CHAPTER - 1

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1. Introduction:

   Education has been considered in all times to be an instrument of social change. This objective cannot be attained without having improved the class room practices.

   Education is the learning of knowledge, information and skills during the course of life. Teachers may draw on many subjects, including reading, writing, mathematics, science and history. Teachers in specialized professions such as astrophysics, law, or Zoology may teach only a certain subject, usually as professors at institutions of higher learning. There is much specialist instruction in fields for those who want specific skills, such as required to be a pilot, for example. Finally, there is an array of educational opportunity at the informal level—such as with museums, libraries and the Internet. Informal education also includes knowledge and skills learned during the course of life, including education that comes from experience.

   The right to education has been described as a basic human right: since 1952, article 2 of the first Protocol to the European Convention on Human Rights obliges all signatory parties to guarantee
the right to education. At world level, the United Nations’ International

Teaching is an activity, designed and performed for the
attainment of a larger number of objectives in terms of changes in pupil’s
behaviour.

Education plays an important role in the progress of an
individual’s mind and country. Ignorance and poverty are major speed-
breakers in the swift developing country and can be overcome easily
through education. You can’t call yourself educated if you can only read
and write, get full marks in every subject and can recite Shakespeare’s
sonnets by heart. A person who is educated has a certain aura around
him/her of dignity and wisdom. If you are educated, you don’t need to
abide by the facts that the book recites or follow and Aristotle’s
philosophy. An educated person builds on the facts the book says and has
his own philosophy. If you are educated, you can’t have a wrong
philosophy. Education is everything. People are made aware of what is
going on in the wide world and can understand these issues and take
necessary measures. If people are educated, it is not difficult to find a
job- keeping in mind the fact that no job is low. Education tames the
astray mind, nurturing its capabilities the same way training builds a
clever dog. Do you think any country will ever look back if the people
are fully educated, have some income to support their family, are aware
of the happening in the world, and contribute to the country’s development? If you think it will look back, dear reader, you need education.

The field of education, covering ethics, religion, skills and general knowledge, is a very broad and very vital one. The importance of learning in enabling the individual to put his potentials to optimal use is self-evident. Without education, the training of the human minds is incomplete.

Education makes man a right thinker and a correct decision-maker. It achieves this by bringing him knowledge from the external world, teaching him to reason, and acquainting him with past history, so that he may be a better judge of the present. Without education, man, as it were, is shut up in a window less open to the outside world.

At present, explosion of knowledge is being achieved through the development of science and technology. Instructional technology has come out with bubbling ideas. Pupils have varied personalities, which need different styles of learning. The common implication of both facts is that teacher should use such strategies of teaching which would match the instructional objectives of learning styles. There are many powerful models of teaching designed to bring about particular kinds of learning and to help students become more effective learners. As educators, we
need ability to identify these models and to select the ones we will master in order to develop and increase our own effectiveness.

1. 1. Science education:

The Oxford dictionary (2003) defines science as a branch of knowledge which involves the systemized observations of an experiment with phenomena. The NCERT (2006) in its position paper on science describes science as a human enterprise undertaken to gather an understanding of the Biological and Physical aspects of the world around us. This understanding includes the development of ideas (or) Concepts, which emphasis the comprehension of related situations events and objects to be linked together in order to make past experience a foundation.

Based on the above, science education has been bestowed a prominent place in school curricula of the Indian educational system. It is compulsory subject for all students up to class X (NCERT, 1975). This position has been accorded to science with the prime objective of nurturing scientific temper among the students. The curriculum aims to develop among student’s abilities and values such as spirit of inquiry, creativity, objectivity the courage to question and the aesthetic abilities (NPE 1986) All these, in turn will help foster in students, proficiencies in solving problem and decision making skills and to discover the relationship of science with health, agriculture, industry and other aspects.
of daily life (NPE 1986) Therefore science education aims to develop ingenuity among the students.

However the rate at which knowledge in science today is getting absolute. It is all the more essential that the emphasis of science education should be on the development of abilities and disposition of mind rather than merely the transfer of dead subject matter.

1.1.2. Problem of misconception:

Learning science requires learning its language, which often differs from daily language. Today’s education intends to produce citizens who can deal with words, concepts and scientific symbols necessary for the success in the technologically advanced modern age. From the developmental view of science education children do not comes to school with “Zero” in science learning. They have already reacted to gravity, energy, lightning, thunder, darkness, light, weather and lots of other scientific phenomena.

Misconceptions in science are ideas that are at a variance with accepted views (or) student’s ideas that are different from the ones generally accepted by scientists.

Preconceived notions (or) preconceptions of the natural world are popular conceptions rooted in everyday experience, when the children experience. When the children exploring their surroundings they will naturally attempt to explain some of the phenomenon they encounter in
their own terms and share their explanations. When students reach incorrect assumptions these pre-conceptions also misconceptions.

**Vernacular:** Misconceptions arrive from the use of words that mean one thing in everyday life and another in a scientific context, for example everyday use of words work, power and sound.

