Chapter – I

Introduction

1.1 Nature of Teaching

Education is an important process through which men preserve their culture. School is a special institution which has been entrusted with the responsibilities of young ones, and teaching is the main activity through which schools discharge their duties and attain their objectives. If teaching is done effectively, schools, successfully, achieve their goals. Many efforts have been made to study teaching and improve it in order to make it realise pre-determined goals. Teaching involves setting appropriate learning expectations for students, and, for that purpose, includes selection and sequencing of activities or kinds of interactions that would lead to expected learning. In view of this, the term, “teaching-learning”, has come into vogue, So, the term is used widely to indicate the process of teaching in all its dimensions viz., making decisions or choices of why, what and how, as well as actually executing decisions and appraising outcomes.

Teaching is human engineering and soul doctoring. Teaching refers to the multiple tasks carried out by teacher for leading the learners to the expected learning. This shows that teaching is both
technical and noble. The term ‘human engineering’ means the possibility of modifying and constructing human behaviour in intended ways on the basis of certain technical procedures. The term ‘soul doctoring’, means providing better nourishment to the development of the soul.

Varied descriptions of teaching are available in literature, ranging from the highly ideational, idealistic descriptions of teaching to very specific task descriptions of what it involves. Teaching is described as an interactive process between the teacher and the students under certain conditions for facilitating effective construction of knowledge by students. It is also described as a process to influence learners so as to ‘impinge on them through their perceptual and cognitive processes’. It is in this sense that teaching can be said to be ‘educating’ a person. Education, no doubt, is a broader process of leading to individual development and social progress. However, teaching is central to education in attaining its purpose; that is, teaching is the instrument through which individuals are educated. Teaching is always intended to lead to some learning. Without learning teaching is incomplete. Effective teaching in the classroom is the need of the hour.
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1.2 Defining Teaching

Teaching has been defined by many in various ways as being given below:

Teaching is an intimate contact between a more mature personality and a less mature one which is designed to further the education of the latter (H.C. Morrison, 1934). Teaching is an arrangement and manipulation of a situation in which there are gaps and obstructions which an individual will seek to overcome and from which he will learn in the course of doing so (John Brubacher, 1939). Teaching is a system of actions intended to produce learning (B.O. Smith, 1960). Teaching is a form of interpersonal influence aimed at changing the behaviour potential of another person (N.L. Gage, 1963). Teaching is a system of actions involving an agent, an end in view, and a situation including two sets of factors—those over which the agent has no control (class size, size of classroom, physical characteristics of pupils, etc.) and those that he can modify (way of asking questions about instruction and ways of structuring information or ideas gleaned) (B.O. Smith, 1963). Teaching is defined as an interactive process, primarily involving classroom talk which takes place between teachers and pupils and occurs during certain definable activities (Edmund Amidon, 1967). Teaching refers to activities that are designed and
performed to produce change in student (pupil) behaviour (Clarke, 1970). Teaching is the task of a teacher which is performed for the development of a child (Thomas F. Green, 1971). Shri Aurobindo (1972) have defined it as "The first principle of true teaching is that nothing can be taught". In the words of English and English (1959) "The teaching is the art of assisting others to learn. It includes the providing of information (instruction) and of appropriate situation, conditions or activities design to facilitate learning".

Where as Morse and Wingo (1968) viewed the teaching as "understanding and guiding of children as individual and as groups. It means the providing of learning experiences that will enable each learner to grow continuously and sequentially towards his delth role in society".

Lawrence (1966) also viewed teaching as a complex process to be studied entirely in a "live" situation. In other words teaching is a series of events where teacher attempts to change the behavior of the students along the intended direction. In the process of teaching teacher and student act as two poles interacting with each other through the path of curriculum to achieve the predetermined objectives i.e. to promote the learning of students.
Gage (1963) in his book ‘Handbook of Research on Teaching’ tried to give a concise account of information on teaching which at places is so fragmentary and diverse that no conclusion can be drawn for the nature of teaching. It is assumed that the teaching processes are merely images of learning process.

In these days, specially, in school education, there exists the irrelevance in the educational system which may be due to incompetent teaching.

Gage (1963) have suggested three questions, which each teacher should answer before going to the classroom in order to know the nature of teaching. These questions are : (a) How do teachers behave? (b) Why do they behave as they do? and (c) What are the affects? Thus, it has covered all the aspects of teaching as the behavior of teacher, cause of a particular behavior and lastly the acquired by the students in terms of effects.

Flanders (1976) defines teaching as a "reciprocal contact" between student and teacher where as Haugh and Duncan (1970) remarked that teaching is a complex process which includes four-phases - (a) curriculum planning phase, (b) an instructing phase, (c) a measuring phase, and (d) an evaluative phase. For curriculum planning
phase teacher should know the goals of education and the specific objectives to achieve those goals should be formulated. Second phase "instructing" involves the creating, using and modifying instructional strategies, which help the students to learn. Measuring, the third phase of the teaching process deals with the ability to develop measuring devices, organize and analyze the results. Evaluation of teaching outcome requires the help of data obtained from measuring devices. This evaluation is very much in terms of judgment about instructional objectives and subject matter.

Joyce and Weil (1985) defined teaching as a process by which teacher and students create a shared environment including sets of values and beliefs which in turn colour their view of reality.

1.3 Components of Teaching

Teaching is a process which involves the active participation of teacher and students. In the very beginning teaching was a bipolar process which include only student and teacher but, now, another dimension that is curriculum of teaching is well recognized and it is the curriculum through which teacher and students interact. All these components have their own roles.
(1) Teacher plays a vital and important role of planning, organizing leading and controlling the teaching in order to provide full learning facilities to the students.

(2) Students are dependent upon the teachers for the learning strategies and the content chosen by the teacher. Pupils are there to act according to the planning and organization of teacher to maximize learning.

(3) Lastly, the curriculum, is a medium of interaction between the students and teachers. So it is a intervening variable to facilitate learning. There are methods, teaching strategies or techniques of teaching through which various interactions between students and teachers take place.

1.4 Purpose of Teaching

The aforesaid discussion reveals that the purposes of teaching are as follows:

(a) Teaching is tri-polar process which purports to develop all round personality of the learner through the curriculum.

(b) Teaching shapes the behavior of individual in a desired direction.

(7)
(c) Teaching also helps the student to adjust in the new environment and live harmoniously in the new situation.

(d) Teaching also encourages the student to learn and think for themselves to solve the problems.

(e) Teaching mainly purports to acquaint the students with the content of the subject to be taught.

1.5 Phases of Teaching:
Teaching acts or operations need systematic planning and careful execution. In doing so, the teaching proceeds in some sequential and organized steps. These steps or stages are known as phases of teaching. In general, a teaching task may systematically be analyzed under three phases as pre-active phase, interactive phase and post-active phase.

