CHAPTER V

SUMMARY

5.0 INTRODUCTION

"Education is the process of living through a continuous reconstruction of experiences. It is the development of all those capacities in the individual which will enable him to control his environment and fulfill his potentialities." (John Dewey, 1950). In the words of Redden (1954) "Education is the deliberate and systematic influence, exerted by the mature person upon the immature through instruction, discipline and harmonious development of physical, intellectual, aesthetic, social and spiritual powers of the human being, according to individual and social need and directed towards the union of educant with his creator as the final end."

Everyone is born as a member of community that exists with some of its members being unaware of its organization or purpose. It is the impact of education that brings out the development of social consciousness. It is this consciousness that makes members of a community into potential members of a society that is united by common set of aims and values. In order to achieve these aims & values education plays a double role. It attempts to develop personality of educant and then prepares him/her for membership of the society. Thus education plays dual role of individual personality development and that of adjusting individual to human environment which is dynamic in nature. The process of imparting of education to young member of a community has been mostly through a system of formal education and
school is its modern incarnation. In school or in formal education emphasis is laid on teaching and learning.

The relationship of teaching and learning is an aid to understand the nature of theories of teaching. Recent work of Piaget, Bruner and Ausubel has also made significant contribution in the field. Gage (1963) explained that the relative neglect of theories of teaching has probably taken place because it may be in the minds of researchers that if there are satisfactory theories of learning, then the teacher can act upon these theories without developing a separate theory of teaching. Teaching is thus viewed as mirror image of learning. And now it is conceptualized that there is difference between the process of teaching and learning. Gage (1972) made a distinction between the process of learning and the process of teaching. He mentioned that theories of learning deal with the ways in which an organism learns while theories of teaching deal with the ways in which a person influences an organism to learn. Bruner (1966) also explained the distinction between theories of learning and theories of teaching. He mentioned that theories of learning and development are descriptive in nature. A theory of teaching, on the other hand is prescriptive. It is prescriptive in the sense that it sets forth the rules concerning the most effective ways of helping children to achieve knowledge and skills.

The researchers are yet to evolve a theory that encompasses all the above acts of teaching. In the absence of theories of teaching teacher behavior and teaching style are guided by a number of teaching strategies. According to I.K.Davis "Strategies are broad methods of teaching". Teaching
strategy is a skillful planning of a working system by which objective can be achieved conveniently. Strategies are never the same. They change according to changing situations. Teaching strategies have been regarded as broad ways of instruction. Pupils with multi-dimensional personality have different learning styles. Hence an effective teacher should be able to adopt different strategies of teaching keeping the objectives of teaching, pupils learning style and their personality dimension in mind. With the help of learning theories, an effective teacher should create rich and interactive environment for students. This lead to variety of approaches to design instructions along with teaching learning situation to achieve specific instructional objectives. The functional and structural guidelines to design instructional material and environment came forward as Models of Teaching.

Models of teaching are prescriptive teaching strategies. Teaching strategies can be Teaching Models. Models of teaching differ from general teaching strategies as they are designed to reach specific goals. When a teacher sets goal and adopts a particular strategy in order to achieve educational objectives, here we can say that the teacher is using model approach. Model approach to teaching was developed by Joyce Bruce and Weil (1972). The concept of 'Models of Teaching' seeks to systematically expose the interaction among educational purposes, pedagogical strategies, particular designs and materials.

A teaching Model can be considered as a type of blue print for teaching. They differ from general approaches of teaching in that they are designed to realize specific instructional objectives (Eggen et al. 1979).
General approaches of teaching are considered to be applicable to all teaching situations. However, models of teaching are not applicable to all situations. A model of teaching, according to Joyce and Weil (1980) "is a plan or pattern of teaching that can be used to shape curricula, to design instructional materials and to guide instructions in classroom and other settings." These models are based on practice, empirical work, theories of learning and speculations about the meaning of theories and researches done by others.

Joyce and Weil (1997) have identified twenty-four models of teaching, which are classified into four families - Information Processing Models, Personal Models, Social Interaction Models and Behavior Modification Models.