Physics (and so Chemistry and Biology) has concepts and skills (processes). Temperature is a concept and measuring temperature with a thermometer is a skill. Weight is a concept and weighing with a spring balance is a skill. Weighing anything in two pan balance (physical balance, Chemical balance) gives mass of the body, not weight. People say, “It is weight”. This is misconception. Weight =mass x g, (g= acceleration due to gravity)

Conceptual misunderstandings are resulted when teaching of scientific information is in a manner that does not encourage students to settle any cognitive disequilibrium.

There are numerous ways for misconceptions to occur. Scientific data are constantly changing. Parents and teachers relay their misconceptions to the children they teach. One of the causes of misconception is cognitive overload.

Students can become confused in science because of many factors, Language usage, everyday experience, analogies and metaphors, examination papers and text books.
1.1.3. How to correct misconceptions?

Studies on misconception can help to remove misconception with relevant methods facilitated by improved understanding of the field. This can contribute to the national development through eradication of superstitions, and through developing objectivity, open mindedness, critical thinking, and adoption of scientific method in solving problems.

Misconceptions are very stable. Most of students’ misconceptions exist after instruction. Confidence in Misconception increases over time and becomes more intransigent despite instruction to the contrary.

Replacing the existing false knowledge with scientific one is one of the aims of conceptual change strategies.

Often the students themselves can easily correct vernacular and factual misconceptions. However simply insisting that the learner dismiss preconceived notions and ingrained non-scientific believes is not elective for a teacher. For a change in conception Posner et. al., (1982) suggested four conditions.

1. Students must become dissatisfied with their existing conceptions.
2. The new concept must be clear and understandable for students.
3. The current problem is solved by using the new concept.
4. Similar future problems can be solved by using new concept.
Therefore teaching should develop strategies to create cognitive conflict in students, organize instructions to diagnose errors in students thinking and help students’ translate from one mode of representation to another.

1.2. Concept Of Science:

It is indisputable that today science is the by word and that the scientific aspect of things is emphasized wherever one goes. Science is the central enterprise of the societies populating the planet earth. Still virtually anywhere in the world that we might stop to inquire, science means almost nothing to the average person. Yet its impact on all of us is for growing. Science is known to many people because of its applications and not of its theories.

Our environment to a great degree is influenced by science. The cloth’s we wear, the houses we build and live in, the agricultural methods which produce our food, our automobiles, our electrical appliances used are all based upon scientific information. Our environment would be entirely changed if it were not for our continual exposure to the results of the application of scientific principles. Industry would still be an infant if it were not for science. Without science most of our luxuries and comforts would be unknown. It has helped in the reduction of pain and human sufferings which accompany diseases and injuries of the human mechanism. It has shrink the world and made it
more accessible. It has controlled health, transportation and power. It is the technological innovations derived from science that determine the character of a nation.

Intact, the term science (Scientia) is ‘etymologically synonymous with knowledge’ which, of course, true does not imply that all knowledge is science. The description of science as a body of systematized knowledge is also inadequate because the ‘extensions of the definition, customarily and legitimately made, embrace the practices of finding out and using what becomes known, together with the human skills necessary for or acquired in the process’. ‘Science there by becomes knowledge acquired in a particular way that it becomes a human activity, an attitude and an exercise of the mind that puts us as it were in a state of familiarity with nature’ (Gilbert Archey).

The Columbia Encyclopedia defines science as ‘An accumulated and systematized learning, in general usage restricted to natural phenomena’. ‘The progress of science is marked not only by an accumulation of facts, but by the emergence of scientific method and of the scientific attitude’.

Science Manpower project defines, “Science is cumulative and endless series of empirical observations which result in the formation of concepts and theories, with both concepts and theories being subject to
modification in the light of further empirical observations. Science is both a body of knowledge and the process of acquiring it”.

According to Gagne (1965), ‘Science is what the scientist does. It is a process by which we increase and refine understanding of ourselves and of the universe through continuous observation, experimentation, application and verification’.

In terms of policy, the Government of India adopted in 1968, “it is an inherent obligation of a great country like India, with its tradition of scholarship and original thinking and its great cultural heritage, to participate fully in the march of science, which is probably making greatest enterprise today”.

From these definitions it is evident that science is a body of knowledge acquired through scientific method of inquiry. This indicates that science is both a product and a process. ‘Accumulation of Knowledge’, forms the product side of science. Science is being taught in our schools as a body of established facts obtained by individuals using infallible methods. Our present classroom practices emphasize on this product side of science rather than the method of acquiring this knowledge which is the scientific method which forms the process side of science. Observation, classification, making inferences, formulating and testing hypotheses and conducting of experiments of natural phenomena are processes which form the process of science.
In an attempt to define processes in science the American Association for Advancement of Science (AAAS) asked scientists to reveal, what they actually do. This inquiry led to the following identifications.

a. Observation
b. Classification
c. Number relations
d. Measurement
e. Space/time relations
f. Communication
g. Prediction
h. Inference
i. Making operational definitions
j. Formulating hypotheses
k. Interpreting data
l. Identifying and controlling variables
m. Experimenting.

