CHAPTER – I

1. 1 INTRODUCTION:

   Education has occupied a supreme place of special importance, because it moulds the personality of our children who are the future citizens of our nation. Education enables an individual to use his potentiality to the maximum extent. Education modifies the behavior of younger generation, in a desired direction. In this regard school plays a significant role.

   School is an important, primary unit of society because it has a crucial responsibility of preparing the prospective citizens of the nation. This indeed has been rightly expressed in Kothari Education Commission’s report (1964-1966) that “The destiny of our nation is shaped in her classrooms” In Rigveda, Education has been defined as that which makes man self-reliant and selfless.

   According to Swami Vivekananda Education is not the amount of information that is put into one’s brain rather it should be life building and man-making character. He also emphasized that “Education is the manifestation of perfection which is already in man”.

   As stated in University Education Commission’s report, Education according to Indian traditions is not merely a means of earning a living or it is a nursery of earning a living thought or school for citizenship. It is the imitation into the life of spirit, training of human souls in the pursuit of truth and practice of virtue. It is second birth “Divityam Janma”.

   According to Ridden, Education is the deliberate, the systematic influence exerted by a mature person upon immature, through instruction, discipline and harmonious development of physical, intellectual, aesthetic, social and spiritual powers of human being, for the individual and social values are directed towards the union of the educand with his creator as the final end, so education is the background of any progressing nation.
Science has helped the man to acquire supremacy over nature. It has greatly affected the way the people view themselves and the world around them. The wonderful achievements of science have glorified the modern world and illuminated the human creative potential. In ancient times most of the people believed that natural events and everything that happens to them is because of the actions of God and spirit, but the ancient Greeks were among the first to use systematic observation and reasoning to analyze natural happenings. As scientific creativity, thinking gradually developed, nature was seen less and less as the product of mysterious spiritual forces.

Science in literal sense, means the pursuit of knowledge, the word science comes from the Latin word scientia which means to know. The term science in the sense of knowledge was used for long to include the entire subject matter of study though it is correct it does not imply that all knowledge is science. This is very clear by the fact that all the branches of social sciences and humanities are universally excluded from the purview of science. Thus the facility to measure, quantify and verify the object in question is the part of science and its conclusions are universal. The body of knowledge in science is factual and verifiable and the results are data based. Hence many efforts were made to arrive at a precise meaning and definition of the word science.

The Columbia Encyclopedia defines science as 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 the emergence of scientific method and of scientific attitude. Albert Einstein felt that science searches for relations which are thought to exist independently of the searching individual.

In today’s world creativity is fundamentally important for our social economic and cultural wellbeing. Unless we help the young talents to develop
their innate desire to be creative, their capacity to create fails to educate them as wholesome and complete individuals.

Scientific-Creativity, Scientific-Attitude, and Scientific-Interest improve pupil’s self esteem, motivation and achievement. The pupils who are encouraged to think creatively and independently, become more interested in discovering things for themselves more open to new ideas, work and explore ideas. Scientific-creativity, scientific attitude and scientific interest prepare pupils for life; the pupils who are creative will be prepared for a rapidly changing world, where they may have to adapt to several career in life time. Scientific creativity, scientific attitude and scientific interest are central to the way society functions in an obvious way through the science, technology and myriad other manifestations. It enlivens our cultural, social and working relationships for economy. Scientific creativity, scientific attitude are essential in an increasingly competitive world. Scientifically creative individuals are able to see problems in ways that others do not. They use divergent thinking and the process of insight to solve problems/complete projects.

It is very essential to help the young talents to develop their innate desire to be creative and to shape their personality. Hence there is a need to guide and develop the younger individuals in relation to their scientific creativity, scientific interest and academic achievement.

Science occupies an important position among subjects included in the secondary school curriculum. Science is defined as “The study of systematized knowledge produced by careful observation, measurement and experiment which attempt to establish general laws or principles to describe the phenomenon under study”.

A comprehensive definition of science, states that “Science is a cumulative aggregation of empirical observations subject to modification in the light of
further empirical observations that result in the formation of facts, concepts and principles.