Information Processing Models based on the ways people handle stimuli from the environment, organize data, sense problems etc. The goals of information processing models are to help individuals to acquire knowledge through an analysis of data from the world around us. They aim at intellectual growth of the individual. These models are - Inductive Thinking Model, Inquiry training Model, Concept Attainment Model, Cognitive Growth Model, Biological Science Inquiry Model, Advance Organizer Model, Memory and Group Investigation.

Social Interaction Models emphasize on the development of capabilities for interpersonal relationships. They lay stress on the development of skills which help individuals to engage in democratic processes, The Models of teaching in this category are - Social Inquiry, Laboratory Model, Jurisprudential Inquiry Model, Role Playing and Social Simulation.
The goals of personal models are to develop the capacity for personal development in terms of creativity, self-concept, self understanding, and creative problem solving. These models are- Synectics, Awareness Training, Nondirective teaching, Conceptual systems etc.

Behavioral Modification Models have evolved from endeavours of researchers to develop efficient system for sequencing learning tasks and shaping behaviors by manipulating reinforcement. Exponents of reinforcement theory, such as Skinner (1957) have developed these models and operant conditioning as central mechanism. The Models of this family are - Stress reduction, Assertive Training, Desensitization, Relaxation, Self control, Contingency Management etc.

Seven Models of teaching have been grouped under Information Processing Models. Each has a distinct goal. According to Joyce Weil and Bruce Marsha (1980), each model of teaching consists of the following fundamental elements -

1. Focus - Focus is the central aspect of a teaching model. For what the model stands is the theme of the focus. All of the teaching models are meant for achieving some specific goal or objectives 2. Syntax - The term syntax or facing of the model refers to the description of the model in action. Each model consists of several phases and activities which have to be arranged in a specified sequence quite unique to a particular model. The syntax helps the teacher to use the model. It tells him how he should begin and proceed further.
3. Principles of Reaction - While using the model how should a teacher regard and respond to the activities of the students is a concern of the element. These responses should be quite appropriate and selected. Every model through its principles of reaction provide the teacher with particular and unique rules of thumb by which "tune in" the student and select appropriate responses to what the student does (Weil & Joyce, 1978).

4. Social System - The fourth element refers to a description of the following - of teaching in relation to the environment of the learner. Therefore, objectives of teaching and aspects of environment generally constitute the focus of the model.

A. Interactive roles and relationships between the teacher and students.

B. The kinds of norms that are encouraged and student behaviour which is rewarded.

Models differ from each other with regard to the description of the above mentioned aspects. In some models, the teacher is the centre of activity or activities are somewhat equally distributed between teacher and students while in others the students (A few or the whole group) occupy the central place. The leadership role of the teacher comprising the location of authority and the amount of control over that emerges from the process of interaction also varies from model to model. Similarly the way in which student's behaviour is rewarded also differs from model to model.

5. The Support System - This element of model refers to the additional requirements beyond the usual human skills or capacities from the
teachers and the facilities or schedules available in an ordinary class room. Such type of additional support may demand some special skills, knowledge and capacity from the teacher or some special aid material facilities like films, self instructional system, visit to some place, a flexible schedule and a particular organizational climate suiting to the requirements of a particular model. It is needless to emphasize that the support system of a model contributes towards the success of a model by generating a desirable class room environment.

6. Application - The last element of a model describes its application aspect. Some models are meant for short lessons, some for the large and some for both. They also differ in terms of the goal achievements - conative, cognitive or affective - and subsequently prove suitable for one or the other type of teaching. Therefore each model through its element of application context tries to describe the feasibility of its use in varying context achieving specific educational goals and demanding specific work environment.

