CHAPTER 1
CHAPTER - I

INTRODUCTION

1.1 Introduction:

It is a paradox that India is a rich country but is inhabited by poor people; and that in its ancient past, it made notable contributions in the fields of philosophy, mathematics, astronomy, medicine and agriculture. It then had a long period of stagnation running over several centuries. As a British dependency and all that it implies, it had to miss for historical reasons the first Industrial Revolution. Today, when the second industrial revolution has arrived at the door-step in the west, this country, like an adolescent in fever is trying hard to achieve its past glory by recapturing its traditions of scholarship and original thinking and its great cultural heritage to participate fully in the march of science, which is probably mankind’s greatest expertise in our times.

India is rich in human resource but it is not used appropriately. If human resource of our country is used efficiently then no doubt our country will rank first among developed countries. The main defect is lack of education among villagers. They are unaware of importance of education. The development of a country depends on the scientific advancement of that country. If a country is able to produce worthy scientists then it will surely enter into the list of developed countries. Science is part of our life.
Education is not preparation for life, but life in itself. School is a place where ‘the young rebel’ is being shaped into a ‘young citizen’.

The school is the most powerful, most valuable agency and the most naturally evolved agency for the purpose of proper regulation of the social side of pupil’s life.

Education should help the children to express and bring out their talents to limelight. The main aim of education is to help the child to grow to his fullest extent possible using all his potentialities. In this modern society, education is thought to bring about desirable changes in the behaviour of its members.

In education, Curriculum development considered in its widest sense has been recognised as the main generating force not only for quality in education, but also for fostering the ability to assimilate changes, especially those due to rapid scientific and technological evolution now in process.

Science has occupied almost all spheres of human life. The wonderful achievements of science have glorified the modern world, transformed the modern civilisation into a scientific civilisation and illuminated the human creative potential.
"The aim of science teaching is not the acquisition of information and a few skills but to attain the understanding of the relationship which connects the answer to the problem"

- W. Pauli. (1985)

The National Policy on Education (1986) has emphasised the system of well planned and rigorously implemented programme of vocational education which is crucial in the proposed educational reorganisation.

These elements are meant to enhance individual employability, to reduce the mismatch between the demand and supply of skilled manpower and to provide an alternative for those pursuing higher education with out particular interest or purpose.

It is a non-discussible reality that Science are the factors by which the men’s life become easy. Completion of Science brings the success in Science. Science had occupied an important place through the history of Science. Besides, they had related with each other, i.e. the development in one of them had affected to other. The consistency, completion, concentration, between the Science education must be common goals of educators.
Security degree of boy students' learning ability of Science is higher than girl students'. Girl students have lower positive attitude toward Science and are not successful in Science. Teachers can develop the Attitude toward Science of the students, via more approximation of students on center and more organized configuration of the class (Myers and Fonts, 1992).

Recently, educational researchers have investigated what factors, affect the success in learning in science. For this reason, students' Attitude toward Science have been examined (Oppenheim, 1992). In these fields, Likert-type attitude scales are appropriate to designing-studies.

Students' knowledge of Science is random and has no plan. One of the factors which affects attitude toward Science negatively is abstraction increased in the other is irregular and heterogen structure of the Science classes. Besides, students' knowledge, environmental conclusions on their daily behaviours play role on the attitude toward Science negatively. (Stanisstreet, 1993). To develop especially the positive attitude toward Science, more contemporary and more persuasive hypothesis must be made (Crawly and Koala, 1994).

Furthermore, it is very useful to obtain the opinion students' tendency to react toward Science, which define their beliefs, preference,
decision, sensitive thoughts. (Hendley, et al., 1995). Studies showed that the teaching method, the support of the structure of the school and the family, students' attitude toward the school affect the Attitude toward Science too. Usually, the way that science is represented in the classroom and perceived by students, even when teachers believe they are presenting it in authentic and context dependent ways tends to alienate many students from science (Barton, 2000)

Studies show that, children in many classrooms have spent too much time observing, experimenting and ostensibly doing science, while never really thinking about what they were doing, never articulating ideas and never developing and conceptual awareness the Science (McNay, 2000).

Education shapes and inculcates overall development of the individuality of the child, so that he can make an original contribution to the human life. Education combines both needs and aspirations of the people and there by made powerful instrument of social, economic and cultural transformation.

Attitude are most important in the field of education. Students have favourable or unfavourable Attitude towards their study. The Attitude of students towards their study are the intensity of positive or negative affect. It may be for or against the study.
This shows that the attitude of the students towards their study differs according to their liking or disliking for the study. The pupils who have more likings for the study have favourable attitude towards study while pupils who dislike study have unfavourable attitude towards the study.

The teacher who is the moulder constantly perturbed in the existing situational problem like how to organize the syllabus, which effective teaching aid is to be used, what are the problems that students are facing in understanding the taught lesson, how better results can be brought, standard measures and planning. In this direction a study is to be taken up to understand how attitude and aptitude affect on science subject. Attitude, Aptitude, economic status, interest all these directly or indirectly influence academic achievement.

1.2 Science- Concept and Nature:

The relevance of science to the future of society is considerably more far-reaching than the influence it has had on human affairs in the past. Some of the pressing problems of society today are related to the rapid decline in the quality of global environment, depletion of natural resources, increasing poverty, hunger and illiteracy in many countries and regions of the world. Solutions based on science and technologies are likely to provide remedial
measures to some of these pressing problems, and yet science and technology as we understand today, are not available to a vast human population. A high percentage of the human population does not appreciate science or its utility and potential for economic and social development. Such an understanding is regarded today by the barriers impending the sharing and the use of scientific and other knowledge necessary to make decisions and choices. They include poor education, lack of exposure to science in the formative years, inadequate grasp of science in the general public, non-availability of proper facilities for training, poorly endowed laboratories and teaching institutions (for those already trained) and isolation of scientists and teachers. Even in the advanced countries, science or specifically science education is facing difficulties, disenchantment or absence of excitement being one of the factors.