Pre-active Phase: The pre-active phase is the planning phase. A good planning makes the task of the teacher smooth, functionable and successful. There are two major steps involved in this phase, namely, establishment of some kind of goals or objectives, and discovering ways and means to achieve these objectives. Operations and activities concerning the planning phase may be as logical first step in planning for any teaching is the attempt made by a teacher for
the establishment of certain goals or objectives. Accordingly, he formulates, in detail, the specific instructional or teaching objectives and writes them in a proper way in behavioural terms. The organization or sequence of the content or material, consideration about the principles and maxims of teaching, decisions and planning about the proper use of teaching aids, choice of methods, techniques and strategies of teaching, the duration, place and management of classroom teaching, decisions about the evaluation tools are taken into account. Thus, in the pre-active phase, a teacher has to chalk out the details of his journey that he wants to perform in the classroom along with his students.

The Interactive Phase: The interactive phase is concerned with the implementation and carrying out what has been planned or decided at the planning stage. It is the stage for actual teaching, success or failure of which depends on the degree and quality of the classroom interaction between the teacher and pupils. The major activities undertaken in this phase may be grouped as perception, diagnosis and reaction process.

Interaction process demands an appropriate perception on the part of the teacher as well as student. When teacher enters the class
his first activity is concerned with the classroom climate. He tries to weigh himself, his abilities and pre-planning for teaching against the class group. Similarly, the students also try to have a perception of the abilities, behaviour and personality characteristics of the teacher in order to seek desirable interaction in the touching-learning process.

A proper diagnosis of the abilities and behaviour of both students and the teacher is very essential for the appropriate interaction. A teacher, therefore, tries to assess and diagnose the achievement level of his students with respect to their abilities, academic background, intelligence, interest and aptitude. The diagnosis work may be done in several ways. He may ask some questions or assess their performances and behaviour potential by providing opportunity for performing or behaving. The students also, through verbal or non-verbal interaction, get the opportunity to access and diagnose the abilities, interest, aptitude and behaviour performance of their own responses and reactions for contributing towards effective interaction in the teaching act.

Action-reaction processes play the central role in the task of classroom interaction for this purpose, a teacher has to take right decisions with regard to the selection and use of the proper stimuli,
schedule of reinforcement and feedback devices, and development of suitable strategies suiting the needs of the pupils, teaching environment and teaching objectives. The pupils or students have also to learn the proper ways of reacting and responding to the various stimuli and teaching techniques presented to them. In this way, the interactive phase of teaching is responsible for establishing appropriate verbal and non-verbal classroom interaction between the teacher and pupils by arranging suitable teaching-learning activities and an equally suitable and controlled classroom environment.

Post-active phase: It is concerned with the evaluation activities. First of all, the stipulated objectives are considered and attempts are made to measure or assess the degree or qualities of the expected behavioural changes in the students as a result of the teaching activities performed in the interactive phase. This can be done in a number of ways including tests or quizzes or by observing students’ reactions to questions, comments, structured or unstructured situation and behaviour situation. The teacher should try to take right decisions about the selections of the appropriate evaluation devices for this purpose. The results of the carried evaluation may be used by the teacher as well as students for bringing desirable improvement in their roles and activities as: The suitability of the stipulated objectives may
be properly assessed. The extent or quality of their accomplishment makes them take decisions about further continuation, alteration, or improvement. The suitability of the content and its organization may be suggested. Decisions regarding re-teaching the content or moving to new content may be introduced in the strategies and techniques of teaching. The suitability of the instructional process, aid material and teaching’ strategies are evaluated. As a result, change and improvement may be introduced in the strategies and techniques of teachings. The role of the classroom environment and learning situations may be evaluated. Accordingly, the desired changes may be affected in the management of these elements. In nutshell, the post-active activities concerning evaluation help the teacher and the students in bringing desirable improvement in their performances by providing necessary corrective feedback. All the above three phases of teaching, although described separately, are closely interrelated.

It may help us to conclude that the process of teaching does not confine itself with mere classroom interaction or presentation of the content, teaching material or learning experiences. A teaching task can never be confined to the face-to-face dialogue between the teacher and the students carried out in the interaction phase. It begins even before the teacher enters the classroom, with the work of planning the
teaching task, and continues after the interaction singe in the form of evaluation, feedback and similar other post-active activities, many times even after the teacher leaves the class.

1.6 Teaching and Educational Objectives

Education is an important means by which the existence of individual has been decided by all philosophers, sociologists and educationists. All these philosophers, socialists, and educationists have given their favourable opinion that education helps in the perpetuations and advancement of the society. Education have sown broad objectives though the aims and objectives of education are very dynamic in nature. It changes from time to time, with the philosophy of life and with the needs of the country. These objectives have come to mean a particular type of behavior and the relation between the behaviour and the objectives has been recognized by many workers in the field.

Mainly three domains of objectives are given by Bloom et.al. (1956) and these are cognitive, affective and psychomotor. Similar type of three fold organization of objectives such as cognitive, conative and feeling, thinking, willing and acting etc., is as old as Greek philosophy. Cognitive objectives deal with the processes like knowing, perceiving,
recognizing, thinking, conceiving, Judging and reasoning. Affective objectives are related with the feelings, emotions, attitude appreciation valuing and the like. Psychomotor objectives deal with the skilled ways of moving such as hand-writing, type-writing, dancing and playing any musical instrument. These three objectives are so much interrelated with each other that it is not possible to make a distinguishing boundary-line between these three (Wertheimer, 1945, Bloom and Broder, 1950, Johnson, 1955, Festinger, 1957, Heider, 1958; Rokeach, 1960).

**Cognitive Domain**—Cognitive domain of educational objectives can be divided into six parts as knowledge, comprehension, application, analysis, synthesis and evaluation. Knowledge is the ability to remember, recall and reorganize the ideas, facts etc. in a situation, similar to the situation in which knowledge has been stored. Memory is also equally important for the knowledge part (Hasting, 1977).

Comprehension is the ability of making of the communicated knowledge. Application part helps the students to use the abstractions, rules, principles, ideas and methods in a particular and concrete situation. Analysis of communicated knowledge strengthens the ability of breaking down any whole components into parts. Contrary to the
analysis synthesis make the students able to combine all the parts to make a whole. Lastly evaluation is the ability to make quantitative and qualitative Judgment about the extent to which materials and methods satisfy criteria. Evaluation is the highest level of cognitive activity.

**Affective Domain** – Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience. We find a large member of such objectives in the literature expressed as interest, attitudes, appreciations, values and emotional sets or biases. From the analysis of the objectives of affective domain given by Bloom et.al. (1965), five broad categories of behavior can be identify which are— (a) receiving, (b) responding, (c) valuing, (d) organization, and (e) characterization by a values or value complex.

**Psychomotor Domain**– Numerous taxonomies have been developed for the psychomotor domain (Guilford, 1958, Dave, 1969, Kibler 1970; Simpson, 1966; Harrow, 1972 etc.) According to Harrow’s taxonomy psychomotor domain has following components: (a) reflex movements, (b) basic fundamental movements, (c) perceptual abilities, (d) physical abilities, (e) skilled movements, and (f) non-discursive communications.
Along with the above said aims of education, good teaching is the teacher's ability to change the beliefs, attitudes and values of students in a desired way (Bloom et al. 1956). If the teacher is able to change the affective behaviour of pupils, then the attainment of knowledge take place at a very fast rate, (Pande, 1978; Pandey, 1974; Walaytiram, 1974). Teaching is a tripolar process which includes the teacher, curriculum and the learner. Teacher teaches through the medium of curriculum to the learner. Few studies are there to support the effect of non-intellectual factors say attitude and interest etc. on academic achievement.