The effectiveness of Models in Concept learning process has been established time and again. Through education, pupils must be prepared to face the challenges and to keep pace with the advancement of science and technology. Generally, pupils memorize the content and reproduce the same to pass the examination. In such an environment creative thinking interest in inquiry activities and other skills for example problem solving skills, co operativeskills can not be developed among them. To motivate students to learn and to develop skills like mentioned above Concept Attainment Model is
the right model to choose. Concept Attainment Model of teaching provides scientific knowledge as well as inculcates enquiry skills. Therefore researcher had planned to study the effectiveness of Concept Attainment Model in teaching of Biology. To give an organized body of content in a meaningful way, keeping in mind the cognitive map of the learner simple ideas are presented first to the students followed by complex ideas and join them in hierarchical manner so that proper learning can take place in sequential and integrated manner. In this way, habit of precise thinking and interest in enquiry can be developed among the learners. The researcher selected Concept Mapping Model to test its effectiveness in teaching of Biology. Both the models have long term effects e.g. interest in inquiry are common researcher has planned to study the relative effectiveness of Concept Mapping Model and Concept Attainment Model in the class room situation. Various investigators have studied the effectiveness of Concept Attainment Model in the different subjects outside India. Feldman Jacob (2003), Carlson Johnson, Kastl R. (1992), Danielle (1991), Klausmeir (1992). In India the effect of Concept Attainment Model Advance Organizer Model and traditional method on conceptual learning efficiency and retension in relations to divergent thinking was investigated by Jaimini (1990). Naresh (1995) studied the effectiveness of Concept Attainment Model and compare it with Inquiry Training Model. There is hardly any study seen in which the relative effectiveness of Concept Mapping Model and Concept Attainment Model has been studied.
The views of Novak and Gowin (1984) and Jerome Bruner should be studied to appreciate the difference between Concept Mapping Model & Concept Attainment Model. Novak and Gowin (1984) developed the Model of meaningful verbal learning i.e. Concept Mapping. In this concepts are arranged hierarchically in a deductive manner with the broader concepts placed at the top followed by the less inclusive concepts to facilitate meaningful learning. Jerome Bruner and his associates (1980) developed Concept Attainment Model. It is an approach of teaching based on thinking process used by learner to learn concepts.

5.1 Concept Mapping Model

It is found that Concept Mapping Model is a learning Model that facilitates meaningful Learning. That learning is said to be meaningful which enables the learner to relate the newly acquired knowledge with the previously learnt knowledge. It enables the learner to apply the new knowledge to other situations. It helps the pupils to retain the concepts for a long time. It is found that students who employ meaningful learning can retain knowledge for a long span of time than the students who learn by rote. Meaningful learning depends upon how the learning material is organized and how it is processed by mind. On the other hand, rote learning takes place when new knowledge is arbitrarily incorporated into the cognitive structure. It is seen that the students who learn by rate are able to recall the new information but they can't apply it in other situations.

5.2 Concept Attainment 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.

5.3 Need of the study

Through education, pupils must be prepared to keep pace with the advancement of science and technology as existing traditional method of teaching doesn't develop creative thinking, interest inquiry activities among pupils. Looking into the practical situation, the researcher felt that there is need to use such a teaching model, which can motivate students to learn. Concept Attainment Model lays stress on understanding concept. Through this model independent thinking, interest inquiry, problem solving skill can be developed among students, which is the dire need of the present. Concept Mapping Model is a novel teaching model, which lays stress on arranging the concept in a deductive manner. Through this model interest in inquiry, problem-solving skill can be developed among the pupils. Since some long term effects of both the models, for example interest in inquiry related to concept, are common. Researcher has planned to study the relative
effectiveness of Concept Mapping Model and Concept Attainment Model in classroom situation.

5.4 Rationale of the study

Educational institutions play an important role in the all around development of the students. Striving for academic excellence is the dire need of every pupil today. To meet this need we should improve our teaching strategies. Various models like Advance Organizer Model, Biological Science Inquiry Model, Concept Attainment Model, Concept Mapping Model affect the achievement of the students. Out of these Concept Mapping Model and Concept Attainment Model affect adversely the academic achievement of students in Biology. The models in the present study develop creative thinking, interest in inquiry activities among pupils and the effect will be seen on adolescents, the age of stress, strain and full of energy. Researcher felt that for giving proper direction to their energy Concept Mapping Model and Concept Attainment Model was used for teaching of Biology. Through these models problem solving skill, independent thinking can be developed. Keeping the time limit and resources limitations are in mind the researcher choose the students of ninth grade.