Science seeks to understand how nature behaves by observing and correlating available factual information. Our understanding science is therefore based upon, and limited by, the factual information available. In science, fact based explanations are called “theories”. Theories may be good, bad or indifferent. It all depends to the accuracy and the amount of the factual information available and how logically these facts are interpreted. The characterization of evolution as “only on a theory, not fact” is a gross distortion of the meaning of words “theory” and “fact”. The term fact should be limited to what can be observed. It is the job of the scientist to determine the accuracy of this factual information and how it can be used to increase our knowledge or how nature behaves.

The natural sciences do not deal matters involving religion, philosophy and politics. Although evolution is incompatible with some sectarian religious dogma, there is nothing in evolution that rules out the existences of God. Darwin’s theory of natural selection has been falsely interpreted to apply to the philosophical concept of “Social Darwinism”, which states that those who believe in the validity of evolution must necessarily support the politics of “might makes right”.

Creation believes that if a person believes that people are descended from primitive ancestors, they will behave as an animal, instead of an enlightened human being. There is nothing in the history of human events to support this allegation. It is bigotry, pure and simple.

The term scientific creativity has become popular in educational circles in the past few years. Teaching for scientific creativity has become one of the latest and most flourishing terms very often used in the field of education and it is used as a catch phrase on the current educational system. Scientific creativity is the term, which is generally used to refer to “rare and unique talent in a particular field of education”. Scientific creativity is essentially a human phenomenon. It is a
process in man, which helps him achieve dignity and meaning in life. Scientific creativity is considered to be identical with the expansion of the universe and the main task of man on this planet. Moreover Guilford (1965) has stated that, creativity is the key to education in its fullest sense and the solution of mankind’s serious problems. In this context, National Council of Educational Research Training NCERT (1975) has also stressed that child’s spontaneity; curiosity, creativity and activity in general should not be restricted by rigid and unattractive methods of teaching and environment for learning.

The major criticism about our present educational system is that it does not encourage creativity or scientific creativity. In this connection, Rogers (1959) also has criticized the schools for turning out conformists and stereotyped individuals rather than creative and original thinkers. It is generally believed that the scientific creative abilities of students are influenced by a number of factors like scientific aptitude, parental involvement, emotional adjustment, school environment, academic self-image and achievement in science.

Identifying the factors of scientific creativity as an area of key interest to educationists and psychologists, The present study has been undertaken with a view to find out the scientific creative powers of the individuals and its relationship with other variables, which are likely to affect or promote their academic achievement.

1.2 Science education in the twenty first century;

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 reasons of the world. Solutions based on science and technology are likely to provide remedial measures to some of these pressing problems, and at 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. The barriers impeding the sharing and the use of scientific and other knowledge necessary to make decisions and choices retard to such an understanding. 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 and absence of excitement being one of the factors.

The changing global scenario has credited unusual situations for most countries today. Those 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 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. The situation has direct impact on the strategies that one has to adopt for science and technical education.

Science has greatly revolutionized the world in the past two centuries. It has opened up ever increasing vistas of knowledge both embracing the physical as well as the psychological realities of life. Now it has emerged as a prime mover of culture, philosophy and a total way of life. Science is dynamic in nature. It gives new insight to our life with improved techniques and tools and makes the facts understand. It is because of dynamic nature, science has become indispensable part of our life and living styles. Therefore scientific outlook is essential for all members of the society to get away from a number of irrational and superstitious beliefs. As such, a rational and just society requires development of scientific temper among the individuals up among the adolescent learners for progressive growth and modernization. The scientific way of looking at things and thinking
logically as well as independently on only problematic situation, may unable to one to find out desired solution while marching ahead on the path of innovation and exploration.

Science may become a way of life and enable individuals and societies to cope up with the problems likely to arise in science dominated future due to its significant role in the field of inventions and innovations, discovery of new facts and truths for explaining and elaborating old facts and findings in a new way analyzing causes behind natural and super natural phenomena, finding out solutions to the ever increasing problems of human life. To face these problems with courage and vigor development of rational outlook and scientific-attitude seems to be of supreme importance.