The changing global scenario has created unusual situations for most countries today. Those in developing countries, face a formidable challenge in terms of the pressing problems related to poverty and illiteracy and at the same time, they have to compete with the advanced countries in science and technology. Thus, at no time in the history of mankind has a democratic country such as India faced such challenges where it has to feed to poor and at the same time, has to be at its very best in science and technology to be able to compete. This situation has direct impact on the strategies that one has to adopt for science and technical education.
Science is one of those human activities that man has created to gratify certain human needs and desires. Disintegrated curiosity has been the greatest motive power of scientific research. The 'search of truth' became the dominant motive in the prosecution of science. Science is valued mostly for its practical advantages though it is also valued for gratifying disintegrated curiosity and as an object of great aesthetic charm.

"Science is a 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."

- Frederic (1960)

"Science thereby becomes knowledge acquired in a particular way. 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"

- Archey (1966)

"Science as-An accumulated and systematized learning in general usage restricted to natural phenomena."

-Columbia Encyclopaedia (1977)
"Science includes the methods by which man put limiting values on his preconceptions"

- Niels Bohr (1977)

The goals and expectations of the science education change with time and with them the curriculum. Science has a variety of facets. Important of them are the processes through which one can gather information, knowledge gathered through the use of such processes and the Attitude possessed by people who use scientific processes to gather knowledge.

1.3 Aims of Teaching Science in Secondary Schools:

The world is progressing with an accelerated speed in the space-age and trying to probe through the unsolved mysteries of the universe. In order to keep abreast of time, the teaching of science in our Secondary schools is to be accelerated. Kothari commission (1966) says:

The world is now at the beginning of the second scientific, industrial revolution of automation and cybernetics, which is likely to be in full swing before the close of this century. It is
difficult to visualise the changes it will make in man’s life. One thing however is certain, unless proper steps are taken right from now, the gap between us and the industrial countries, following this second revolution may become too-wide to be bridged (18:3)

In order to take right steps from now only, teaching of science in our Secondary schools should be revolutionised. Scientific and technological revolution is not merely the concern of the scientists, but humanity at large. The destiny of a nation depends upon the progress in science. In this space-age, science alone controls the factors that influence the progress of nation and its healthy development. It provides rapid economic development and high standards of living. For the survival of democracy and socialism, Science should be taught very efficiently from the Secondary school itself. One cannot but agree with the academician, Million Shehikov (1971):

In the final analysis the scientific and technological revolution is incompatible with social injustice, it will emerge as crucial, test in great school of human history, which is profound belief, socialism alone is able to pass (4:6)
Ours is a developing nation. For all-round development of the individual and progress of science, all-round utilization of the latest achievements of science and technology is essential. For this every individual must be trained to acquire knowledge and skills of science. Science and its application permit modern life so extensively that every citizen has to have knowledge of science for effective living.

Science is interwoven with our day-to-day life. One cannot survive and live successfully without science. In this space-age, Vaidya (1971) says:

Scientific revolution has maximised opportunities for human happiness and through its technical arms it is providing material wealth, and long and healthy lives. New knowledge and the process by which it is obtained; promise a spiritual fulfilment, unavailable from the dry bones of fatalism and mysticism (14:55).

So in order to enjoy material happiness one must be acquainted with adequate knowledge of science.

Science should be recognised and taught as a major human activity which
explores realms of human experiences,
maps it methodically, but also imaginatively
and by disciplined speculation creates a
concentrate system of knowledge. (19:55)

Science and technology provides a better way of living, fulfilling the
material satisfaction and is held responsible for the development of human
personality.

Scientific knowledge and skills create confidence and a sense of
security. Ignorance gives rise to fear and insecurity. Knowledge increases
one’s ability to use it more effectively. Man by nature possesses innate
urge to know more about universe and the things around him, and wants to
establish his supremacy over everything. The ultimate goal of human
beings is to lead a happy life. So he wants more and more facilities and
securities from external danger. For this schools must teach how to possess
knowledge and powers.

This is the age of struggle for existence. This makes man to possess
superior mental powers, to strive hard to explore and to control nature,
which is not always helpful to him. So the schools should aim at
developing the mental powers.
Man is curious to know about the nature of the universe. Children by nature are curious to know more about everything they come across. Make use of this curiosity to develop the mental powers so all knowledge, skills, habits, should enable the student to increase, security happiness and progress of his social life.

Through the teaching of science most of the aims of general education can be fulfilled. The students should acquire the knowledge of the fundamental concepts of science. They should possess the ability to apply this knowledge to new situations, which they have to face in their day-to-day life.

Science should aim at developing rational thinking. A rationalist longs to know and understand. He has got the habit of questioning, searching for data, and their meaning, demanding for verification, respecting logic, consideration of premises and consequences. Science teaching should inculcate sound thinking habits in all walk of life.

1.4 Science Education:

Science education is not separate and detachable unit of Secondary education. Its growth has to be seen in the context of the past historical events. From 1905 to 1917 there was little improvement in the expansion of
science education. Then the first world war intervened which consequently interrupted this expansion considerably. Expansion in Secondary education both in the rural and urban areas after the recommendations of the Calcutta University commission when intermediate colleges in arts, science, medicine and engineering etc., were set up. Since then, the expenditure on and expansion of Secondary education has been on the increase except during the second world war, when the educational system was just kept going on.

Science is one of the areas in which it is essential to check ideas against empirical experience. Children have to check their ideas against what actually happens even though this may not always be what they would like to have happened the nature of science itself. Then forces students who study it into certain patterns of behaviour that can become almost desirable part of their Attitude and habits.