1.2.1. Outcomes of Science Education.

According to great French scholar, H.I. Marion, any education worthy of its name has two aspects: the technical education and the ethical education. The technical education is the education necessary to know the content and process of science (with technology deliberately
eliminated) with a view to meet nation’s needs for scientists, engineers and technicians. The ethical education means the education by ‘which men attempt to resolve the confusion which exists as we try to find ways by which men will live with men and their environment which is the challenge which has faced tribes and nations since the dawn of history”.

Education and the spirit of Science, a document already referred to, asks us to address ourselves to this challenge in our times and the times to come. This view is quite consistent with the view expressed by John ciardi who sees two different kinds of education, namely, the categorical education, i.e., the education for the scientific services and the education through confused ideas, i.e., developing friendship with confusion (fluid inquires in contrast to stable inquiries where only gaps are filled in a growing body of knowledge). In our opinion, there is no inherent conflict between these two aspects of education which in fact need to be dovetailed in the very educative process.

Looking deeply into the nature of science, its auto-acceleration, two aspects of education and its aims of teaching at school, it becomes quite clear that, as far as possible, teaching of science to its young consumers should include proposing problems, refining and defining them more productively, setting up hypotheses and their testing with the help of control experiments, thinking out new solutions, discarding personal opinion in the light of new evidence and suspended judgment in
case of conflicting evidence, discarding even the principle of authority, if found necessary, and, in short, distinguishing between scientific information and popular information and beliefs, etc. These initiations and expectations should be brought down to the children’s level of experience, comprehension and followed up later on to promote the quality of reasoning as the children go up to the school ladder. These visualized behaviour changes, among the body of children, are referred here as the outcomes of science education.

These outcomes in this light are stated as follows:

1. Functional Understanding
   a. Scientific vocabulary
   b. Scientific fact
   c. Scientific concept
   d. Conceptual scheme
   e. Application to new phenomena.

2. Scientific skills

3. Scientific attitudes

4. Scientific interests

5. Scientific appreciations

1.3 Modern Science:

Science is a way of thinking a way of understanding the world.

The term “scientific method” has fallen into disfavor among educators
perhaps because it conjures up images of a white-coated man hunched over a pretty dish. It ought to be restored. The scientific method is the method of thought of reasoning which applies not only explorations of the physical universe but to all the realms of intellectual inquiry that require hypotheses inference and other tools of brainwork. As Bertrand Russell explained: “A fact in science is not a more fact but an instance”.

Science is the system of knowing the universe through data collected by observation and controlled experimentation. As data are collected, theories are advance to explain and account for what has been observed. The true test of a theory in science is three fold:

1. its ability to explain what has been observed,
2. its ability to predict what has not yet been observed, and
3. Its ability to be tested by further experimentation and to be modified as required by acquisition of new data.

If we read this definition of science you will see three major elements processes, products, and human attitude. Elements of science can be visualized in this way;

- Process or methods-Certain ways or investigating problems, observing – for example, making hypotheses, designing and carrying out experiments, evaluating data, measuring and so on.
- Products - Facts, principles, laws, theories - for example the scientific principle that metals expand when heated.
- Human attitudes - Certain beliefs, values and opinions – for example suspending judgment until enough data have been collected.

1.4 Science Education: Historical Perspective:

Although the use of the word, ‘processes’ in the context of science education seems to be the relatively recent origin, current emphasis on a process ‘approach’ to school science teaching transcends national boundaries and has become part not merely of the rhetoric of official and other policy statements but also of the practice and rationale of growing number of science teachers, particularly in secondary schools. Millar and Driver have categorized these meanings as ‘the processes scientists use in investigating the natural world, the cognitive processes involved in learning science and the pedagogical processes taking place in classrooms’.

1.4.1. The nineteenth-century background:

When John Herschel’s Preliminary Discourse on the study of natural Philosophy was published in 1813, its publication was significant in at least two respects. In concentrating almost exclusively on scientific method, it differed from previous books published in English and concerned in a more general way with epistemological issues. In addition, it reflected a rapidly growing interest in the nature of scientific method which, in the following decades, was to lead to a large increase in
the number of publications devoted to the topic and ultimately to a ‘virtual revolution’ in the study of the history and philosophy itself. This rise in interest in scientific method coincided with the increasing organization and professionalization of the scientific community and, in particular, with the establishment by erstwhile natural philosophers of specialist learned societies to promote their particular scientific interest. For example, the geological, astronomical, and chemical societies were founded in 1800, 1820 and 1841 respectively.

The role of the British Association for the Advancement of Science (BAAS) as a general scientific forum was almost immediately undermined by the establishment of separate specialist sections, the ideal of unity among the sciences remained important, not least for political purposes. The question, therefore, was how such unity could be nurtured at a time when scientific specialization was bringing such success and it was rapidly becoming impossible for a scientist to keep in touch with developments outside his own specialism. The answer lay in the notion of consensus about the methodology of the various sciences. In Herschel’s words, ‘natural philosophy is essentially united in all its department, through all of which one spirit regains and one method of inquiry applies’. This view was promoted in a succession of Presidential Addresses to the British Association and, where necessary, was invoked
to defend science from its critics or to distinguish reputable science from the suspect of bogus.