According to Bentleys Glass the Chairman of BSCS: Science is a great human enterprise not only endless and faceless but also stable and fluid. It is self accumulating, self-growing and self-accelerating and attempts to provide an objective body of knowledge through objective as well as subjective procedures. In every generation it operates in a certain frame of reference which yields to another gradually. It thus wheels on dogmatism, dynamism and discovery at the same time.

It is more than problem puzzle solving or an exercise at obstructing with a view to approach and understands the unknown through the so called scientific methods, techniques and approaches. It is an international activity which strengthens national economics, creates new or indirectly to a course of action. The literature of science education, the terms imply such qualities of mind as intellectual curiosity, passion for truth, respect for evidences and appreciation of the necessity of free communication in science.

Pandit Jawaharlal Nehru describes the concept of scientific temper as follows in a very lucid manner.

“A person who cannot understand another’s view points is to that extent limited in mind and culture because nobody can pleasure to how the fullest knowledge and
wisdom or truth. If we shut our minds to that then we not only deprive ourselves of it but we cultivate an attitude of mind which is opposed to that of uncultured man. An open mind is scientific approach to life’s problems”.

Jawaharlal Nehru, the first Prime Minister of our Independent India, perhaps was first to emphasize the importance of scientific attitude and cultivating it from the national point of view. He had a deep faith in the capacity of science to dispel the myth of age old orthodoxy and dogmatic traditions in India and considered it as salvation of India’s and their future. He emphasised on promoting scientific attitude to create a congenial environment for scientific, social, and economic and resources, accelerates employment and attempts to build global outlook on problems which affect man, his life and society”.

Science as a product and process adopts a scientific mode of enquiry and it forms a systematized body of knowledge obtained through a series of observations both in fundamental part and functioning of scientific attitude.

1.3 Concept of creativity;

Creativity involves divergent thinking namely the ability to generate multiple, desperate, and unusual ideas in response to a problem (Guilford, 1967). Creativity means a person’s capacity to produce new or original ideas, insights, restructurings, inventions, or artistic objects, which are accepted by experts as being of scientific, aesthetic, social, or technological value (Vernon, 1989). Creativity as the process of sensing difficulties, problems, gaps in information, missing elements, making guesses and formulating hypotheses; possibly revising and retesting them; and finally communicating the results (Torrance, 1988).

Scientific Creativity;

Scientific creativity may be viewed as the attainment of new and novel steps in realizing the objectives of science. Scientific creativity can manifest itself “in the conception of new ideas contributing to scientific knowledge itself, in the
formulation of new theories of science, in the devising of new experiments to probe nature’s law, in the development of scientific ideas applied to particular domains of practical interest, in the realization of new organizational features of scientific research and of scientific community, in the novel implementation of plans and blueprints for scientific activities, in trail-blazing undertakings to transmit the scientific outlook into the public mind, and in many other realms”.

(Moravcsik, 1981, p.222)

The intensive investigations in the area of scientific creativity started in the later half of this century. Since that time a number of factors have been identified affecting this highest of all higher mental abilities of human beings. Researchers have also observed that every human being possesses some spark of scientific creative talent, but its extent depends upon a number of factors, such as, scientific aptitude, home-environment, school environment, academic self-image, and science achievement and so on of the individual concerned.

The term, scientific creativity has become popular in educational circles in the past few years. Teaching for scientific creativity has become one of the latest and most flourishing terms very often used in the field of education. It is used as a catch-phrase on the current educational scene. Scientific creativity is the term, which is generally used to refer to “rare and unique talent in a particular field of education”. Scientific creativity is essentially a human phenomenon. It is a process in man, which helps him achieve dignity and meaning in life. Scientific creativity is considered to be identical with the expansion of the universe and the main task of man on this planet, (Buch (1983-1988)). Moreover, scientific creative talent is a matter of life and death for any society. Therefore its discoveries and development should be considered essential especially in the present space age.