Science education occupies a very prominent place in curriculum both at school and university stages of education in India. It is supposed to perform a two-fold task, the prime objective in individualistic perspective is the cultivation of a scientific temper, which includes a spirit of enquiry, a disposition to reason logically and dispassionately, a habit of judging beliefs and opinions on available evidence, readiness to reject unfounded theories and principles, the courage to admit facts, howsoever, unsettling,
recognizing the limits of reasoning power itself. It is also expected of science education that it would give individuals a firm grasp of the concepts and processes of science and impart to them the ability to use the scientific method of problem solving and the techniques of observation and experimentation in handling problem of comprehension or life. It is essential that the emphasis of science education should be on the development of abilities.

Barman (1983) studied the origin and developments of modern science in pre-independent India while Sharma (1984) studied school science from 1947 to 1977. The journey has been from teaching science through the integrated or concept approach, shifting from general science to separate subjects and inclusion of environmental study programmes. These studies have highlighted the various shifts in the development of modern science curricula.

Science education should be urgently addressed to the problem of developing a scientific attitude in education. Intensive studies will have to be directed towards those fundamental aspects of science education. What does the scientific attitude consists of precisely? How can it be assessed accurately? Which strategies are most appropriate to inculeate the spirit of science in students? What steps should be taken to ensure that the attitude of scientific enquiry is applied also to extra scientific domains. Including
questions having socio-psychological import? Science education awaits answers to those questions.

"Science based education, in coherence with Indian culture and values can alone provide the foundation and also the instrument for the nation's progress, security and culture"


The Secondary Education Commission (1953) has recommended that every Secondary school pupil should study general science as a compulsory subject. Seminar on the teaching of science in Secondary schools held at Tara Devi (Simla) in 1956 dealt with almost all the problems facing the inclusion of General Science as a core subject for the higher Secondary classes. One of the recommendations of Kothari Education Commission (1966-69) was that science should be made a compulsory subject in school curriculum. The recommendation was accepted and science was made compulsory in school.

1.5 Importance of Science in Secondary Schools:

The term science means the same at any level. In one sense, it is a body of information and principles that help us understand the world around us from atoms to stars, from microscopic water life to man. In another sense, science may be regarded as methods of discovery, the methods by
which new information is uncovered, new principles arrived at, old principles modified or discarded. It is characteristic of science that it starts with a perplexing problem, proceeds with the trying of different methods of solution, and results in a new discovery.

In the study of science, we learn ways of exploring in order to learn about the world. For children, the study of science consists of their exploring the world around them in order to learn about it and so answer their questions about it, the better to enjoy and appreciate their surroundings. It seems a natural thing to wonder what makes a rainbow, how magnets can pick up iron nails, how far away the stars are, how a compass can point north, and how an aeroplane can stay in the air. It appears natural, too, to try out things to see how they work, to experiment, to manipulate to be curious, to ask questions, to seek answers. To learn to think scientifically is to learn those concepts and principles, which will enable one to make wise choices in deciding how to live with one’s environment. This is indeed science for the citizen.

Science should help in reducing obscurantism and all sorts of prejudices based on sex, caste, religion, language or region. By emphasizing a rational approach, science should help the development of a democratic, secular and socialist state.

The general objectives of science education have a limited utility unless they are spelt out in terms of stage wise objectives for the guidance of educational planners, administrators, supervisors and teachers.
At Secondary stage the children become adolescent and this period can become difficult for many children. Problems of adjustment in family, the school and the society begin to appear. The child becomes a boy or a girl with greater intellectual, emotional, social and physical maturity and Social demands and responsibilities begin to appear. For many boys and girls, this stage is terminal after which they enter life and work. Therefore they should be prepared adequately to face life and develop capacities and Attitude for productive work in which they have to participate.

In the sciences, at this stage, physical and life sciences should be introduced. At the same time, environmental education, nutrition, health and population education should receive adequate attention so that science is related meaningfully to life. This is the age when work experience should emphasize agricultural and technological processes and tools to help the integration of science, mathematics and technology with production and with the life of the community.

The general objectives of science education may be stated as follows:

1) The child should be able to apply the knowledge of science in everyday life.

2) The child should be able to investigate new knowledge in the field of science.

3) The child should develop scientific Attitude.
4) The child should learn how to learn a part of scientific knowledge on his own.

5) The child should be able to solve problems around him.

6) To make the child creative.

7) To train the child in science processes.

The goals and expectations of the science education change with time and with them the curriculum. Updating, revising, reorganizing, or adopting science curricula are not sufficient to reduce the present state of fragmentation and narrowness. What is necessary is the design of science programmes for the non-specialist, the common man.

The social imperatives of education and specially science education have recently been attributed new importance and urgency. The long term social problems of (1) environmental pollution, (2) food shortages, (3) limitations on available energy and (4) expanding population demand change in the curriculum, emphasis and modes of teaching. Students are not only to be informed about these social problems, they also need practice in making decisions, so that as adults they will be wiser in individual and collective decision-making. Since these social imperatives do not conform to the traditional academic boundaries of the sciences, or even of any subjects commonly taught in schools, new curricular patterns must be generated, developed, tested and evaluated for evidence of effectiveness. Relevant research is needed not only in the development and testing of these new instructional materials, but more basic studies are required on the
ways, means and amounts of various experiences which modify the Attitude and enhance decision making skills. The time seems to be ripe for a serious national debate on the ‘future of science education’ taking into a serious view of its past and present.

Till the end of 18th century, science education has been neglected all over the world and it had no place in the school curriculum. Chief scientific discoveries were made by amateurs such as Priestly, James Watt etc. A number of philosophical societies were started to fill the gap between the educational provision and social needs.

