value and discrimination index for each item was calculated. Only those items were selected which were in the range of 30% to 70% for difficulty value and 25% to 75% for discrimination index. Selected items constituted final form of the test.

Final Form of the test

The final form of the test consisted of 80 items – 32 multiple choice, 19 fill up the blank, 15 true-false and 13 one word answer. The duration of the test was 2 hours. The language of test was reviewed thoroughly. The test was also discussed with the experts. The reliability and validity of the test was determined. A copy of the achievement test along with its blue print developed by the investigator may be seen in appendix.

Reliability

The reliability was measured by split half method, putting all the odd numbered test items into one half and all the even numbered test items into another half. Care was taken to put highly comparable items into two halves. Scores obtained on two halves were correlated and then correction was applied by Spearman Brown formula. The reliability of the test was test was found to be 0.87.

Validity
A test is valid when it measures what it purports to measure. Content validity of the test was assessed. Opinions of the experts from the Biology field, Biology teachers from three schools of Noida were pooled. Content validity was established in terms of consistency of test items with objectives and content.

3.2.6. Treatment

The various activities for each phase of the experiment are presented schematically in Table

The Schematic Presentation of Activities Undertaken During the Experiment
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Phase</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pre-Treatment</td>
<td>Following tests were administered in three groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a) Verbal intelligence test by R.K.Tandon</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b) Socio-Economic Status Scale by Gyanendra P. Shrivastava</td>
</tr>
<tr>
<td>2.</td>
<td>Treatment</td>
<td>The researcher taught the selected content of Biology to the ninth grade students using Concept Mapping Model to group $E_1$, Concept Attainment Model to $E_2$ and traditional method to control group</td>
</tr>
<tr>
<td>3.</td>
<td>Post-treatment</td>
<td>After the treatment Achievement test for selected science concepts (ATSCS) was administered</td>
</tr>
</tbody>
</table>

In order to equate groups $E_1$ and $E_2$ in pre treatment phase, verbal Intelligence Test by R.K.Tandon, Socio-economic Status Scale by Gyanendra P. Shrivastava were administered.

After equating both the groups teaching of groups commenced as in treatment phase. In the present study $E_1$ and $E_2$ groups were taught through Concept Mapping and Concept Attainment Model respectively. Both the groups were taught by the researcher herself. The content of Biology was identified for the experiment. Eighteen major concepts and sub concepts were analyzed and arranged in proper sequence. These concepts and sub concepts are listed in Table

Table - Concepts and sub concepts of Biology taught to $E_1$ and $E_2$
The next step was the preparation of lesson plan based on the Concept Mapping Model and the Concept Attainment Model. For the group E1, lesson plans based on Concept Mapping Model were developed. Steps for preparing lesson plans as given by Joyce and Weil were followed. A copy of one lesson

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Concept</th>
<th>Sub concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cell</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Prokaryotes</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Eukaryotes</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Cell Organelles</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>Mitochondria</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>Golgi bodies</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Nucleus</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>Chromosomes</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Mitosis</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>Meiosis</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Blood</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>Blood Groups</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Photosynthesis</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>Bacteria</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>Plastids</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Infectious Diseases</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>Vitamins</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>Enzymes</td>
<td></td>
</tr>
</tbody>
</table>
plan based on Concept Mapping Model may be seen in Appendix. For the second group E₂ lesson plan based on Concept Attainment Model were developed. Lesson Plan Guide for the Concept Attainment Model as suggested by Weil and Joyce was followed. A copy of one lesson plan based on Concept Attainment Model may be seen in Appendix.

The researcher taught group E₁ through Concept Mapping Model and group E₂ through Concept Attainment Model in Govt. Inter College, NOIDA and Gandhi Samarak School, NOIDA respectively. Achievement Test for Selected Concepts of Science (Biology) was administered to both the groups E₁ and E₂ after the completion of treatment to assess the understanding about the Models.

3.2.7. Statistical Analysis

Statistic has become indispensable tool for research. It is fundamental to the proper analysis of data investigation of a complex phenomenon.

Statistical Analysis was used for achieving the following objectives of the study to find out the effect of Concept Mapping Model and Concept Attainment Model on pupils achievement in science (Biology). To fulfill the above objectives, the main statistical techniques employed are briefly described below-

‘t’ test-

The effectiveness of Concept Mapping Model and Concept Attainment Model was studied by calculating the significance of difference between the mean scores of achievement test, administered on the experimental groups and control group. This test has been defined in terms of the following formula –

\[
t = \frac{M_1 - M_2}{SE_0}\]
SE_D = \frac{SD}{\sqrt{N_1 \cdot N_2}}

E (X_1 - M_1) + E (X_2 - M_2)

SD = \frac{SE_D}{N_1 - 1} + \frac{SE_D}{N_2 - 1}

Where

M_1 = \text{The mean of group –I}

M_2 = \text{The mean of group –II}

E (X_1 - M_1) = X_1^2 \text{ is the sum of the square deviation around the mean of group –I}

E (X_2 - M_2) = X_2^2 \text{ is the sum of the square deviation around the mean of group –II}