Armour (1954), Baraheni (1962) Finger & Schlessor (1965) and Passow and Golberg (1962) have studied the effect of attitude on academic achievement and found that a favorable attitude is must for better achievement. According to Darley and Hagenah (1955) and Super (1960) the effect of interest in any subject is directly related with the academic achievement in that subject.

1.7 Teaching of Science

The twenty first century, laced with highly advanced scientific knowledge and technology, with a strong ambition to explore and conquer the universe, the knowledge of science and development of
scientific temper has become an essential requirement. A thorough understanding of science and scientific methods leads to scientific humanism wherein the people have a command of scientific thought and language, are objective and systematic with a rational outlook and have an ability to make sound decisions.

Science as a subject is mostly misunderstood to be a set of concepts, theories and principles to be learnt by heart. Science is not 'an agglomeration of bits of learning and intellectual instruments to be fastened on to an individual who otherwise persists in all his traditional attitudes and behaviour' (Vaidya, 1992).

Science is the search for knowledge and understanding of nature and explanation of natural phenomenon. Science is a way of thinking, a way of behaving, an approach road to new knowledge. The knowledge of science should train a person to think in a rational manner, to be responsible and systematic, truthful and honest, sincere and hardworking.
Science moves forward on the wheels of dogmatism, dynamism and discovery at the same time. Open-mindedness, curiosity, inquiring into the basis of all things, collection of data, demand for verification and proofs. Statistical reasoning, suspended judgment, acceptance of warranted conclusions and willingness to change one's opinion in the light of new evidence are the ferments which characterize the scientific enterprise.

1.7.1. Aims and Objectives of Science Teaching

Science teaching in India was first introduced in Hindu College in Calcutta, which was founded by David Hare in 1817 under the leadership of Raja Ram Mohan Roy. He felt that 'modern education' could change the outlook of Indians and only then could come the much desired 'social awakening', putting an end to the social evils which were so prevalent in the Indian society at that time.

The aim of starting science education was, therefore, to make scientific knowledge accessible to Indian students and through it develop scientific outlook in them. Since then, science as a subject is available to the students However, it was not seen as a subject for all students but as one for an elite, Who would go on to become a scientist, doctor, engineer or an industrialist. Even in free India, science
remained an optional subject for almost two decades, though several committees and commissions recommended the need of science education for all.

Secondary Education Commission (1952-53) recommended that the aim of education should be 'development of the Scientific Attitude of mind'. A study team on General Education (1955) recommended the inclusion of 'Natural Sciences' in the curriculum at undergraduate level. Indian Parliamentary and Scientific Committee, 1961 recommended for the first time that science education should be compulsory at the High School stage.

The Education Commission (1964-66) recommended introduction of science as a subject on a compulsory basis to all pupils as a part of general education during the first ten years of schooling. It says, "The quality of science teaching has also to be raised considerably so as to achieve its proper objectives and purposes, namely, to promote an ever deepening understanding of basic principles, to develop problem solving, analytical skills and the ability to apply them to the problems of the material environment and social living and to promote the spirit of inquiry and experimentation. Only then can a scientific outlook become part of our way of life and culture."
In the year 1974 - 75 science was introduced as a compulsory subject for all the students up to class X [under the 10+2 scheme of education]. Mass orientation programs for science teachers were organised throughout the country so as to enable them to provide effective science teaching up to secondary level.

Initially, there was a criticism from some students, their parents and even teachers, that every student does not possess an aptitude for science and this compulsion would put up an extra burden on the minds of students. Ishwar Bhai Patel Committee suggested two courses for science education at the secondary level: 'A' and 'B'. Science 'A' course, for the students who intended to pursue science in higher classes and science 'B' for the rest of the students. But this system was not successful and had to be withdrawn soon. Again a uniform curriculum was developed for all the students at secondary level.

National Policy on Education, 1986 and Program of Action 1992 lays stress on quality in science education. It says, "Science education will be strengthened so as to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question and an aesthetic sensibility. Science education
programs will be designed to enable the learner to acquire problem solving and decision-making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life. Every effort will be made to extend science education to the vast numbers who have remained outside the pale of formal education."

National Curriculum for Elementary and Secondary Education (NCERT, 1988) also lays stress on the development of scientific temper. "The role of education in refining sensitivities and perceptions that contribute to scientific temper and independence of mind has been well recognized. The curriculum should develop in the pupil well-defined abilities and values such as the spirit of inquiry, objectivity and the courage to question ... The emphasis of education, therefore, should be on developing in every pupil, a scientific attitude characterized by the use of scientific method of inquiry in solving problems. The curriculum should promote development in the pupil of qualities such as open mindedness, commitment to free inquiry, a habit of seeking more evidence before arriving at a conclusion and a readiness to revise assumptions and hypotheses based on fresh evidence coming to light, all directed to the inculcation of scientific temper."
The aims of teaching science according to this document are: 'developing well defined abilities in cognitive, affective and psychomotor domains such as spirit of inquiry, creativity, objectivity, the courage to question and aesthetic sensibility.'

Thus, the objectives of science teaching taken up on the basis of National Policy of Education, 1986 and National Curriculum for Elementary and Secondary Education- a framework, 1988 are:

The development of:

(i) Knowledge and understanding of the concepts, principles and processes, (ii) ability to think logically, (iii) creativity, (iv) rational outlook, (v) objectivity, (vi) spirit of inquiry, (vii) ability to make decisions, (viii) courage to raise question, (ix) ability to draw conclusions, and (x) aesthetic sensibility.

National Curriculum Framework (2005) deals with the objective of science teaching in detail. The general aim of science education follow directly from the six criteria of validity: cognitive, content, process, historical, environmental and ethical. Science education should enable the learner to know the facts and principles of science and its applications, consistent with the stage of cognitive development, acquire the skills and understand the methods and
processes that lead to generation and validation of scientific knowledge, develop a historical and development perspective of science and to enable her to view science as a social enterprise, relate to the environment (natural environment, artifacts and people), local as well as global, and appreciate the issues at the interface of science, technology and society, acquire the requisite theoretical knowledge and practical technological skills to enter the world of work, nurture the natural curiosity, aesthetic sense and creativity in science and technology, imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment, and cultivate 'scientific temper' - objectivity, critical thinking and freedom from fear and prejudice. In order to realise the aim of science education, the content at the secondary stage has been organised around themes that are potentially cross-disciplinary in nature.

Teaching of science is to develop an ability to live effectively in the present environment. The special objectives of science teaching are many and few of them are - development of scientific attitude to acquaint the students with scientific inventions to give knowledge of science, develop the cognitive domain of individual which helps in solving the learner's problems. Science develops both intellectual and behavioral aspects of pupils. These objectives of science teaching are
very well recognized by different disciplines of science Chemistry, Bio-
Chemistry, Biophysics etc.

1.7.1.1 Goal of Biological Science

The objective of teaching biological science have undergone an
immense change during the last few decades. The rapid progress of
science and technology in the recent years and the two world wars
have changed the objectives of science specially of biological science,
in the school. Falk (1971) in his book "Biology Teaching Methods" have
given that teachers must have a reason for the selection of the content
of every lesson he plans and for the method of its presentation. The
statement of concrete goals of Biology teaching are derived from the
philosophical belief and assumption.