5.5 The Problem

The statement of a problem was a study of

"EFFECTIVENESS OF CONCEPT MAPPING MODEL AND CONCEPT ATTAINMENT MODEL IN BIOLOGY TEACHING AT NINTH GRADE"

5.6 Definition of key terms
The following key terms have been used in the problem

**Effectiveness** - It refers to the effect of particular treatment given to learners which produces a significant change in pupils' behavior in terms of their achievement.

**Concept Mapping Model** - Concept mapping model is a learning model that facilitates learning. As this study compares the relative effectiveness of Concept Mapping Model, Concept Attainment Model, there is need to evolve well defined phases, so as to bring the same functional and operational level.

Four well defined phases of Concept Mapping were evolved after rigorous discussions with experts in the subject and technique of drawing concept maps. These are Presentation of Abstraction, Prepositional Phase, Application, and Closure

**Concept Attainment Model** - Concept Attainment Model of teaching based on thinking process used by individual to learn concepts. In the present study, the investigator tries to explore the effectiveness of the Concept Attainment Model developed by Bruner. The model is found challenging, because it promoting high level of interaction between students and teacher. It develops among students the thinking skills like observation, comparing, generalization. This Model has the following phases- Presentation of data and identification of concept, testing Attainment of Concept, and the Analysis of Thinking Strategies.

**5.7 Objectives of the study**
1. To study the effectiveness of Concept Mapping Model in terms of meaningful acquisition of concepts.

2. To study the relative effectiveness of Concept Mapping Model and Traditional Method.

3. To study the effectiveness of Concept Attainment Model in terms of meaningful acquisition of concepts.

4. To study the relative effectiveness of Concept Attainment Model in comparison to Traditional Method.

5. To study the relative effectiveness of Concept Mapping and Concept Attainment Model in comparison to Traditional Method.

5.8 Hypotheses

The following hypotheses will be formulated -

H01 - There is no significant difference between achievement scores of pupils' taught through Concept Mapping Model and taught through Traditional method.

H02 - There is no significant difference between achievement scores of pupils' taught through Concept Attainment Model and taught through Traditional method.

H03 - There is no significant difference between achievement scores of pupils' taught through Concept Mapping Model and taught through Concept Attainment Model.

5.9 Delimitations of the study
Keeping in view the constraints of time and resources, certain delimitations need to be imposed for conducting the study. Following were the delimitations of the present study:

1. The study was delimited to the subject of Biology.
2. The experiment was limited to eighteen concepts in Biology.
3. The experiment was conducted on Ninth Grade students only, age group is 12-16 years old.
4. The study was confined to Concept Attainment Model and Concept Mapping Model only.
5. Only Achievement test was selected as criteria of effectiveness of Model.
6. The experiment was carried out only in the schools of NOIDA.

5.10 Design

After selecting the research problem and formulating the hypotheses, reviewing related literature, it was worked out empirically so that valid and reliable solution to the questions that the research poses can be obtained.

The present study was related with Concept Mapping Model (CMM) and Concept Attainment Model (CAM). The main aim was to compare relative effectiveness of the Concept Mapping Model. And Concept Attainment 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. For this three groups were made, two experimental groups and one control group.
a) **Experimental Groups** - These groups were given the treatment separately in the form of Concept Mapping Model and Concept Attainment Model 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.

keeping the objectives of the study in mind , the researcher chose Quasi - Experimental design The Experimental group I (G1) was given treatment according to Concept Mapping Model, Experimental group II ( G2) was given treatment according to Concept Attainment Model and the third group was given traditional treatment . The design of the study was followed -

<table>
<thead>
<tr>
<th>Groups</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group 1 (G₁)</td>
<td>O₁</td>
</tr>
<tr>
<td>Experimental Group 2 (G₂)</td>
<td>O₂</td>
</tr>
<tr>
<td>Control Group (G₃)</td>
<td>O</td>
</tr>
</tbody>
</table>

**Where**

- \(O₁\) - Post test observation of Experimental Group 1
- \(O₂\) - Post test observation of Experimental Group 2
- \(O\) - Post test observation of Control Group
- \(G₁, G₂\) - Experimental Groups
$G_3$ - Control Group

t-test - $O_1 - O$ (i)

$O_2 - O$ (ii)

$O_1 - O_2$ (iii)

5.10.1. 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.

c) Age group is round 12 to 14 years old.