In Huxley’s estimation in 1854, the results obtained by science were won ‘by on mental process other than those which are practiced by every one of us, in the humblest and meanest affairs of life Science. In consequence, was ‘nothing but trained and organized common sense, differing from the latter only a veteran may differ from a raw recruit’? Since educational issues were frequently the focus of political or religious controversy, they were unlikely to be espoused by an organization anxious to insulate science from the disputes of politics and theology and committed to the furtherance of consensual ‘objective’ knowledge. However, by mid-1850s, as the Association gained recognition by government and other organizations as vehicle for the advancement of science and its institutions, the attitude of the Associations towards educational questions began to change. The need for greater attention to be given to the study of science in schools and universities featured in several Presidential Addresses.

1.5 Science Education Scenario:

The purpose of science teaching in secondary schools is to enable the students to grasp systematically the basic knowledge of science needed for the further study of modern science and technology and to understand its applications. In addition, it should help them to
acquire experimental skills, develop the ability to think and to use mathematics to solve physics problems.

The less creative children in our schools today are the living testimony to the degree to which creativity can be killed off easily. Once it appears on the surface, its reappearances can be assured by use of all the techniques that cause behaviour to reappear. But it doesn’t appear unless certain conditions are present that because it come forth, nurtures properly for the benefit of the individual and the society. The present condition of science education in India is reflected in the National Curriculum Framework Review – 2005 that, “For the last many decades, science education in India has been an enterprise of unresolved dichotomies and contradictions. For almost three decades now, science is a compulsory subject up to Class X throughout the country, yet this universal science education continues to be largely irrelevant to most students and its quality unacceptably poor. Though the over-all conceptualization of science curriculum at the national level has matured steadily and kept pace with evolving contemporary trends in science education the world over; yet this has hardly translated into any significant improvement in the actual science teaching.

Therefore, for a majority of students, science is just another demanding and difficult subject to be learnt by rote, with no meaningful
learning outcomes. This results a small number of students with outstanding competence in science comparable to international standards.

From the above it is evident that, science education in schools emphasizes the products of science but not the processes of science thus curbing the intuitive and inquiry skills of the students. This trend is a mortal blow to the tender trait—‘Curiosity’. Teaching science has become merely a one-way traffic. Dialogue – the first step in the process of acquisition of knowledge is seldom encouraged. It is essentially a free uninhibited dialogue between an inquisitive student and our experienced teacher that leads to the expansion of the horizons of opportunity for a student to think frankly, to create, and to innovate. Unfortunately, the system turns out students who lack curiosity, innovativeness and are devoid of creativity and self-confidence (Bhide, V.G. and Dr. Frank, 1997).

Prof. C.N.R. Rao, Scientific Advisor to Prime Minister of India expressed his grief about the basic sciences. He lamented, “Information Technology and its related services transformed the population service-oriented rather than manufacture-oriented. The latter would have been possible if the youth had willingly taken up pure sciences leading to indigenous technology development. He also reasoned it due to very shift resulted in the youth with scientific potential being weaned away from pure sciences, leading to the decline of science in India. He also claimed
that there are hardly any students taking up scholarships and research activities in pure sciences. Finally he warned that India has to pay a heavy price in near future.” (Vijay Times – 13 November 2006). Professor C.N.R. Rao’s remarks are supported by many a learned men in the country.

It is also depressing that in the recent International Journal-‘Nature’, it has been indicated that India’s contribution to the world of science is deteriorating. However, it mentioned that the trend is a spreading global phenomenon, differing in proportions.

Professor R.M.Kalra (Former Dean, NIE, NCERT), in a seminar titled- “Science Education at Cross Roads in the 21st Century, at New Delhi, 1997”, opined that- “to popularize among students especially at the school stage, we may have to re-engineer our science education system in the 21st Century. To accomplish this, we have to evolve standards of science education at different stages of school education and determine the attitude of students towards science”.

This need is further emphasized through the words of the Honorable former President of India, Dr.A.P.J. Abdul Kalam,

“The way to development is through purposeful activity. The young especially have to be guided properly, so that their lives find a proper direction and their creativity is allowed to flower. To facilitate this, certain educational reforms must be initiated”.
1.6. Science Teaching and Achievement:

Science is of great interest to children and is ever present. Science is concerned with explanations and resolution of problems. Its study provides a natural opportunity for children to grow in ability to solve problems. This growth in ability to solve problems is one of the primary contributions science can make.

Problem solving in science involves the use of scientific habits and attitudes, which include: careful observations, accurate interpretation of these observations, and skilful recording and communicating them. It includes the habit of withholding judgment, questioning sources of information, consulting many sources, and other familiar aspects of scientific attitude.

The cumulative aspect of science is that knowledge grows as it builds on other previous knowledge. In solving a science problem we do not start from the beginning instead we use what others have discovered and build on it, this is also true when pupils solve problems; it is also true when scientists solve problems. As a human endeavor, science has been arisen out of the process of solving in science itself; however its role in the science curriculum is not very clearly established.