These societies did remarkable work of popularizing science among general public. An important event in the history of teaching science was commenced with the establishment of Mechanics institute of the early 19th century. Anderson (1987) was perhaps the first who attempted to give a course of lecture on experimental physics. The modern civilization is scientific civilization. This is an age where the modern society is completely drawn into scientific environment and science has become an integral part of our life and living. Now we cannot think of a world without science.

Science is mankind’s rational attempt to organise and explain the perceived and events of the world. The role of instruction in science is promoting intellectual development is almost unique. Among school subjects no other subject provides potentials of rapid feedback. The greatly
charging conditions of life and world events are demanding a new perspective in teaching science.

The major goal of science instruction is the development of science concepts. The field of science is wide, its fund of facts, concepts and theories are constantly growing. The student is no longer expected to learn by rote-Memory. In any branch of science, it is the teacher who holds the key to successful learning. The task of teacher is to find ways of making it possible for students to make knowledge meaningful. Ausubel (1968) suggests, “Meaningful” learning takes places if incoming information can be connected in a meaningful and non-arbitrary manner to the particular cognitive structures of the individual learner.”

Scientific research in the past few decades have led to a deeper, understanding and more realistic approach to creativity, giving educationists the knowledge that all are born with creative potential and given proper environment and technique, this potential can be recognized, nurtured and measured.

As we are living in the period of computers, the importance of science is much more than at any time. The increasing need of scientists and technologists made it to give much importance to science and a scientific environment for it’s learning in schools.

The public perception of science is generally idealistic and corresponds to as ‘ivory tower’ image. But times are changing sciences is coming under critical attention of public. In the last few years, the question
about objectivity in science have flared up again, some social scientists and philosophers are questioning the scientists claim that the scientific method is the most objective way of narrating the truth about nature. They say that scientists and science are very much the product of the process of society and ‘facts’ cannot be separated from ‘values’ that the world of science, for from being clinical and objective in as much valuable to objectivity, social context, personal rivalries and passion as any other social science disciplines.

So science is no longer confirmed to a few seriously devoted persons. Living in the present word inevitably warrants the knowledge of scientific facts and laws. Science has become an unavoidable part of general education.

1.6 Role of Science in the Present Context:

Science is one of those human activities that man has created to gratify certain human needs and desires. Disinterested curiosity has been the greatest motive power of scientific research. The ‘search of truth’ became the dominant motive in the persecution of science. It has been pursued for so many centuries and attracted ever-wider extent of attention of a very persisted group of people. Science is valued mostly for its practical advantages though it is also valued for gratifying disinterested curiosity and as an object of great aesthetic charm. It is quite obvious that
the bulk of mankind value science chiefly for the practical advantages it brings with it.

A few decades back, science was given a step-motherly treatment and was considered to be a subject meant for less promising students, the more promising students were encouraged to study the Classics and Mathematics as being more worthy and suitable subjects. Science has now established its claim to be placed in the school curriculum. It has now been recognized as a compulsory subject right from the Elementary stage and now one of the core subjects at Higher Secondary stage. It has taken a good many years of active and persistent effort to reach this position.

It will be futile to prepare separate case for the inclusion of science in the curriculum because the reasons for its inclusion are exactly the same as those for the inclusion of subjects other than science, though it has been given a core place in the curriculum because of some special values provided by science, only and not by any other subject. All the school subjects are taught because they provide a liberal education: they are part of the equipment and preparation for life which we expect the school to give to its pupils so that they may play their part in the community as intellectual citizens. Science takes its place side by side with other subjects as an essential element of one’s education. It affords a knowledge of certain facts and laws and an insight into methods and data peculiar to the domain of science. However, the inclusion of any subject in the curriculum should satisfy the intellectual, utilitarian, vocational, cultural, moral and aesthetic
values. Besides these, the teaching of science imparts training in the 'Scientific method' and develops 'Scientific attitude' which are very valuable and at the same time are transferable to other situations in life.

The rapid advancement of science and technology and increasing need for scientists and technologists have made it all the more important to provide for science based education in the schools. Vigorous methods for the cultivation and promotion of science should be adopted. The Secondary Education Commission has recommended that every Secondary school pupil should study general science as a compulsory subject, so that he gains a basic quantum of scientific knowledge as a part of his general education. In addition, provision should be made for providing elective subjects in science for those students who want to pursue higher study.

The Scientific Policy Resolution of the Government of India, 1958 stated "The dominating feature of the contemporary world is the intense cultivation of science on a large scale, and its application to meet the country's requirements".

The primary goal of education should be the intellectual development of the individual. With its accelerating importance in our society science has become an increasingly important part of general knowledge. Scientific education is best fostered as a part of a general emphasis on intellectual activity.

Science is the result of an intense struggle of human intellect and has wrested from nature not only her secrets but processes also which underlie
them. It has emerged almost a decisive force and its role in education needs to be adequately understood.

Today the world has been facing three major problems of population increase, pollution and poverty. Increasing population and increasing poverty have been nullifying the developmental efforts of developing countries, such as India. Although science and technology have improved lot of large number of human beings some of the worst problems of humanity to date such as mentioned before have either been brought about or aggravated by science and technology. It may be mentioned here that education is one of the potent instruments in the development process, if it is properly utilised for that purpose. Science education being an important component of the education system should contribute in the solution of the problems of the country by developing desirable understandings, skills, abilities and Attitude. The greatest challenge is to humanize science that is to make it relevant to human needs and aspirations.

1.7 Theoretical Framework:

1.7.1 Concept of Aptitude:

Human efficiency is not as easily defined as that of a machine and it is not as easily measured. Some people think of aptitudes as innate abilities. There is increasing awareness, however, that we inherit structures with potentialities for functional use rather than abilities and that the development of one’s potentialities depends upon environmental factors.
"Aptitude is a present condition which is indicative of an individual's potentialities for the future."