If the science programme in the school is to be effective, we
should know what we are trying to accomplish and then put in all our
efforts to achieve it. Any subject in the school curriculum should try to
achieve general aims of education set to make a child good citizen who
can adjust himself and participate in the democratic set of society.
Individual development in all the dimensions of child's personality and
the social efficiency and the like are some other general aims of
education.
Way of teaching in the school days have direct Impact on the students Intellectual social and emotional development so the choice of teaching method should be based on the goals of teaching in particular. According to Falk (1971) the goals of teaching biology are –

(a) Understanding the meaning of the basic unifying themes of biology by learning relevant facts, concepts and generalizations.

(b) Understanding the investigative nature of science and the use of its inquiry skills by conducting biological experiments.

(c) Acquire those values and attitudes that are essential to scientific inquiry and that underlie all rational thought and thus guide future action and relationship.

Sharma and Sharma (1957) have given a list of general objectives which should be realized by the teaching of biological science as : knowledge objective, skills, abilities, training in scientific methods, interest and habits, appreciation, to provide work for leisure, attitude, training for better living, and to form basis for vocation & specialization. The aforesaid goals of biological science should be kept in mind while teaching.
1.7.1.2 Method of teaching Biological Science

The main aim of teaching is bring about socially desirable behavior changes in the student and these can only be achieved if teaching is effective and based on the principles of teaching. How pupils will learn effectively, depends upon the method the teacher adopted. A method should not become an end in itself but should be used as a means to achieve set aims of teaching. Again same method should not be strictly followed at all times but should be made flexible to suit variety of circumstances and conditions existing in a given situation. A teacher is free to use a variety of methods according to his abilities interests and experiences and also of the students working under a particular circumstances.

Our educational system is too much examination dominated. Right throughout the school, generally speaking students solely study under pressure for passing the examination and teachers in their turn over strain themselves for the same. This has resulted hardly in any improvement in the methodology of teaching. In spite of the considerable efforts which have been made during the last few decades. To overcome this situation a number of methods of teaching biological science have been given below in summary manner.
Lecture Method – Lecture method is a dominant method in our classrooms. The reason for this is that it has been far too long with us, secondly it is very convenient to the teacher as no practical preparation is needed for it. At the most a piece of chalk will do, and hence it can be called as chalk - talk method. Thirdly, It is very attractive method as the teacher occupies the central place in the teaching learning process, which is a self-satisfying experience. This method has come into disrepute recently because it falls to develop the varied outcomes of science teaching. Both advantages and disadvantages of this method are there. One of the greatest advantages is that this method is quite economical as only chalk and blackboard is required by the teacher, and also it is a time saving method. It also turns out to be the highly efficient method if one plans to present the teaching material in a highly systematic and logical manner.

The disadvantages of this method are more than advantages because students are not involved in the teaching learning process. Consequently there is not two way communication between the teacher and his pupils. Development of scientific skill is also neglected by using this method. Lecture method can be more infesting by judicious use of audio-visual aids.
Demonstration Method – Demonstration method is more effective method of teaching science. In this method teacher demonstrates and illustrates certain fundamental phenomena and various applications of the abstracts through a series of experiments. During demonstration teacher can take help of his pupils. These pupils may be trained before hand. Successful demonstration in the hands of teacher provide first hand experienced to his pupils. By the demonstration method interest in the subject can be evoked but it lacks the true experimentation on the part of students. They cannot learn scientific phenomena by this method. Curiosity among the students can be developed by using this method but ability of handling the apparatus is not developed through demonstration method.

Lecture-cum Demonstration Method – Lecture-cum demonstration method is a combination of two methods viz. lecture and demonstration methods as the very title of the method indicates. The capable teacher can combine most of the values of both lecture and demonstration methods for making best use of this method. Through subtle integration of lecture with demonstration a teacher is able to reduce their limitations considerably. When the exchange of materials between teacher and pupils goes on in a permissive atmosphere the students themselves from the concepts. So lecture-cum demonstration
must be used accordingly to achieve the advantages of both lecture and demonstration methods and at the same time minimize maximally their disadvantages. Lecture-cure demonstration method has a limited role in the teaching learning process because pupils have less scope of active participation.

**Problem Solving Method** – This is the cry of the hour because this method enjoy the highest prestige as compared with the other methods of science teaching amongst science teachers all over the world. Due to certain physical limitations, teachers find quite difficult to apply it in the classroom and laboratory. But learning in science goes much beyond the accumulation of facts. Students need to be frequently confronted with scientific problems, they provoke thinking, demand thinking and test the quality of concept formed during teaching. For teaching through problem solving method a teacher must plan the lesson according to the stages of the method. These stages are given by Mills and Dean (1959) as: (i) surveying of the problem, (ii) description of the problem, (iii) discussion of the problem, (iv) limitations of the problem, (v) planning for action and lastly, and (vi) further analysis and limitations.


**Heuristic Method** – Heuristic is a Greek word which means discovery. While teaching by this method each and every student is placed in the place of original discoverer. Here teacher creates a situation which is quite similar to the situation of original discoverer and student themselves find out the solution instead of giving them direct solution of the problem. Laboratory work in this method is essential for every student and hence scientific habits of mind and thoughtfulness is developed by this method. This method cannot be used as a main method of teaching by which pupil acquire knowledge and scientific habits because it is very much time taking and many times students learn ambiguous information. This method may be used in accordance with other methods of teaching.

**Scientific Method** – The methods used by the scientist in his efforts to discover truth have long been looked upon as effective in the solution of problems of the non-scientific nature. Scientific method as a method of teaching is now in the new. It is used to standardize knowledge because fundamental ideas in science are not static. It follows the steps as : (i) sensing the problem including its definition scope and analysis, (ii) experimentation, (iii) collection and interpretation of data, selecting and examining the most fruitful hypotheses and arriving at a tentative solution, (iv) establishment of the
law, (v) centralization of the law, (vi) application of the laws to new situation, (vii) predictability, and (viii) idealization and abstraction.

**Project Method** – This is the most advocated but least used method in science teaching in our secondary schools. In progressive countries, teachers try to approach part of the syllabus through the project method. While teaching by this method a group of students select a problem in consultation with the teacher and, then, develop the plan of attack and the type of equipments needed to carry the experiment. Students, then, get training in scientific methods through a series of such project type experiments. The use of projects in the way help to achieve the varied outcomes of the science teaching and education, because it is an activity method of study which capitalizes the children's natural tendencies for educational purposes. There are five stages of the teaching through project method as : (i) proposing and selection of the project, (ii) planning the phases of the project, (iii) execution, (iv) preparation of the report, and (v) evaluation.

**Historical Method** – It is much more neglected than it should be in our country and it is quit fascinating to approach science teaching historically. This approach if employed successfully, give depth to students understanding as each scientific idea has its own past history.
It is quite possible to develop various branches of science historically. Feeling of science, scientific attitude, appreciation can be effectively demonstrated and developed among pupils by unfolding the real story of great discoveries in a concrete and lively manner. Historical method also have its limitations because of which it cannot be used very frequently. No doubt the story telling is very interesting for the students but it does not involve any experimentation on the part of students and teachers. Thus skill in handling scientific apparatus is not developed which is a very important objective. So far aforesaid methods and strategies are being utilized by science teacher in their classroom. However there is a still a vast scope to ponder over various teaching methods/strategies for science classroom.