5.10.02 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

5.10.3 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

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

Achievement Test for selected concepts of science (Biology)

5.10.4 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></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| 1. | **Pre-treatment** | Following tests were administered  
a) Verbal intelligence test by R.K.Tandon  
b) Socio-Economic Status Scale by Gyanendra P. Shrivastava |
| 2. | **Treatment** | 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  
After the treatment, Following test was administered in three groups  
c) Achievement test for selected science concepts (ATSCS) was administered |
| 3. | **Post-treatment** |  |

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 Model and Concept Attainment Model respectively. Both the groups were taught by the researcher herself. The eighteen concepts of Biology were identified for the experiment.
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Concepts</th>
<th>Sub-concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cell</td>
<td>i) Discovery of cell</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Types of cell</td>
</tr>
<tr>
<td>2</td>
<td>Prokaryotes</td>
<td>i) Characteristics of Prokaryotic cell</td>
</tr>
<tr>
<td>3.</td>
<td>Eukaryotes</td>
<td>i) Characteristics of Eukaryotic cell</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Difference between Prokaryotic &amp; Eukaryotic cell</td>
</tr>
<tr>
<td>4.</td>
<td>Cell Organelles</td>
<td>i) Parts of a cell</td>
</tr>
<tr>
<td>5.</td>
<td>Mitochondria</td>
<td>i) Structure of Mitochondria</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Functions of Mitochondria</td>
</tr>
<tr>
<td>6.</td>
<td>Golgi bodies</td>
<td>i) Structure of Golgi bodies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Functions of Golgi bodies</td>
</tr>
<tr>
<td>7.</td>
<td>Nucleus</td>
<td>i) Structure of Nucleus</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Functions of Nucleus</td>
</tr>
<tr>
<td>8.</td>
<td>Chromosomes</td>
<td>i) Structure of Chromosomes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Functions of Chromosomes</td>
</tr>
<tr>
<td>9.</td>
<td>Mitosis</td>
<td>i) Phases of Mitosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Importance of Mitosis</td>
</tr>
<tr>
<td>10.</td>
<td>Meiosis</td>
<td>i) Phases of Meiosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Importance of Meiosis</td>
</tr>
<tr>
<td>11.</td>
<td>Blood</td>
<td>i) Blood corpuscles</td>
</tr>
<tr>
<td>12.</td>
<td>Blood Groups</td>
<td>i) Types of Blood Groups</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Blood Transfusion</td>
</tr>
<tr>
<td>13.</td>
<td>Photosynthesis</td>
<td>i) Definition of Photosynthesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ii) Mechanism of Photosynthesis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>iii) Factors affecting Photosynthesis</td>
</tr>
</tbody>
</table>
Table - Concepts and sub-concepts taught to Group

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
| 14. | Bacteria | i) Characters of Bacteria  
  ii) Classification of Bacteria  
  iii) Functions of Bacteria |
| 15. | Plastids | i) Types of Plastids  
  ii) Functions of Plastids  
  i) Diseases caused by Bacteria |
| 16. | Infectious Diseases | ii) Diseases caused by Virus  
  iii) Diseases caused by Protozoa |
| 17. | Vitamins | i) Fat-soluble vitamins  
  ii) Water-soluble vitamins |
| 18. | Enzymes | i) Enzymes |

5.10.5 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 objectives of the study that is to find out the effectiveness of Concept Mapping Model and Concept Attainment Model on pupils achievement in Biology. To fulfill the above objectives, the main statistical techniques employed were 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 –

\[
\frac{M_1 - M_2}{S_{ED}} = \frac{t}{SE_D}
\]

Where

- \(M_1\) = The mean of group – I
- \(M_2\) = The mean of group – II

\[E( X_1 - M_1)^2 = X_1^2 \text{ is the sum of the square deviation around the}\]
5.11 Analysis and Interpretation

In the scheme of this study, pupils’ achievement in Biology is the first outcome variable. This has been studied here focusing on the following objectives:

1. To compare the mean scores, on criterion achievement test in Biology, of the two groups of pupils – Experimental group I and control group