"A condition or set of characteristics regarded as symptomatic of an individual's ability to acquire with training some knowledge, skill or set of responses such as ability to speak a language, to produce music and the like."

- Dictionary of Psychology (1934)

"Aptitude is a condition, a quality or a set of qualities in an individual which is indicative of the probable extent to which he will be able to acquire under suitable training, some knowledge, skill or composite of knowledge, understanding and skill, such as ability to contribute to art or music, mechanical ability, mathematical ability or ability to read and speak a foreign language."

-Traxler (1957)

"Aptitude refers to those qualities characterizing person's ways of behaviour which serve to indicate how well he can learn to meet and solve certain specified kinds of problems."

-Bingham (1937)
"An Aptitude is a combination of characteristics indicative of an individual's capacity to acquire same specific knowledge, skill or set of organised responses, such as the ability to speak a language, to become a musician, to do mechanical work."

- Freeman (1971)

Aptitude is a present condition, which is indicative of a person's potential for developing proficiency in a certain area,

- Students have to make a decision regarding the choice of subjects in the high school.
- It is mainly useful in vocational guidance.
- It has been given to large numbers of workers on various jobs.
- They serve as a screening device.

- Scientific Aptitude:

  The world is progressing with an accelerated speed in the space age trying to probe through the unsolved mysteries of the universe. Ours is a developing nation. For all-round development of the individual and progress of science all-round utilization of the latest achievements of science and technology is essential. For this every individual tries to get trained to acquire knowledge and skills of science and its application permeates modern life. So extremely that every citizen has to have a knowledge of science for effective living.
Science is interwoven with our day-to-day life. One cannot survive and live successfully without science. So in order to enjoy material happiness, he must be acquired with adequate knowledge of science. The progress of nation depends upon the progress of science. It provides rapid economic development and high standards of living.

The knowledge of science is essential in every walk of life. Science has increased the comforts of the human being. A man with scientific aptitude can easily make use of these benefits and make his life more happy and comfortable.

Now a days, in every walk of man's life, science is putting its hand. The mode of life on earth is changing rapidly with the progress in science. So man has to adjust himself to this new atmosphere. A man without scientific aptitude finds it very difficult to adjust himself to this new situation.

A man who has scientific mind live more happily and adjust to it. Hence it is the responsibility of the education to develop scientific aptitude among children that the coming generation leads a happy life in the world of science.
Aptitude is not totally inherited quality we can modify it if not completely but to a considerable extent. One who has scientific aptitude, not only perceive the knowledge correctly but also apply it in understanding new situations. The application of knowledge in problem solving is another ability of an individual having scientific aptitude.

The scientific aptitude may be considered as in inferred state of readiness to react in a characteristics way towards particular type of situations.

One who is scientific minded and has aptitude for science is curious to solve problems curious to know things and raise significant questions with reference to observed phenomenon.

"The ability to raise significant question and to formulate fruitful hypothesis."

- Allyn A. Young (1962)

Through the teaching of science, independent thinking can be fostered, train the pupils to think objectively, critically and constructively, train their mind to be receptive to new ideas.
Science teaching is not confined to the teaching of scientific facts alone. Emotion admiration intellectual pleasures are brought about by the scientific aptitude.

Developing scientific aptitude amongst our children should be the major aim of science teaching and education. It completely changes the outlook of child. By teaching science effectively, keeping this scientific aptitude in view, it can bring about the desirable changes in the behaviour of the child. School is the only institution where children can be trained to develop this aptitude.

Science teaching is not mere presentation of facts. It develops new ways of thinking this development reveals in itself increased skills, new habits of action, desirable aptitudes and improved character. Scientific aptitude can turn the tradition bound society into a modern world.

1.7.2 Concept of Attitude:

The main aim of education is to modify the behaviour of the child according to the needs and expectations of the society. Behaviour is composed of so many attributes and one of these important attributes is attitude. One’s behaviour to a great extent depends upon one’s attitude towards the things, ideas, persons or objects in his environment.
Attitude is the amount of degree of positive or negative feelings towards an object. Attitude means the way in which one looks upon “psychological objects”. Psychological object means any symbol, phrase, person, institution, ideal or idea towards which people can differ in respect to positive or negative effect. It is the tendency to show favour or disfavour for some type of objects.

Attitude are not inborn traits. The individual develops his own attitude towards the subject science, upon social learning, his readiness to accept or reject, etc. The formation of attitude takes place gradually. Some of the Attitude may be permanent while some may be temporary. The concept ‘Attitude’ is defined by many psychologists in different ways. Some of them are given below:

Thurstone (1946) defines attitude as “the sum total of man’s inclinations and feelings, prejudice or bias, preconceived notions, ideas, fears, threats and convictions about any specific topic”.

Sheriff (1956) sees an individual’s attitude “as a set of categories for evaluating or judging various social stimuli – persons, objects, events, etc. Further that his social Attitude are learned and established through social
interaction and that they are a matter of degree, rather than being all or none, positive or negative”.

Katz (1960) defines attitude as “a predisposition of the individual to evaluate some symbol or object or aspect of his world in a favourable or unfavourable manner.”

According to Freeman (1965) “Attitude is a dispositional readiness to respond to certain situations, persons, objects or ideas in a consistent manner which has been learned and has become one’s typical mode of response”.

It is a tendency to react in a certain way towards a designated class of stimuli. These are the ways in which an individual thinks, feels and acts.

According to Mckeachie and Doyle (1966) “An attitude as an organisation of concepts, beliefs, habits and motives associated with a particular object.”

According to Anastasi (1968), “An attitude is often defined as a tendency to react favourably or unfavourably towards a designated class of stimuli, such as national or racial group, a custom or an institution. Thus,
defined, Attitude cannot be directly observed but must be inferred from overt behaviour, both verbal and non-verbal.”