1.8 Models Approach to Teaching

Instructional goals for different classes and different subjects very greatly and thus to realize these educational goals different teaching strategies must be utilized by the teacher. For realizing the different instructional objectives models approach to teaching was proposed by many educationists and psychologists. Flanders (1960) gave his model as social interaction model of teaching and for this approach he categorized the statements of students and teachers Into
ten categories. Glaser (1962) developed his stripped down model of teaching which after some modification is well known as basic teaching model. In this basic teaching model instructional material is divided into four components. First component is of the instructional objectives, next is the entering behaviour of the students. Third component is of instructional procedure and lastly the performance and assessment.

There is another well recognized computer based teaching model of Stolurow and Daniel (1965). Here the computer replaces the teacher in making decisions and providing actual Instruction. In 1980 Joyce and Weil, in their book "Models of Teaching" proposed four major families of models of teaching and they claimed that different Instructional goals can be realized by the use of these models.

1.8.1 Definition of Model of Teaching

From the dictionary meaning the word model is the representation of any object (Urdang & Flexner, 1977) but educationist and psychologists have defined it in different ways. In the words of Joyce and Weil (1988) "A Model of Teaching is plan or pattern that can be used to shape curriculum (long term courses of studies) to design instructional material and to guide instruction in the classroom and other settings". The basic aim of any model of teaching is to improve
the instructional effectiveness in an interactive atmosphere. So these models are more directed towards the teacher and students. But according to Joyce and Weil (1985) these models can also be used to improve or shape the curriculum.

Ausubel (1968) have said that the two words model and theory can be used interchangeably. According to him theories of teaching and learning are not different but they are the same. In a chapter of Handbook of research on teaching (Traverse, 1973). Nuthall and Snook (1973) have defined the model, though there is ambiguity in the definition, ‘Model can be used for Imitation, description or prediction’. The word has different references for different subjects say for example teachers use Iconic model for making his lesson interesting and easily understandable and scientists use symbolic or analogical model to explain data, suggest predictions or stimulate factors, which cannot be manipulated in the real world.

According to Brodbeck (1963) "Models are frequently used for those theories which are either speculative or quantified or most likely both". Those who have involved in research on teaching hare designed descriptive symbolic models of teacher pupil relationships which are intended to coordinate in a single picture, those elements of
observation, research and educational folklore which they consider significant (Smith 1968, Strasser 1967). These models show the characteristics of simplicity, and abstraction and are of explanatory and predictive significance and thus they represent the popular notion of model in physical sciences.

Being an educational psychologist De Cecco (1968) also described the models of teaching to justify and structure the content of his text book. Eggen et. al. (1979) is of the that model is a blue print for teaching". For each type of content and each educational objective different types of blue prints must be formed by the teacher or the teacher selects the model or designs the blue print according to the content and goals to be achieved. Both the blue print and the models give the direction to the teacher for successful teaching and also for achieving the set instructional goals. They also have given few similarities among blue print and model, as the blue print in not a institute for the basic engineering skill and model is not a substitute for teaching skills. Blue print does not dictate all the actions of builder and model cannot dictate all the actions of a teacher. Rather model is a "tool to help good teachers teach more effectively, by making their teaching more systematic and efficient. Model also provides flexibility to allow teachers use their own creativity Just as builder uses the
creativity in the act of construction. As with the blue print, a teaching model is a design for teaching, within which the teacher uses all the skills and insights at his command”.

So teaching model is a good tool of teaching in which components are interrelated and arranged in a sequence which provide guidelines for achieving the educational objectives.

1.8.2 Model Differentiated from Teaching Methods and Strategies

Teaching Models are the means of attaining educational objectives. According to Gage (1969) teaching method in general is a recurrent pattern of teacher behaviour applicable to various subject Matters, characteristic of more than one teacher and relevant to learning." The term teaching method is most widely used and overlaps a great deal in common usage. Gage and Berliner (1984) is of the view that teaching methods are the procedures to help the students to move from their initial ways of behaving to those that have been set up as objectives." In general teaching methods is a particular order imposed upon the teaching activity. It is a style of presentation of content in the classroom. It has certain set steps and follows, some definite rules while presentation (Broudy & Palmer 1965). These rules are of theoretical orientation.
Teaching strategy is a purposeful combination of more than two methods to achieve the objectives of the content. Gerhard (1971) said that "Teaching strategies have been classified as a series of methods ranging from lecture discussion and recitation to the multi-method, the project, the self discovery and self selection approach. Stones and Morris (1972) have defined the teaching strategy as generalized plan for a lesson which includes structures, desired learner behaviour in terms of goals of instruction and an outline of planned tactics necessary to implement the strategy. The lesson strategy is a part of a larger development scheme of the curriculum". For making the teaching strategy effective methods involved in it should be such as they can be articulated with each other. The basic difference between the teaching method & teaching strategy is that the method includes only the way of presentation of any learning material where as the strategy involve the behavioral objectives and learning conditions While teaching any school subject.

Models of teaching are there to achieve the specific goals of teaching. For any lesson when a teacher select any particular instructional approach for achieving the well defined goals of that instructional material then it can be said that the teacher is using the Models approach in teaching that lesson. Before using the model
approach a training for the categorization of institutional objectives is essential so that the teacher will be able to match the suitable model for reaching those identified goals.

1.8.3 Assumptions Underlying the Models of Teaching

It involves the following assumption -

(a) Teaching creates an environments of learning, which is a dependent variable upon teaching.

(b) The content and skill function as an instruction through which student and teacher interact with each other. Thus, it provides to develop social and physical efficiency.

(c) Teaching elements are arranged in various ways and the different teaching goals can be realized.

(d) They provide the learning experiences by creating conducive environment for behavioral goals.

1.8.4 Purpose of Models of Teaching

Models of teaching aims to serve following purposes :

(a) It purports to help the curriculum designer to plan learning centers and curriculum which nourishes pupils with a variety of educational experiences.
(b) Teachers also get help in giving information to more children in an appropriate atmosphere.

(c) Instructional designers are also guided to create more interesting and effective instructional materials and learning resources.

(d) Students self-learning can be encouraged by improving the capacity of learner's personal domain.

(e) Theory of teaching can be formulated by the help of these models of teaching.

(f) It can attempt to enter the social domain to change the learner at the point of interaction with his fellows.

(g) It helps in making teaching scientifically controlled and goal oriented.

(h) It helps the teacher to identify and select the teaching model as the various steps of any model are very clear.

(i) The academic domain of students are improved by teaching academic skills and ways of dealing intellectually with the complexity of the world.
1.8.5 Grouping the Models –

Joyce and Weil (2008) have grouped all the models of teaching into four major families and these families are –

1. **Information Processing Family** – which refers to the any people handle stimuli from the environment, organize data, sense problem, generate concepts and solutions to problems, and employ verbal and non-verbal symbols.

2. **Personal Family** – Personal Family of models of teaching. They emphasize the processes by which Individual construct and organize their unique reality. They give much attention to emotional life and also focus on helping individual to develop a productive relationship with their environment.