For the teacher should be effective, they must not only have a thorough knowledge about the subject matter, but also know their students. This knowledge is believed to be critical in designing an
instructional process that teaching youngster’s memory strategy that can be used in challenging the status-quo. Through the use of instructional models such as Concept Attainment Model, Inquiry Training Model and Synectics, students’ thinking is extended and problem solving knowledge are introduced, practiced and applied. It is emphasized that students should be engaged in the process of learning as a contextualized experience that relates subject matter, achievement, personal and community issues, and a challenge to the status-quo of most culturally diverse families (Ladson-Billings, 1994).

It is the present investigator’s intention to find whether the memory leads to achievement in science? If so, do the students develop attitude towards the subject domain taught? Hence, it is imperative to analyze the concept of Attitude and Attitude towards Science.

1.7. Science Teaching and Retention:

Repetition beyond the criterion of initial correctness is necessary to ensure maximum retention of materials learned.

Benton J. Underwood states in the Scientific American that the “ultimate degree of learning rather than the rate of learning is the critical factor in forgetting”. Many studies have indicated that one of the basic aims of education, retention, is aided by over-learning.

Much of the interest in forgetting and retention shown by researchers in this century was inspired by the work of the German,
Ebbinghaus. He found that a series of syllables which were learned twice faded away more slowly than those that were learned only once. The more often they were repeated the less easily they were forgotten.

Kreuger used a list of 12 monosyllabic nouns on a memory drum to find whether increased learning was proportional to retention. He concluded that “a certain degree of over-learning, at least 50 percent, is highly economical from the standpoint of retention for intervals of 2 to 28 days, and the larger the interval the greater the economy”.

Klausmeier and Check, however, put little faith in trying to draw conclusions for understanding retention of classroom learning of meaningless syllables. It may be well, therefore to cite experiments conducted under classroom conditions. Spitzer made a study of the effect recall tests on retention. He found that they were an effective method of aiding retention since the students reviewed the material learned. Raffel studied the effect of recall on learning words by college students. She found that retention tests given at spaced intervals acted as relearning devices and were superior to other schedules of testing.

Other investigations have attempted to ascertain the effect of reviews on retention. Peterson and others investigated the effect of review of historical materials on retention in college classes. One review group showed a superiority of 57 percent over the control group.
Tiedman found that the retention of material learned in the classroom was significantly benefitted by review tests.

*Implication for science Education:*

Science teachers for many years have been familiar with the fact that one of the best ways to prevent subsequent forgetting is to provide for over-learning. But mere repetition does not guarantee that what is to be learned will be more easily retained. To make Ram repeat 100 times any scientific principle does not guarantee that he has learned. In fact, it may well work the other way. The repetition or review must be meaningful to the child and he must want to retain. The science teacher, therefore, should devise methods that will keep the review from merely taking the form of drill or rote learning. This can be done in numerous ways. A student may learn concept in science but instead of his repeating it over and over it would be well to utilize the skill in the solution of problems in a large number of different circumstances so that ample opportunity is provided for over-learning. Recall tests, reviews and exercises can be used frequently and varied frequently, to save the learner from becoming bored, and yet providing for over-learning.

If there is a failure of recall, it is probably because of the interference coming from subsequent new learning. However, subsequent new learning need not necessarily mean that there will be a failure in recall.
There has been a considerable amount of research done on “interference theory” or “retroactive inhibition”. Since there are numerous variables to be considered in experiments on retroactive inhibition and forgetting, most of the investigators consider one or more of these variables as part of their study. Mordock has demonstrated that interference among verbal lists can be shown with chains as short as three verbal items if a learner is instructed to count backwards by three’s from some given number. McGeoch and McGeoch found that retroactive inhibition was partly a function of the number of repetitions of interpolated lists. The same authors also found the synonymy between the members of the original and interpolated lists to be highly favorable condition for the production of retroactive inhibition, and hence forgetting. Melton and Irwin have found that using 5, 10, 20 and 40 trials for the interpolated learning following the original learning of 18 nonsense syllables, the greatest retroactive inhibition occurred after ten trial interpolations, and the least for five. In another experiment, Melton and Lackum demonstrated that part of the total interference must be attributed to factors other than competition at the point of recall. They identified another 5 factor as the unlearning of the original response.

Implications for Science Education:

One of the obvious conclusions one could draw from the research evidence is that if a new scientific principle interferes with old
learning and causes a failure of recall, then there is little point in learning things that will interfere. But the old saying “the more I learn the more I forget” is not entirely true; this can be overcome in a number of ways.

One of the ways to overcome interference is to over-learn the material to be learned and, as already pointed out, make it more resistant to forgetting. If a science teacher is aware of the fact of interference, he can make sure that material is thoroughly learned before new learning is introduced.

Another way of combating retroactive inhibition is for the science teacher to be constantly teaching science with discrimination in mind.

It has also been shown by research that if the material is meaningful to the learner it is less easily forgotten and less easily interfered with. Science teachers, therefore, should attempt to make the learning experiences of the student as meaningful as possible through careful motivation and application to real life.

Thus the teaching of science has a number of purposes to achieve if it is to merit a place in the school curriculum.