According to Whittaker (1970) “An attitude is a predisposition or readiness to respond in a pre-determined manner to relevant stimuli.”

According to Travers (1973) “An attitude is a readiness to respond in such a way that behaviour is given a certain direction.”

Dutt (1978) sums up as:

a) Attitude underlies many of the significant and dramatic instances of man’s behaviour.

b) Attitude, when fully developed, function as an internal frame of reference.

c) Attitude serves as a fabric for philosophy of life.

d) Attitude work as state of readiness for motive arousal: thus they serve the attempted achievement of various goals. The state of the organism, in which the energy flows towards the goal, is the motive.

e) Attitude gives continuity to human personality.

f) Attitude gives meaning to one’s daily perceptions and activities.
Thus loosely defined, an attitude is a predisposition to behave in a particular way towards a given object. Attitude are not purely cognitive in nature but cognito-motive in nature, i.e., they have two components namely, cognitive and emotional, towards psychological objects – complex or simple. Attitudes are about generalized objects.

An opinion is merely the verbal expression of an attitude. Attitude refers to an orientation towards a psychological object whereas value implies an orientation toward a series of a class of related objects. Thus a value is often a collection of Attitude.

The main aim of education is to modify the behaviour of the child according to the needs and expectancy of the society. Behaviour is composed of so many attributes. One of these important attributes is attitude. One’s behaviour to a great extent depends upon one’s attitude towards the things –idea, person, or object, in this environment.

o Characteristics of Attitude:

- Attitudes are relatively enduring states of readiness.
- Attitudes have motivational affective characteristics.
- Attitude are numerous and varied as the stimuli to which they refer.
- Attitudes are learned.
• Attitudes have a subject-object relationship.

• Attitude range from strongly positive to strongly negative.

Attitudes are intellectual, social and emotional components that are derived from experience and exercise a determining influence upon behaviour. An attitude is defined as a developmental state of organic valence. Created by psycho-biological process, exerting a motivational influence upon the individuals responsive behaviour in situations directly and indirectly related to it.

Various factors influence the formation of Attitude. These are within the individual and within the individual’s environments. The factors within the individual are physical growth and development, intellectual development, ethical and moral development. Factors within the individual’s environment are home, family and social environment.

- **Scientific Attitude:**

Scientific Attitude is the most important outcome of science teaching. Though some people view the Scientific Attitude as the by-product of teaching science, yet a majority of the people consider it as equally important as knowledge aspect. Scientific Attitude is of very significant concern in the process of science education.
Henry (1947) says “As we consider the future responsibilities of citizens we will probably agree that helping children to become more co-operative, more responsible, more open-minded and at the same time, more critical-minded is certainly worth the effort.”

There is no place for prejudice or bias in science. Scientific pursuits warrant objective observation and impartial judgement. Engagement in any scientific activity, be it theoretical or experimental, therefore, pre-supposes intellectual honesty, perseverance, concentration of mind and broadmindedness.

According to Sylvia (1955) “High intelligence, opportunity for development and personal attributes were the three factors necessary for high science potential and for determining the selection of science as a carrier.”

The Educators Encyclopaedia, Smith, Krouse and Atkinson (1960), gave the following characteristics of a person with Scientific Attitude:

- He based his actions, thoughts and conduct on the best knowledge that is available to him
- He suspends reaching conclusions and forming judgements when reliable and objective information is lacking or until such time as he has the opportunity to study such information
- He has no time for old tales, rumours or superstitions

- He is willing to change his mind when he observes new evidence that he can accept as valid.

- He has no preconceived notions unless they have basis in his objectives understanding of the problem

- He is willing to work together

- He has critical thinking

- He is patient in checking the results

- He has a thirst for new knowledge

Smith et. al. further observe that if all teachers pointedly work toward the development of the scientific attitude among students, a positive result in this direction will be evident

Science Education (1960) mentioned the characteristics of Scientific Attitude as Open mindedness, a desire for accurate knowledge confidence in procedure or seeking knowledge and the expectation that the solution of the problem will come through the use of verified knowledge.

The Scientific Attitude, which is an outcome of science education during schooling, is the important outcome of science teaching. Developing Scientific Attitude is one of the main goals of science education. The teaching of science imparts training in the scientific method and develop
scientific attitude, which are very valuable and at the same time are transferable to other situations in life. Scientific Attitude is the mental attitude characterised by Rationality, Curiosity, Open-mindedness, Aversion to Superstitions, Objectivity of Intellectual Beliefs and suspended Judgements.

Science Encyclopaedia (1963) emphasised that “Science is an accumulated and systematized learning in general usage restricted to natural phenomenon. The progress of science is marked not only by an accumulation of facts, but by the emergence of scientific method and of the science attitude.”

According to Educational Policies Commission (1966) Science can provide “power, prestige, standard of living, education, and health but the spirit of science”. It promises to less tangible but equally profound benefits, increased individuality and increased brotherhood of men.

The basic principles of science can be identified as –

- An accumulated and systematised body of knowledge.
- The scientific method of inquiry
- Scientific Attitude.
The NCERT (1971) conducted a workshop at Chandigarh and evolved the following specific behaviour of a pupil who has developed scientific attitude. They are,

- Is clear and precise in his statement
- Based his judgement on verified facts
- Is willing to consider new ideas and discoveries
- Reacts favourably to efforts made to use science towards human welfare
- Is prepared to reconsider his own judgement
- Arranged the apparatus, materials etc., in their proper places at the end of the work
- Suspends judgements in the absence of sufficient data
- Is free from superstitions
- Is objective in his approach
- Is honest and truthful in recording and collecting scientific data

It is a tendency to seek truth, think logically and act reasonably. The National Policy on Education (1986) has also emphasized the generation of Scientific Attitude among the students through its curriculum and teachers.