3. **Social interaction models** – The models in this family emphasizes the relationships of Individual to society, or to other persons. They focus on the processes by which reality is socially negotiated.

4. **Behavioural Family** – All the model in this family share a common theoretical base, such as learning theory, social learning theory, behaviour modification and behaviour therapy.
These model stress on changing the visible behavior of the learner rather than the underlying psychological structure and unobservable behaviour.

1.8.6 Information Processing Models of Teaching as Focus of the Study

Information processing models of teaching focus to help the Individual to develop a particular relationship with their environments and to view themselves as capable persons is also expected to result in richer interpersonal relations and a more effective information processing capability. Each model in this family has a distinct point of view about how people think and how to affect the ways they operate on Information. All these models have been given by different educationists and, thus, focus on information processing have come to us from different sources.

There are studies about the development of intellectual processes in the child and adolescent. Piaget (1952) work is leading authority on the intellectual development of the child. Because Information processing family of models of teaching deals with a large number of variables related to the cognitive domain, it has taken the major area for the present study. These models provide the Information
about the knowledge and It Is a primary goal of the school teaching so present researcher has attempted to study the two models and its effect, on the attitude towards biological science and achievement in the subject.

1.8.7 Selection of the Models

From the information processing family the two model selected for the present study are -

1. Advance Organizer Model (AOM) by Ausubel
2. Concept Attainment Model (CAM) by J.J. Bruner

These two models have been selected because of their wide applicability across the subject and acceptability by the teacher community due to their inductive deductive nature and sound pedagogical base. Both the models strengthen the information processing capabilities of the learner.

1.8.7.1 Description of the Models:

The detailed description of Advance Organizer Model and Concept Attainment Model along with the researches done are being given as follows;
1.8.7.1.1. **Advance organizer Model** – Advance organizer Model is developed from Ausubel's (1968) theory of meaningful verbal learning. The model purports to equip the teacher convey information meaningfully as it is one of the goals of schooling. The teacher has to organizer his lecture in such a way that the students internalize the knowledge. This objective can be net through strengthening the learner's cognitive structure. Cognitive structure means a person's knowledge of a particular subject-matter at any given time and the way it is organized. The available structure is the foremost factor governing whether new information is potentially meaningful or not and how well it will be acquired and retained. Strengthened cognitive structure of the students is desirable in order to assimilate new information and similar attempts should be made for them by the teacher in the classroom.

Meaningful verbal means solidly connecting the new material with the existing ideas and concepts in the learner’s cognitive structure. It is basically a supsumptive process whereby new and more highly differentiated learning material becomes assimilated into previously learned super-ordinate ideas/concepts. Advance organizer are designed to manipulate the overal cognitive structure of the learner by creating a new part of cognitive structure of the learner by creating a new part of cognitive structure that bridges the new learning material to
the larger, already existing assimilative context (cognitive structure). The advance organizers are, thus, presented at a higher level of abstractions, generality and inconclusiveness than the material to be learned, and they serve “to provide specifically relevant anchoring ideas for the more differentiated and detailed material that is subsequently presented.” (Ausubel, 1977). An advance organizer provides, in addition to ideational scaffolding or a meaningful context for new learning material, an overview of the more detailed information to follow and may influence the learning set by increasing student motivation and/or encouraging use of active encoding strategies on the part of the learner.

There are two types of advance organizers depending upon the learner's degree of familiarity with the material. Expository organizers are used when material to be learned is completely new, whereas comparative organizers are used when the material to be learned is familiar or relatable to previously learned ideas.

There are two principle involved in meaningful verbal learning as progressive differentiation and integrative reconciliation. Progressive differentiation means that the most general ideas of the discipline are presented first followed by a gradual increase in details and specific".  

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Integrative reconciliation simply means that new ideas should be consciously related to the previously learned content.

Description of the model in terms of its basic elements Focus:

The advance organizer model mainly focuses on

1. Helping the teachers in improving their methods of presentation of the subject matter, lecture and other expository form of teaching.

2. Organizing and conveying large amounts of information as meaningfully and efficiently as possible.

3. Helping the learners to strengthen their existing cognitive structures by receiving, processing and retaining the presented information/knowledge for its use in their further learning and living.

Syntax: The activities are carried out in the following three phases:

*Phase One*—*Presentation of advance organizers*: It is the preparatory stage. Here, the stage is set for the actual presentation of the learning task or material on the part of the teacher. The following types of activities are generally undertaken during the execution of this phase:

Clarifying the aims of the lesson: Here teacher is supposed to introduce the students with the aims and objectives of the lesson. It
may help the students in getting motivated for the proper acquisition of the presented material and also orient both the teacher and the students to their respective teaching-learning goals.

Presenting the advance organizer. After introducing the students with the aims and objectives of the lesson, the teacher tries to present the relevant advance organizer, expository or comparative to the students by keeping the following things in his mind: (i) The organizer has to be constructed in the manner so that it may contain ideas distinct from and more inclusive than the material in the learning task itself quite helpful to the learner in the task of motivating, understanding and grasping the information delivered by the teacher. (ii) While presenting the organizer, care should be taken for its proper teaching in the following manner: (a) Its contents involving the major concepts and/or prepositions of a discipline or area of study should be clearly pointed out and carefully explained, (b) Teacher may cite the essential features, explain them and provide examples for its being clearly perceived, understood and continually related to the presented material on the part of the students. (c) For better results, the presentation of organizer may be repeated several times by having its illustration in multiple contexts or having its citation under new or special terminology.
Prompting awareness of the learner's relevant knowledge: At the preparatory stage, before the actual presentation of the subject matter of the delivered lesson, it is also essential to have a prior idea and awareness of the learners' existing cognitive structure in terms of their previous knowledge and experiences relevant to the learning task and organizer. Such awareness is going to help the teachers in a good way for the planning and delivery of their lessons.

Phase Two—Presentation of learning task or material: It is the executive stage where the material to be learnt or lesson to be delivered is actually presented before the students. Generally, the following things are needed to be cared by the teacher in such a presentation:

- There is a formal presentations of the learning material. It may be done- by a teacher through a lecture, discussion, or presentation of films, transparencies, charts, pictures, visual writings, experiments, or readings.

Care is to be taken that what is presented before the students is well communicated to them by taking proper cognition of their existing cognitive structure as well as the intellectual food already supplied to them through the advance organizer.
During the presentation as Joyce and Weil (2003) observe, care is to be taken that "The organization of the learning material needs to be made explicit to the students so that they have an overall sense of direction and can see the logical order of the material and how the organization relates to the advance organizer".

**Phase Three—Strengthening cognitive organization:** It is a follow-up stage that strengthens the impact of the activities performed at the second stage. In the words of Joyce and Weil (2003): "The purpose of phase three is to anchor the new learning material in the students existing cognitive structure, that is, to strengthen the students' cognitive organization." The following activities need to be performed for this purpose:

*Promoting integrative reconciliation:* New knowledge can be incorporated and acquired well if due care is taken for its reconciliation with the learner's existing cognitive structure. The following activities may be undertaken by a teacher for the promotion of such reconciliation: (i) He can remind the students of the ideas related to the imparted learning material, (ii) He can ask the students to provide a summary of the major attributes of the new learning material. (iii) He can repeat precise definitions. (iv) He can ask for differences between
the aspects of the material, (v) He can ask students in describe how
the learning material supports the concept or proposition that is being
used as organizer.