2. To compare the mean scores, on criterion achievement test in Biology, of the two groups of pupils – Experimental group II and control group

3. To compare the mean scores, on criterion achievement test in Biology, of the two groups of pupils – Experimental group I and Experimental group II

The three groups have been compared using ‘t’ test. For this purpose, the Tables provide the mean, standard deviation and ‘t’ values in respect of scores on criterion achievement test of experimental and control groups of pupils. ‘t’ test has been applied to test the significance of difference between the means of (i) experimental group I and control group (ii) experimental group II.
group II and control group (iii) experimental group I and experimental
group II. These have been discussed below:

Table
CONCEPT MAPPING MODEL AND TRADITIONAL METHOD

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>S.D.</th>
<th>Degree of freedom</th>
<th>‘t’value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Group I</td>
<td>85</td>
<td>66</td>
<td>11.35</td>
<td>(85 +85) -2 =</td>
<td>23.36</td>
</tr>
<tr>
<td>Control Group</td>
<td>85</td>
<td>24.645</td>
<td>11.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the above Table it may be observed that the ‘t’ value of 23.36
for the difference in mean achievement scores, of the pupils of experimental
group I and control group, is significant at 0.01 level. The table also reveals
that the mean score of 66 of the pupils of experimental group I is higher
than the mean score of the control group which is 24.645. This indicates
that achievement in biology of the pupils of experimental group I is higher than that of the control group after the treatment.
### Table

<table>
<thead>
<tr>
<th>Group freedom</th>
<th>N</th>
<th>M</th>
<th>S.D.</th>
<th>Degree of freedom</th>
<th>'t' value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>90</td>
<td>52.0178</td>
<td>11.26</td>
<td>( 90 +85) -2 = 15.91</td>
<td>I</td>
</tr>
<tr>
<td>Control Group</td>
<td>85</td>
<td>24.645</td>
<td>11.46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From the above Table it may be observed that the 't' value of 15.91 for the difference in mean achievement scores, of the pupils of experimental group II and control group, is significant at 0.01 level. It may also be observed from the table that the mean score of 52.0178 of the pupils of experimental group II is higher than the mean score of the control group which is 24.645. This indicates that achievement in biology of the pupils of experimental group II is higher than that of the control group after the treatment.
## COMPARISON BETWEEN CONCEPT MAPPING MODEL AND CONCEPT ATTAINMENT MODEL

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>M</th>
<th>S.D.</th>
<th>Degree of freedom</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Experimental</strong></td>
<td>85</td>
<td>66</td>
<td>11.35</td>
<td>(90 + 85) - 2 =</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.18</td>
</tr>
<tr>
<td>Group I</td>
<td>90</td>
<td>52.0178</td>
<td>11.26</td>
<td>173</td>
</tr>
<tr>
<td>significant at</td>
<td></td>
<td></td>
<td></td>
<td>0.01 and 0.05</td>
</tr>
<tr>
<td>Group II</td>
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From the above Table it may be observed that the 't' value of 8.18 for the difference in mean achievement scores, of the pupils of experimental group I and experimental group II, is significant at 0.01 level. It may also be observed from the table that the mean score of 66 of the pupils of experimental group I is higher than the mean score of the experimental group II which is 52.0178. This indicates that achievement in biology of the pupils of experimental group I is higher than that of the experimental group II after the treatment.

**5.12 conclusion**
The results obtained from the above tables indicate that the mean score on achievement in Biology of the pupils of:

i) Experimental group I is significantly higher than that of control group

ii) Experimental group II is significantly higher than that of control group

iii) Experimental group I is significantly higher than that of experimental group II

On the basis of the results obtained from the analysis of the data and the interpretation of the results done numerically, related to pupils’ achievement in Biology, the following hypotheses of the present study were rejected:

H₀₁ There will be no significant difference between achievement scores of pupils’ taught through Concept Mapping Model and Traditional Method

H₀₂ There will be no significant difference between achievement scores of pupils’ taught through Concept Attainment Model and Traditional Method

H₀₃ There will be no significant difference between achievement scores of pupils’ taught through Concept Mapping Model and Concept Attainment Model

Thus it may be concluded on the basis of this study and studies conducted by other researchers, both in India and abroad, that Concept Mapping Model and Concept Attainment Model are effective in raising pupils’ achievement. It shows that pupils who learn through Concept Mapping Model
and Concept Attainment Model learn better than those who learn through Traditional Method.