It should carry young people farther along in their understanding of selected generalized concepts, the methods of science, and the social implication of science. It should develop an appreciation of the role of science in advancing man’s understanding and control of the world of
nature. It should develop a disposition to use the knowledge and methods of science whenever appropriate. It should develop abilities that make young people increasingly independent investigators and learners.

1.8. Attitude towards Science:

Science educators have recognized that fostering a favorable attitude towards science is the most important outcome of Science Teaching. Many experiments have been carried on in the field of measuring attitudes. Science teachers and educators are not, however, aware of the need of some valuable and reliable research on the measurement of attitude towards science and its influence on certain school achievements and its development. They have realized the importance of inculcating and developing favorable attitude towards science among different groups of pupils. Development of attitudes can be achieved only through many directions and associated behavioural factors.

The term attitude towards science is composed of two words - ‘Attitude’ and ‘Science’. Attitude according to Thurston (1948) is the degree of positive and negative effect associated with some psychological object. Object here is Science as a discipline. Richard W. More (1970) has rightly defined science attitude as the opinion or position taken with respect to a psychological object in the field of science. Attitude towards science indicates feelings of an individual or a group concerning science
like faith in Scientific Method, opinion about scientists, values of science, interaction of science with individual and society, opinion held about science related social issues. It is the tendency to react favorably or unfavorably towards science or in science. Hence attitude towards science if the generalized attitude the universe of science content and being measured in terms of its favorableness estimated from the scores obtained by the subject on an “Attitude Scale towards Science”.

1.9. Emergence of Models of Teaching:

In the history of pedagogy, though myriad methods of teaching have emerged and evolved, teachers all over the world including our own country follow fixed ways of classroom teaching. Teachers following such a fixed ways of teaching fail to achieve a variety of instructional objectives, for which teaching is designed and performed. They further fail to meet the needs of pupils with multidimensional personalities with different learning styles. Complementing such deficient implications teachers should use different strategies of teaching to match the objectives of teaching and the different learning styles and personalities of students (passi, Singh and Sansnwal, 1990).

Dunn and Dunn (1979), Fischer and Fischer (1979), Ellis(1979), Joyce and Weil (1980) have strongly believed that the strength in education resides in the intelligent use of the powerful variety of approaches – matching them to different goals and adapting them to the
students’ styles and characteristics. Competence in teaching stems from the capacity to reach out to different children and to create a rich and multi-dimensional environment for them.

“Models of Teaching” emerged out of search by Joyce and Weil (1972) to find a variety of approaches or strategies of teaching to match the various learning styles. A model of a bridge does not guide an engineer to construct a building. It is meant for a particular purpose. In the teaching-learning process, models have the same interpretation as they have in the case of bridges, dams etc. Thus, models of teaching present the steps necessary to bring about a desired outcome.

According to Joyce and Weil (1972), a teaching model is pattern or plan which can be used to design face-to-face teaching in classrooms or any other settings to shape instructional materials, and curricula and long-term courses of study. They further glorified the models of teaching as follows.

“Models of Teaching are really Models of learning. As we help students acquire information, ideas, skills, values, ways of thinking and means of expressing themselves, we are also teaching them how to learn”.

The models of teaching enjoy the following significant characteristics:
• They are some sort of plans or guidelines of patterns or strategies of teaching.
• They are not haphazard combination of facts but are, on the other hand, systematic procedures to modify the behaviour of the learners.
• Models of teaching specify the learning outcomes or instructional objectives in terms of observable and measurable performance of students.
• Models of teaching specify in definite terms the environmental conditions under which a student’s response should be observed.
• They specify the criteria of acceptable performance expected from the students.

The concept of Model of Teaching thus reveals three major functions in the learning process. They are:

• Designing of Curriculum or Courses of study;
• Development and selection of instructional materials; and
• Guiding the teacher’s activities in the teaching-learning situation.

During the last two decades, a lot of attention has been paid to improving the process of teaching, resulting in the development of a number of models of teaching by various researches. All these models are based on empirical researches, theories, hunches, postulates,
hypothalorical propositions, etc. Among them, the monumental work of Joyce and Weil (1980) collected 24 teaching models. These models of teaching because of their interactive, participatory, adaptable, implementing and persuasive nature have a great potentiality for achieving the aims and objectives of education. They are classified into four families namely:

i. Information Processing Models

ii. Social – Interaction Models

iii. Personal Models and


No single model, from the above families is superior for all purposes. Every model has its dramatic effect in specific applications. Among them Inquiry Training Model, Concept Attainment Model, Advanced Organizer Model, Biological Inquiry Model and Inductive Thinking Model are relevant to teach concepts in science.

1.10. The Concept Attainment Model:

The Concept Attainment Model is an inductive teaching strategy designed to help students of all ages reinforce their understanding of concepts and practice hypotheses testing. Developed from concept – learning research (Klausmeier, 1985; Tennyson and Cochiarella, 1986), the model uses positive and negative examples to illustrate concepts as simple as square or dog and as sophisticated as oxymoron or socialism.
The design of this model, first suggested by Joyce and Weil (1972), is based on the work of Bruner, Goodnow, and Austin (1956) who investigated how different variables affect the concept-learning process. The model is consistent with the views of constructivism which suggest that learners “construct” their own understanding of the way the world works rather than having it presented to them in an already – organized form. When the Concept – Attainment Model is used, positive and negative examples of concepts become the basis for students’ constructions.