Promoting active reception learning: The advance organizer
model wants to place the learner in an active receptive model instead
of a micro-passive recipient of the presented learning material. For this
purpose, it recommends the following types of activities on the part of a
teacher. The teacher may ask students (i) To describe how the new
material relates to the organizer (ii) For additional examples of the
concept or propositions in the learning material. (iii) To verbalize the
essence of the material using their own terminology and form of
reference, (iv) To examine the material from alternative points of view.

Eliciting critical approach to subject: Meaningful learning on the
part of the learners can take place well if the teacher gets success in
equipping them with a critical approach to knowledge or the learning
material. In general, the following types of activities may be undertaken
by the teacher. He may ask students to (i) Reorganize assumptions or
inferences that may have been made in the learning material. (ii) Judge
and challenge these assumptions and inferences, (iii) Reconcile the
contradictions perceived among them.
Clarification: New ideas or learning material can be fully assimilated or reconciled with the already existing ideas and knowledge only when these are fully understood and known. The unfamiliar can be made familiar only by providing its needed introduction, identity and meaningfulness to them. Hence, what is not clear and understate to the learners should be made absolutely clear and familiar by the teacher by making use of all the needed techniques, strategies, and aid materials.

Thus, by mentioning the needed activities in the syntax of the model has provided us with a method for "improving not only presentation but also students ability to learn from them. The more we teach students to become active to look for organizing ideas, reconcile information with them and generate organizers of their own (engaging in inductive activity while reading or watching)—the greater their potential for profiting from presentation becomes".

Social system: The social system of the advance organizer model is quite structured and teacher dominated. Here the teacher has to take lead the students to the learning track as it becomes an utmost necessity on his part to relate the learning material to the organizers and to help the students differentiate new material from the previously
learned material. However, as soon as the learning material is presented to the learners in the Phase II the social system of the model, the Phase III begins to be turned into an interactive style. The students now may engage in initiating many questions and comments as well as making use of their critical faculties for the desirable understanding and assimilation of the new learning material into their existing cognitive structure.

Principles of Reactions: The model calls for appropriate attention caring and responses on the part of the teacher to the students' reactions and requirements concerning with the attributes namely:
1. Seeking clarification about the meaning, nature and purpose of new learning material. 2. Differentiating it from and reconciling it with the existing knowledge for strengthening one's cognitive organization. 3. Making the acquisition of new learning quite relevant to the students' future learning and life. 4. Resulting in the promotion of a critical approach and information-processing ability for the acquisition of knowledge.

In this way, the employment of the model requires a quite active role, keen observation and readily responses on the part of the teacher
in dealing with the students’ silent and verbal reactions for acquiring meaningful learning as a result of the teachers’ expository teaching.

Support system: The model requires the following support for resulting into some meaningful outcomes: 1. A well-organized learning material. 2. Conceptualization and building of the appropriate advance organizers relevant to the learning material. 3. Establishment of the integral and appropriate relationship between the conceptual organizer and the content. 4. The needed competence and presentational skills on the part of the teacher for helping the students gain maximum advantages out of his expository teaching.

Application context: The model can be used for teaching the contents related to almost all the subjects of the school and university curriculum through its skilled presentation. It can help the teacher convey a large amount of information meaningfully within a time frame through expository methods of teaching like lecturing, demonstration, reading and exhibiting verbal contents. The all-round applicability of this model as suggested by Joyce and Weil (2003) can be summarized as: 1. This model can be successfully used for structuring extended curriculum sequences or courses and to instruct the students systematically in the key ideas for ultimately gaining perspective on the
entire curriculum area of a subject. 2. It can prove helpful in increasing the learner's grasp of factual information linked to and explained by the key ideas through the advance organiser and presentation of the learning material on the part of the teacher. 3. It can be quite helpful to the teachers as well as learners for teaching and learning the skills of meaningful reception learning through expository teaching. 4. It can help in explaining and making the students learn the art of critical thinking and cognitive reorganization through its mechanism of direct instruction in orderly thinking and in the notion of knowledge hierarchies. 5. The material presented through the application of this model in a deductive way can be further subjected to inductive concept attainment for reinforcing the material and also informally evaluating the student's acquisition of the material. 6. The use of the model may enable the students to learn from expository teaching like lectures, reading and other media used for presentation, besides being useful in developing their interest in inquiry and precise habits of thinking.

1.8.7.1.2. Concept Attainment Model

Concept attainment model of teaching is proposed by Bruner, Goodnow and Austin (1977). This model has been developed from the “study of thinking”. It belong to a major family of models i.e. Information
Processing Family of Models of teaching which develops the cognitive aspect of students behaviour. There are five basic elements of this model – (1) Name - is the term given to the category. (2) Examples - refer to the instances of the concept. Some examples are positive examples and some are negative. Positive examples are the instances of the concept. (3) Attributes - They are the common features or the characteristics that causes to place the example in the same category. (4) Attribute Value - The range of any given dimension is called attribute value. (5) The Rule - It is the definition or the statement specifying the special attributes to a concept.

The concept attainment model as the name indicates is to acquaint the students with the selected concepts. Apart from this it also helps in understanding the relationship among data examples, attributes and concepts, and also thinking pattern. The model develops by Bruner and his associates have three variation. These three models have the same conceptual base but each has slightly different set of activities. These three different models are – (i) reception model, (ii) selection model, and (iii) organized material model.

For the present study the researcher have chosen the Reception Model and thus the description of only Reception Oriented Model is
Given here. Reception Model of Concept Attainment

Focus of the model—This model mainly focuses on the clarification of the events and activities. Clarification is mainly done by classifying the special attributes of the concept.

Syntax — Syntax of the model describes the main steps of teaching through the model. The author have given three phases for the development of the model. Presentation of data and identification of concepts—During this step data is presented before the students. Each concept is presented along with examples and non examples during the development of the lesson. It is told to the student that few examples are provided to you and each one is labeled as 'ye' or 'no'. Some common elements exist in each example labeled with yes and you have to identify that common element. They are also asked to compare and justify the attributes of different examples. Finally they are asked to name the concept and form a rule or definition of the concept according to their special attributes. Testing Attainment of the Concept — This is the phase in which students test their attainment of the concept. This is done by asking the students to identify examples of the concept from the additional unlabelled examples and then again they are asked to give their own examples of the concept. After this
teacher and students will confirm or disconfirm their original hypotheses and then restate the definition according to the essential attributes. Analysis of Thinking strategy – In the last phase of the model the students begin to analyze the strategies by which they attain the concept. Social System– In the present model the teacher acts as a controller and organizes the data to facilitate learning. Teacher presents the data and tells about the positive examples but never tells the special attributes of the concept. Teacher is free to participate in the free dialogue within the phases but students are encouraged more to participate in the discussion.

Principal of Reaction -
(a) Daring the teaching learning process teacher supports the hypothesis formulated by the students.

(b) Teacher helps the students to balance one hypothesis against the another.