5.13 Educational Implications

The results and conclusions arrived at during the course of this study clearly underline the effectiveness of Concept Mapping Model and Concept Attainment Model in raising the students cognitive achievements. These findings have a number of important implications for teachers, teacher educators, curriculum makers and planners and for the society by and large.

1. The first finding of the present study imply that the students taught through Concept Mapping Model and Concept Attainment Model achieve significantly higher than the student taught through Traditional Method. One of the major implications of the finding that equality of learning outcome can be a goal of education rather than equality of opportunity. In order to achieve this goal of education, it becomes imperative for the teacher to address himself to the requirement of each student and help him when he needs it.

2. Concept Mapping Model involves certain steps which have to be followed for obtaining the optimum results. This suggests that teachers need to be trained in Concept Mapping procedures so that they may employ the model efficiently to achieve the goal of maximizing student’s cognitive outcome. Since Concept Mapping Model is geared to tackle sensitively and systematically the needs of the students, it necessitates the use of resources and time in accordance with the student’s requirements. This in turn underlines the significance of the
role of teacher in organizing the classes. An efficient organization of classes can not be possible unless a teacher is allowed some degree of freedom.

3. Since Concept Mapping is significant, the role of the teacher can not be under estimated if it is to be used effectively in actual class room conditions. It, therefore, becomes essential that the teacher educators should incorporate the theoretical and practical aspects of this model in teacher training courses at all levels. This will impart the skills, abilities and knowledge related to Concept Mapping Model to the prospective teachers. But in order to make it an integral part of teaching methods widely used in our schools, it is necessary that it would also be incorporated in in-service training programmes for teachers.

4. Even after providing necessary training to teachers in the use of Concept Mapping Model and allowing them some freedom in organizing their classes and resources, it is near impracticable ideal to expect teachers to prepare and provide all the necessary material to the students. It is, therefore, necessary that curriculum developers should prepare packages of instructional material, which may be used by teachers in their actual working conditions with minor adaptations if necessary.

5. To enhance the effectiveness of teaching, planners and makers of curriculum should provide details and practicable guidelines to the teachers regarding the selection and use of material to suit the
requirements of their students. Concept Mapping Model envisages teaching of learning units in hierarchical order. A student equipped with the pre requisites learns the learning unit more efficiently and in a shorter period. This implies that courses should be constructed keeping in view hierarchical relationships in the units to be taught.

6. The results of this study, in conjunction with those of other researches conducted in India, indicate that Concept Mapping Model if adapted suitably to Indian conditions can offer answers to many of the problems and challenges besetting our educational scene. Concept Mapping Model emphasizes raising the achievements of students by a sensitive and systematic response to the needs and difficulties of each student. This introduces the element of personal fear and instruction in this method of teaching. The increase in student achievement cultivates in him a sense of confidence and of desire to learn more. This can prove very effective in controlling and even reducing the rate of drop outs in our schools.

7. The findings of this study suggest that a sizeable number of learners can be brought to the high level of achievement in any area of learning if suitable conditions are provided to the learner. It implies that to meet the requirements of our society in modern times of rapid development in Science and people with special talents, abilities and skills can be provided by our educational institutions if Concept Mapping Model is used extensively and efficiently at different levels on instructions. It must be geared to develop the education system
relatively early and to educate such talents in a systematic way over relatively long periods of time.

8. Concept Mapping Model can prove relevant and effective in tackling some of the other socio-economic problems affecting our society. Any observer of Indian educational system and society can easily notice the gaps which exist in the quality of education being imparted to the pupils of the upper class and to those coming from the lower strata of our society. Students coming from the educated and well off families get intensive and efficient coaching even outside the class. But those students whose parents can not afford expensive schools for extra private coaching for their children find themselves at a disadvantageous position. These gaps in the quality of education tend to perpetuate the social and economic disparities. Since Concept Mapping Model holds out the promise of developing the cognitive outcomes of our vast majority of students within the class room facilities, it can bring the students of socially and economically backward section to the level of achievement where they can compete with the boys and girls of the more fortune sections of our society.