Scientific attitude of mind, perseverance, accuracy of measurement, concentration of mind, persistence, patience, logical objective, and un
prejudiced judgement, respect for others opinion, respect for truth. Etc.,
these disciplinary qualities of mind can be cultivated through the teaching
of science.

Developing Scientific attitude amongst our children should be the
major aim of science teaching and education. It completely changes the
outlook of child. Science teaching is not mere presentation of facts.
Science can justify its place in the curriculum, only when it changes the
outlook of students that leads to the all round development of personality.

To think objectively, critically and constructively mind should be
receptive to new ideas. Emotion is very essential strong emotions hinder
clear thinking. Scientific attitude can turn the tradition bound society into a
modern world. A pupil possessing Scientific Attitude has the following
characteristics;

• Clear and precise in statements.
• Reacts favourably to efforts made to use science towards
  human welfare.
• Free from superstitious.
• Honest and truthful in recording and collecting scientific data.
• Prepared to reconsider own judgement.
• Suspends judgement in the absence of sufficient data.
The significant aspect of science is that whatever the student learns it has immediate application in the world around. This is educationally very valuable. Science gives opportunity for creative thinking and constructive imagination.

It is a most important outcome of science teaching the characteristics of scientific attitude as; open-mindedness, a desire for accurate knowledge, confidence in procedure for seeking knowledge and the expectation that the solution of the problem will come through the use of verified knowledge.

Scientific pursuits demand qualities such as minute observation, scientific attitude of mind, persistence, perseverance, concentration of mind, accuracy of measurement, patience, logical objective and unprejudiced, respect for other opinions, respect for truth etc. These disciplinary qualities of mind if cultivated through the teaching of science, may be carried over and manifest in the general behaviour of the learner. This will prove useful for living as an efficient social individual in the society.

1.7.3 Concept of Achievement Test:

Achievements of an individual in allied fields provide sufficient information in regard to his aptitude for those fields of knowledge and skills. Achievement in a particular branch of knowledge or skill is
considered as a good indicator of aptitude. Without an aptitude for a particular subject, student cannot achieve highly in that subject.

According to Bingham (1937) “There is a close relationship between achievements tests and aptitude tests because achievement in a particular branch of knowledge or skill is considered as a good indicator of aptitude.”

According to Anasti (1961) “One of the strongest objections to the use of achievement tests pertains to the excessive standardisation of instruction that may thereby be encouraged.”

- An achievement test is self-evident.
- It has been found useful in remedial teaching programmes as well as in determining the class to which a pupil should be admitted.
- It is to be seen when there is need for selecting candidates in regard to certain jobs and courses.
- Attainment of minimum performance standards.
- They provide reliable and valid information in regard to a person’s achieved abilities.
- It measures how much has been learned in the subject and what specific abilities or skills have been developed.
According to Freeman (1971) “Achievement test is designed to measure knowledge, understanding, skills in a specified subject or group of subjects.”

“An achievement test is used to ascertain what and how much has been learnt or how well a task has been performed.”

Generally, achievement tests are of two types, namely:

- Educational achievement tests
- Vocational achievements tests.

To measure the achievement of the students in different subjects, generally a teacher constructs achievement test. It is done with the help of the prescribed curriculum.

Achievement tests for measuring attainment in different trades are also prepared and they can be classified in terms of various trades. Achievement tests are merely tools and they should not be regarded as goals. In other words, no teacher should make it a point to emphasise excessively achievement test scores.

- **Academic Achievement:**

   Academic achievement in the present competitive challenging scenario in the cultural, socio-economic status places great emphasis on achievement right from the beginning of the formal education.
Educational development in India is changing Curricula, teaching techniques needs systematic and up-to-date information to correlate pupils achievement. It is very opt to consider various factors affecting the academic achievement. Pupil’s study habits, socio-economic status, intelligence, language, medium of instructions, personality traits, motivation, interest, method of teaching all have their effect on academic achievement. These factors help in developing suitable curricula and designing education programs to suit the needs of pupils of various backgrounds. The study has special relevance to indicate to the teacher for planning, Curriculum development, effective teaching and better academic achievement.

Lack of motivation may lead a bright student to lose potentiality and future. Some pupils have higher aspiration but may not achieve expected level due to improper method of achievement and may lead to inferiority complex. Many below average pupils may not come up due to lack of necessary facilities for teaching. Dull students have to face still more worst situations due to language limitation. Such students start disliking the school. It is the responsibility of the teacher to make school the best place for students to learn.

"An achievement test is one designed to measure a student’s grasp of knowledge or his proficiency in certain skills."

- Ebel (1965)
1.8 Need for the Study:

The National Science Foundation was established in 1950 by an act of Congress to develop a national policy for the promotion of basic research and education in the sciences. Fund for the Advancement of education financed for innovation and experimentation in schools.

Science is playing a major role in the present age to satisfy the needs and desires of the people and it has also becomes one of the major human activities.

Science Education by virtue of the fact that it provides more developments of the scientific aptitude required of an individual in the Secondary schools is likely to be associated with the scientific attitude on academic achievement in science of the students. Previous studies have identified that in Indian students, the scientific aptitudes are related to academic achievement. Studies were made to identify the association between scientific aptitude and academic achievement tests developed through education. Since scientific aptitude is an outcome of science education a study of scientific Attitude with reference to the scientific aptitude may serve a useful purpose.
Scientific aptitude and scientific attitude is within the reach of many schools to provide training in scientific observation and thinking through cheap materials.

It provides immense exciting and educational possibilities.

- Students can easily develop various aspects of the scientific skills, namely abstract, concrete and communication, etc.
- It provides ample opportunities for personal exchange of experience among students, strengthening.
- Discovery is the familiarized them with the staff and operations of science.
- Problem-solving abilities and develop desirable personality traits like persistence and self-confidence in the face of frustration.
- The importance of individual work and opinion, group work, cooperation, sincerity, emotional stability and intellectual honesty.
- To achieve varied objectives for various categories of the students at different levels of treatment right throughout the school.