(c) Specific feature of each example is focused.

(d) Students discuss and evaluate their thinking strategies with proper assistance of the teacher.
Support System – In this model the learning materials and aids used to facilitate concept formation. Both examples and non-examples are used to present learning material. By studying this model students do not produce any concept but they only try to understand the concept which have been selected by the teacher and thus the data source should be known beforehand.

Instructional and Nurturant Effect – Model of concept attainment has been designed to enrich the students on specific concepts and by the nature of concepts. It is also helped in practicing the inductive reasoning and also provides opportunity for alternating and improving students concept building strategy. Model also nurture the student on, the awareness of an alternative perspective, in a sensitivity to logical reasoning and tolerance of ambiguity.

Applications of the Model

(1) This model is applicable to all ages and grade levels.
(2) The use of model shapes the particular learning activity. (3) The model can be used as a tool of evaluation of important ideas Introduced earlier. (4) This is also used for opening a new conceptual area by Initiating a sequence of individual or group Inquiries.
1.9 Need for the Present Study

So far teaching is being done through common sense and individualistic approach. A teacher decides how to teach a subject on the basis of his student days experiences with certain modifications, to suit his personality and level of knowledge. Teaching was mostly decided by the way teacher himself was taught the subject. The approach worked satisfactorily because the quantum of knowledge available in the field was limited and the students passing these courses were highly motivated. Now, the situation has been changed in following ways–

The horizon of a particular subject has widened to unexpected largeness. It has become very difficult to communicate even narrow specialized fields to coming generations. Hence very rigorous approach to teaching are to be selected. Student population coming to school is not so motivated as it was in the past. They cannot be taught by any method selected by the teacher. For them more specific and research based effective methods are to be employed for successful communication of the selected discipline in the limited time with its inflated magnitude.
Joyce and Weil (1980) have empirically tried out the efficacy of teaching models and claimed that these models can take into account the educational goals and curriculum together with the psychology and need of the child. These models of teaching result is more effective teaching of the basic school subjects both at elementary and secondary levels, than the methods generally employed to teach them. Joyce, Showers (1982) have supported the above view. According to them these models teach thinking as well as increase the learning of subject matter and academic skills.

Researches on science teaching shows that the effect of different teaching strategies needs further verification. Systematic and experimental type of research in science teaching is inadequate. Though the area of science teaching has long been touched by Henry (1947) but the prevalent teaching strategies or methods are proving to be less feasible and effective in accomplishing specific Instructional goals. Models of teaching given by Joyce and Weil (1980) seems to be suitable for the teaching of all school subjects as they emphasize on both content and process of teaching. Present investigator, from the study of related literature, has found that the effectiveness of different models for teaching Biological science is very few. So, there is a need of the hour to adopt suitable teaching methods with a conscious effort.
to help the students achieve the objectives of science teaching.

Keeping this view in mind the present study has taken Advance Organizer Model and Concept Attainment Model for its purpose.

1.10 **Statement of the Problem**:

The proposed study may be stated as **Effectiveness of Advance Organizer and Concept Attainment Model for Teaching Biological Sciences to Grade IX Students**.

**Assumptions Underlying the Study**: The following are the assumptions underlying the present study:

1. Ausubel’s Advance Organizer Model and Bruner’s Concept Attainment Models representatives of expository and thinking methods.

2. Teaching can be programmed to a great extent to teach according to these models.

3. Relative effectiveness of these models can be judged in terms of pupil’s achievement in and attitude towards the subject to be taught.
4. Teacher behaviors are only partially controlled by student’s responses and to a large extent by the method adopted.

5. Error variance due to random fluctuations are self-compensating.

6. There is no one best way to teach.

1.11 Definition of the Terms Used:

1. **Effectiveness**: The term effectiveness refers to the effect of teaching model on achievement of Grade IX students in Biological Sciences.

2. **Achievement in Biological Sciences**: It refers to total marks obtained by the students on achievement test of Biological Sciences, (developed by researcher). The difference between post-test and pre-test has been taken as gain achievement scores.

3. **Attitude towards Biological Sciences**: Attitude refers to student inclination towards the Biological Sciences as measured on Jeev Vigyan Ke Prati Chhatra Abhivitri Mapan Suchi (developed by Sushama, 1987). The
difference between of the post-test and pre-test has been taken as gain scores in attitude.

4. **Models of teaching**: In the present study models of teaching refers to the prescriptive teaching strategy designed to accomplish the particular instructional goals in a specific, well structured and logically consistent teaching learning situations. The models selected are: (i) Advance Organizer Model (AOM), (ii) Concept Attainment Model (CAM). These models have been developed by Ausubel and Bruner respectively, is adopted as described by Bruce- Joyce and Marsha Weil in their book Model of teaching (1990).

5. **Conventional Teaching**: Conventional teaching refers to the teaching as practice by teachers in our classroom usually based on Herbartian steps - introduction, presentation, association, generalization and application.

1.12 **Objective of the Study**:

The objectives of the present study were -

1. To study the effect of Advance Organizer Model based teaching on pupils’ achievement in Biological Sciences.

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2. To study the effect of Concept Attainment Model based teaching on pupils’ achievement in Biological Sciences

3. To compare the effectiveness of Advance Organizer Model, Concept Attainment Model and Conventional Teaching on pupils’ achievement in Biological Sciences.

4. To study the effect of Advance Organizer Model based teaching on pupils’ attitude towards Biological Sciences.

5. To study the effect of Concept Attainment Model based teaching on pupils’ attitude towards Biological Sciences.

6. To study the difference in change in pupils’ attitude towards the Biological Sciences when taught through Advance Organizer Model, Concept Attainment Model and Conventional Method of teaching.

1.13 Hypotheses

The following null hypothesis was tested during the proposed study:

Ho₁ : There is no significant difference between the pre-test and post-test achievement scores of pupils in Biological Sciences taught through Advance Organizer Model.
Ho$_2$ : There is no significant difference between the pre-test and post-test achievement score of pupils in Biological Sciences taught through Concept Attainment Model.

Ho$_3$ : There is no significant difference among the mean gain achievement scores of pupils in Biological Sciences taught through Advance Organizer Model, Concept Attainment Model and Conventional Teaching.

Ho$_4$ : There is no significant difference between the pre-test and post-test attitude scores of pupils in Biological Sciences taught through Advance Organizer Model.

Ho$_5$ : There is no significant difference between the pre-test post-test attitude scores of pupils in Biological Sciences taught through Concept Attainment Model.

Ho$_6$ : There is no significant difference among the mean of gain scores of pupils attitude towards Biological Sciences when taught through Advance Organizer Model, Concept Attainment Model and Conventional Teaching.
1.14 Delimitations of Study

The present study was specified according to the following delimitations:

1. The study is confined only to two models of teaching i.e. Advance Organizer Model (AOM), Concept Attainment Model (CAM).

2. Only two criteria variables achievement & attitude towards the Biological Sciences was selected to evaluate the effectiveness of the model of teaching.

3. Only male students of IX grade were taken into account in the present study.

3. The experiment was conducted on IX grade students of Maharaja Kumar Ananta Narayan Singh Vidya Sansthan, Gyanpur under the U.P. Madyanik Shiksha Parishada, Allahabad.

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