9. Concept Attainment Model has an important role in bringing about enrichment in teaching process; it could serve as instructional approach to manage the class room activities according to the pre disposition of the learners in order to achieve a variety of educational objectives.
10. Concept Attainment Model is aimed at teaching skills of arriving at generalizations through meaningful processing of large and fragmentary data. During the course of using this Model, the learner develops inferential hypothesizing skills also. Concept Attainment Model has a varying degree of structure depending upon the initiative and control of the teacher during various phases of the model. Every phase of the Model is initiated with questions posed by the teacher to direct the student’s attention to certain specific aspects of the data and undertake various mental activities. The class room environment becomes more cooperative. The students are encouraged by the teacher in active responsiveness.

5.14 Suggestions for further research

In this age of unprecedented development complexity and competition, the role of education has assumed a central crucial significance all over the world. It is, therefore, not only desirable but absolutely necessary to find and develop ways and means to make our educational system fully responsive to the emerging needs of today. The present study has been a modest attempt at testing the effectiveness of Concept Mapping model and Concept Attainment Model in coping with pressures and challenges being confronted in our country. This study, however, does not pretend to offer the final word on the effectiveness of Concept Mapping Model and Concept Attainment Model. In order to supplement the outcomes of the present endeavour, more research related to Concept Mapping Model and Concept Attainment Model are
warranted so as to develop a body of vital knowledge of how to optimize students learning.

1. The present study was confined to an experiment treatment of twenty days only. It is therefore reasonable to avoid wide and sweeping generalizations about its outcomes particularly the long term consequences of Concept Mapping Model and Concept Attainment Model. Hence, detailed longitudinal studies that follow students and teachers over a period of several years, particularly through continued applications of Concept Mapping procedures are required in order to arrive at still more reliable and precise results of this model.

2. Another area for potential research is provided by the effect of using Concept Mapping Model on the teacher and his role in the class. Since Concept Mapping Model involves a measure or a personal interaction between the teacher and the taught, it makes the teacher more observant, innovative and responsive to the needs of each student. The results obtained also affect the attitude towards the commitment to the profession. An examination of the various effects of Concept Mapping Model on teacher role and on interpersonal relations of students can thus provide new insights into the outcomes of Concept Mapping Model.

3. The present endeavor has remained confined only to ninth grade students. It may be rewarding to examine the effects of Concept Mapping Model on students of other grade also. It can provide useful
information above the level of effectiveness of Concept Learning with students of different grades and age groups.

4. Different socio-economic and cultural backgrounds have a casual relationship with student’s achievements. Since the present study was conducted on sample taken from schools of NOIDA, studies are warranted in rural areas, urban slums and of students of schedule caste and schedule tribes. Such studies can provide useful information about how to make Concept Mapping Model more efficient in the conditions under which students of socially, economically and culturally backward sections of our society have to work. Mapping classes learnt faster than their peers. A research aimed at finding out how their extra time in the class can be best utilized can offer suggestions to make Concept Mapping Model more effective.

5. Concept learning can offer an effective instructional procedure to head students needing special care and attention. In this context, emotionally disturbed habitual trend mentally retarded and physically and visually handicapped students and their problems offering challenging and fruitful area of research to investigate.

6. Effectiveness of Concept Mapping Model and Concept Attainment Model may be researched at large scale for learners of different age groups, subject area, self esteem, sex etc.

7. The teacher behavior under the two models of teaching here also needs to be analyzed from the transcripts of the lesson transacted using these two models.
8. School curriculum consists of number of subjects mainly Social Science, Physics, Chemistry and languages. Since the present study has focused on the effects of Concept Mapping Model and Concept Attainment Model on student’s achievements and their creative abilities in Biology, research in our country is needed to assess the effects of these models in teaching other subjects also.

9. An investigation into less time and learning tasks can be best managed to achieve the optimum results and how initial abilities of students affect their achievements can prove to be a rewarding area for research.