The effect of Scientific aptitude and scientific attitude on Academic achievement in science of Secondary school students is an important area for research. Knowledge of the level of scientific aptitude and scientific attitude held by student population will be helpful in planning science education. Individuals having high scientific aptitude and scientific attitude...
are needed for the modern Indian society. Knowledge and the expectation that the solution of the problem will come through the verified knowledge. To develop scientific aptitude and scientific attitude the teachers should always remember that without a questioning of mind and a spirit of inquiry, studies in science will only mean acceptance of dogma and will never led to development of scientific aptitude and scientific attitude in the students.

In India, the Secondary school student has no freedom to choose the curriculum that suits him and, curricular choices are made only at the beginning of the higher Secondary stage that too mainly on the basis of his academic achievement. But in developed countries, the student has the advantage of counselling and guidance, which is a part and parcel of the educational system.

Scientific aptitude and scientific attitude are the complex behavioural aspect of science. It can be studied at various educational levels say primary to post graduate. In the present study is concerned with the effect of scientific aptitude and scientific attitude on academic achievement in science of Secondary school students, viz., IX class students. It is also concerned with Gender, Type of Management and Medium of Instruction.

Many research scholars studied scientific aptitude and scientific attitude as components of research but still there is a need for further
research. Because the study conditions living conditions, habits, lifestyle, curriculum, Method of teaching are changing at a rapid rate. The statistical studies of past ten years on academic achievement in science of ninth standard students have shown that most of the students have secured less mark in science. There may be many factors affecting their academic achievement but reviews of related factors revealed that scientific aptitude and scientific attitude are major factors affecting the academic achievement in science. Though lakhs of children pass ninth standard exams they show least interest in science when choosing it as a subject for higher studies.

Today students are influenced by modernization. Hence it may be interesting to identify the effect of scientific aptitude and scientific attitude on academic achievements in science.

The investigator wanted to identify the effect of scientific aptitude and scientific attitude on academic achievement in science of students of standard IX in the age group of 15 to 17 to get useful educational data.

The above discussion raises a number of research questions;

1) To what extent do the students of standard IX have effect of scientific aptitude on academic achievement in science?

2) Is there any difference in the scientific aptitude of boys and girls of standard IX?
3) To what extent do the students of standard IX have effect of Scientific Attitude on academic achievement in science?

4) Is there any difference in the scientific attitude of boys and girls of standard IX?

5) Is there any association between the scientific aptitude and Academic achievement of the students of standard IX?

6) Is there any association between the scientific attitude and academic achievement of the students of standard IX?

1.9 Statement of the Problem:

The problems selected for the present study is stated as “Effect of Scientific Aptitude and Scientific Attitude on Academic Achievement of Secondary School Students in Science.”

1.10 Basic Assumptions of the Study:

The following assumptions were framed at the on set of the study –

1) Students of standard IX possess scientific aptitude and has influence on their academic achievement in science.

2) Scientific aptitude is normally distributed among students.

3) Scientific aptitude is influenced by various factors.

4) Students of standard IX possess scientific attitude and has influence on their academic achievement in science.
5) Scientific attitude is normally distributed among students.
6) Scientific attitude is influenced by various factors.

1.11 Objectives of the Study:
The study was taken up with the following objectives;
1) To study the effect of Scientific Aptitude on academic achievement in science among the IX standard students.
2) To study the effect of Scientific Attitude on academic achievement in science among the IX standard students.
   i. To study the effect of rationality of IX standard students on academic achievement in science.
   ii. To study the effect of curiosity of IX standard students on academic achievement in science.
   iii. To study the effect of open mindedness of IX standard students on academic achievement in science.
   iv. To study the effect of personal confidence of IX standard students on academic achievement in science.
   v. To study the effect of aversion to superstitions of IX standard students on academic achievement in science.
   vi. To study the effect of objectivity of intellectual belief of IX standard students on academic achievement in science.
   vii. To study the effect of suspended judgement of IX standard students on academic achievement in science.
3) To study the relationship between scientific aptitude and scientific attitude on academic achievement in science among the IX standard students.

4) To predict the influence of scientific aptitude and scientific attitude on academic achievement in science.

5) To study the direct and indirect of independent variables (scientific aptitude and scientific attitude) on dependent variable that is academic achievement in science.

1.12 Limitations of the Study:

The study has certain limitation. They are:

1) The study was limited to the IX standard students studying in Bangalore City only.

2) The sample was limited to (1000) One thousand students of standard IX of Bangalore city of which 500 students were from North Zone of Bangalore City and 500 students where from South Zone of Bangalore city.

3) The factors like intelligence, socio-economic status, interest, etc were not included in the study.
1.13 Overall View of the Study:

The research report consists of five chapters.

The first chapter deals with the Introduction, Science – Concept and Nature, Aims of Teaching Science in Schools, Science Education, Theoretical Framework, Need for the Study, Title of the Study, Basic Assumptions of the study, Objectives of the Study, Limitations of the Study and Overview of the study.

The second chapter deals with the review of related literature.

The third chapter deals with Research design, Variables of the Study, Operational Definitions of the terms used, hypotheses of the Study, Tools used for the study, Procedure of the Construction of tools, Population and Sample of the Study, Procedure of the Data Collection, Statistical Techniques used.

The fourth chapter deals with analysis of data and interpretation of ANOVA, Coefficient of Correlation analysis, Multiple Regression and Path analysis will be used.

The fifth chapter deals with the summary and conclusions of the study. It includes major findings of the study, conclusions, educational implications and suggestions for further research.

Bibliography and Appendices are given at the end.