The Concept-Attainment Model is also useful for giving students experience with the scientific method and particularly with hypotheses testing, experiences that are often hard to provide in content areas other than science.

Concept attainment is the process defining concepts by determining the attributes that are essential absolutely to the meaning and disregarding those that are not. It also means learning to discriminate between what is and what is not an example of the concept.

According to Chohan (1989) model of teaching is an instructional design which describes the process of specifying and producing situations which helps in bringing desired changes in students, behaviour. Cele (1988) described that concept attainment model is a
teaching strategy based on analysis of the nature of concepts and how they are acquired. This strategy is the most structured. Students must be guided carefully. Concept attainment is a search for “listing of attributes that can be used to distinguish exemplars from non-exemplars “of various categories (Joyce & Weil 2007) A concept has 4 elements.

i. A name

ii. Example

iii. Attributes

iv. Attribute values

1.10.1. Goals for the Concept-Attainment Model:

Content goals for a Concept-Attainment and an Inductive-Model lesson are related but not identical. There are two important differences between the models.

- First, while the Inductive Model is designed to teach concepts, principles, generalizations, or academic rules, the Concept-Attainment Model- as the name implies focuses exclusively on concepts.

- Second while the Inductive Model can be used to teach a topic essentially from “search” the Concept Attainment Model requires that the students have some background with the concept.

For this reason, the Concept Attainment Model is often most effective for enrichment of a concept rather than for initial learning. It
can be effectively used as a form of review and to help students understand the relationships between closely related concepts, Developing Students’ Critical Thinking.

The Inductive Model and Concept-Attainment Model also differ in their emphasis. Unlike the Inductive Model, which emphasizes students’ deep understanding of specific topics, the Concept-Attainment Model strongly focuses on the development of critical thinking in the form of hypotheses testing.

1. 11. Need and Importance:

In the point of view of teaching according to Joyce and Weil (1985) a model of teaching is a plan or pattern that can be used to shape curricula, to design instructional material and to guide instruction in the classroom and other settings.

There are varying instructional goals for different classes and different subjects. We can refer Bloom’s taxonomy of educational objectives, which is categorized into three domains cognitive, affective and psychomotor. To achieve these educational objectives or goals, the teachers must practice different teaching strategies. Model approach was proposed by a number of educationists and psychologists.

The most important aim of any model of teaching is to improve the instructional effectiveness through an interactive atmosphere. Models of teaching serve a simplifying metaphase to concept, the model also
nurtures awareness to alternative perspectives, a sensitively to logical reasoning in communication and a tolerance of ambiguity.

In education, learning is measured through academic achievement. Achievement is the accomplishment of proficiency of performance in a given skill or body of knowledge. The knowledge attained or skills developed in a school subject usually designated by test scores or by marks given/assigned by the teacher or by any other is known as achievement.

Models of teaching are very important in enhancing the achievement of students in different subjects. There are many models of teaching to improve instructional effectiveness. Now a day the teachers are following conventional method in teaching Science. The researcher possessing Master degree in physics was interested in studying the effectiveness of models of teaching Science.

Keeping these views there is need to implement Advance Organizer model in improving academic achievement in Science. So the researcher selected to study the effect of Concept attainment model in improving academic achievement in Science of secondary school students.

In the present context education focuses on Discovery learning, problem solving, self motivated learning, meaningful learning, these methods help the learners to become innovative, creative, productive
citizen of the country which is the need of the our globalized world, hence the researcher found need to study the effect of above mentioned model to investigate into effectiveness in bringing about desired learning outcomes.

Over past few years, researcher on how students think about their own thinking has given considerable insight into the human information processing system.

How teaching is conducted has a large impact on student’s abilities to educate themselves. Successful teachers are not simply charismatic, persuasive and expert presenters. Rather they present powerful cognitive and social tasks to their students and teach the students how to make productive use of them.

Models of teaching enhance the ability of students to achieve various learning objectives. Thus, in a very real sense, increasing aptitude to learn is one of the fundamental purposes of these models.

The core of the process of teaching is the arrangement of environments within the student can interact [Dewey, 1961]. A model of teaching is a plan or pattern that we can use to design face-to-face teaching in class-rooms, or tutorials settings to shape instructional materials including books, tapes, computer-material programs and curricula (long term courses of study). Each model guides us as we design instruction to help students to achieve various objectives.
Models focusing on information processing have come to us from several sources. They can be listed as follows:

1. **Studies of thinking:**

   From the days of the earliest Greeks, philosophers have theorized about how the mind works, and how inductive and deductive thinking function. During the present century studies of thinking have been carried on using laboratory experiments and observations of individuals in problem-solving situations. Whole science of information theory has grown up to assist in the study of thinking and in problem solving.

2. **Learning theorists:**

   Many theorists are concerned with developing models for teaching concepts because, they feel, the student uses concepts; he or she learns to process information. To teach a set of concepts would be by this view, to change a portal of the individual’s thinking processes. Theorists such as David Ausubel have confined them primarily to verbal learning, where as other have dealt with additional kinds of learning. We have included the model contained in David Ausubel’s theory of meaningful verbal learning and a creation of our own.

3. **The scholarly disciplines:**

   Many models have been developed to teach either the major concepts or the systems of inquiry used by the disciplines, with the
assumption that as students learn the processes and ideas of the discipline, they incorporate them into their own system and behave differently as a result.

4. Developmental studies of the human intellect:

   Investigators have also studied the development of intellectual processes in the child and adolescent. These numerous studies provide what is still, for the most part, fairly tentative map of intellect development, but they can be used to generate theories about how to increase intellectual development.

   The range of information-processing models is considerable, and they offer the teacher several views of how students think and a good variety of techniques for trying to improve thinking ability.

1.12. Statement of the Problem

   Effect of concept attainment model on different abilities of IX standard students’ achievement, retention and attitude towards science.

1.13. General objectives of the study:

For any study there are two categories of objectives,

   i. General objectives.

   ii. Specific objectives.
The general objectives are the overall objectives related to the entire subject. Whereas the specific objectives are related to the present topic of study.

*The general objectives of the study are,*

*the students will be able to,*

1. Acquire the knowledge of Models of teaching.
2. Understand the ideas, concepts and generalizations in science subjects of secondary school.
3. Develop the skill of planning concept attainment model lessons in science.
4. Apply the Model of teaching on science.
5. Appreciate the Model of teaching.
6. Prepare the achievement tools in science.
7. Equate the groups according to students intelligence.
8. Know the experimental design.
9. Differentiate inductive model and concept attainment model.
11. Generate examples and non-examples for a concept.
12. Improve their memory power.
13. Inspire the students to use critical thinking strategies to find critical attributes of the concept.
1.14. Specific objectives of the Study:

1. To study the effect of concept attainment model on achievement in science among 9th Standard students.

2. To study the effect of concept attainment model on attitude towards science among 9th standard students.

3. To study the effect of concept attainment model on retention of science concepts among 9th standard students.

4. To compare the effect of concept attainment model on achievement in science among boy and girl students of 9th standard.

5. To compare the effect of concept attainment model on attitude towards science among boy and girl students of 9th standard.

6. To compare the effect of concept attainment model on retention of science concepts among boy and girl students of 9th standard.

7. To compare the effect of concept attainment model on achievement in science with respect to ability group (low ability, average ability and high ability) of 9th standard students.

8. To compare the effect of concept attainment model on attitude towards science with respect to ability group (low ability, average ability and high ability) of 9th standard students.
9. To compare the effect of concept attainment model on retention of science concepts with respect to ability group (low ability, average ability and high ability) of 9th standard students.

10. To compare the effect of concept attainment model with that of traditional teaching on achievement in science among students of 9th standard.

11. To compare the effect of concept attainment model with that of traditional teaching on attitude towards science among students of 9th standard.

12. To compare the effect of concept attainment model with that of traditional teaching on retention of science concepts among 9th standard students.

13. To compare the effect of concept attainment model with that of traditional teaching on achievement in science among 9th standard boy students.

14. To compare the effect of concept attainment model with that of traditional teaching on attitude towards science among 9th standard boy students.

15. To compare the effect of concept attainment model with that of traditional teaching on retention of science concepts among 9th standard boy students.
16. To compare the effect of concept attainment model with that of traditional teaching on achievement in science among girl students of 9th standard.

17. To compare the effect of concept attainment model with that of traditional teaching on attitude towards science among girl students of 9th standard.

18. To compare effect of concept attainment model with that of traditional teaching on retention of science concepts among girl students of 9th standard.

19. To compare effect of concept attainment model, traditional teaching method on achievement in science among Girl and boy students of 9th standard.

20. To compare effect of concept attainment model, traditional teaching on attitude towards science among girl and boy students of 9th standard.

21. To compare effect of concept attainment model, traditional teaching method on retention of science concepts among girl and boy students of 9th standard.

22. To study the interaction effect with respect to gender (boys & Girls) teaching methods (concept attainment model, traditional teaching method) and ability groups (low ability, average ability
and high ability) on achievement in science among 9th standard students.

23. To study the interaction effect with respect to gender (boys & Girls) teaching methods (concept attainment model, traditional teaching method) and ability groups (low ability, average ability and high ability) on attitude towards science among 9th standard students.

24. To study the interaction effect with respect to gender (boys & Girls) teaching methods (concept attainment model, traditional teaching method) and ability groups (low ability, average ability and high ability) on retention of science concepts among 9th standard students.

1.15. Resume of the Succeeding Chapters:

This thesis is divided into six chapters. The first chapter being the “Problem and its context”, the second chapter deals with “Review of the Related Literature and its Synthesis”, the third chapter deals with theoretical overview of models of teaching, the fourth chapter has “The Methodology”, and transacts with “The Development of Tools”, while the fifth chapter details about “Data Analysis and Interpretation” and last Chapter VI concludes with “Summary of the Study, Findings, Conclusions, Recommendations and Suggestions for further research.”