Science is no less a creative enterprise and calls no less upon the imaginative productions of man than done the arts. Imagination and intuitive insight are the necessary steps in the advancement of any scientific system. The application of the special ground rules follows the exercise of creation; it does not
restrict it. Clarity, precision and invariance can only be demanded as a goal of scientific creativity (George and William, 1959).

Science and creativity are inseparable, Behind each scientific theory there is human being, the inventive researcher, with high powers of imagination, reasoning and intuitive thought who first cuts through confusion or doubt and is able to state the illuminating principle. These are the men who are in Freud’s Phrase, ” obliged to build (their) way out into the dark” (Freud, 1900; 1954).This calls for ingenuity in setting up explanatory systems. In addition to this, a creative scientist seems to have a peculiar sensitivity to discrepancy, a nose for the unexpected or disconcerting event. He will not put the discrepancy out of view or assign it ‘error’. He takes the odd event as a starting point for his thought and his research. In this context, Cannon (1945) tells of his annoyance at the variations in stomach contractions he observed among his animal subjects. For him they served at first only to limit his research on gastric mobility, yet out of his “error variance” grew his classic studies on the bodily effects of emotions. Similarly for Pavlov, the ‘psychic secretions’ of his dogs interfered seriously with accurate determination of physiological salivation. Instead of controlling this effect, he changed the entire course of his research career. Thus for a competent scientist or creative researcher an irritating discrepancy becomes the beginning of a search. Cannon (1945) was remarkably optimistic about the generality of this characteristic and in speaking of “gains from serendipity” and he suggested that such good luck is possible for anyone.

Creativity may be characterized as having two levels (Mansfield and Busse, 1981): One is professional creativity and the other is amateur creativity. Scientists are considered as professional creators because they may make significant and innovative contributions to their areas of specialization. Amateur creators also demonstrate creativity in comparison to their non-professional peers. For instance, high school science fair winners or secondary students whose scientific reports were considered unusually creative by their teachers may be
characterized as amateur creators. Although most researchers focus on professional creators, students, since it is generally assumed that most professional creators in science emerge from amateur creators. Researchers (Parloff, Datta, Kleman, and Handlon, 1968; Ypma, 1968) found that research scientists who conducted scientific experiments on their own initiative in both high school and college were judged to be more creative in their professional work.

A large amount of work has been done in exploring scientist’s creativity, whereas a few researchers have focused on student’s creativity in science. Most major approaches to scientific creativity of scientists have focused on products to identify persons as creative. Many researchers use publications, citation counts, expert ratings, and patent rates as the external objective criteria for evaluating creativity of scientists (Musil and Ondrusek, 1982). In addition, intelligence structure tests, divergent thinking tests, cognitive style tests, and questionnaire of creative personality have been the internal criteria for evaluating scientific creativity.

Scientific Creativity may be considered from the following points of view.

- Scientific creativity deals with the unusual and original excellence in the field of science or scientific productivity.
- Scientific creativity can also be thought as scientific method or scientific process primarily involved in production of unusual and original scientific contribution.
- The unusual scientific thinking abilities characterized by systematic approach for all contents whether from science or humanities or otherwise could be considered as the basic attribute of scientific creativity.

For developing such a measure which could tap exactly the scientific creativity as defined here, it is essential that content of the test items of scientific creativity should be of very general nature though the content need not be restricted to the field of science, however it would be effective in measuring such
a dimension of scientific creativity if they touch the fundamental or general elementary contents of science.

In the present investigation, an attempt has been made to identify the scientific creativity, scientific attitude, scientific interest and their correlation with academic achievement of secondary school students by the research investigator. Scientific creativity, scientific attitude and scientific interest improve pupil’s self-esteem, motivation and achievement of pupils who are encouraged to think creatively and independently become more interested in discovering things for themselves more open to new ideas are keen to work others to explore ideas.

Scientific creativity and scientific attitude prepare pupils for life. Pupils who are creative will be prepared for a rapidly changing world where they may adopt to several carriers in a life time. Scientific creativity is central to the way society functions in an obvious way through the science technology and myriad other manifestations it enlivens our cultural social and working relationships. For economy creativity, scientific attitude is essential in an increasingly competitive world. Scientifically creative individuals are able to see problems in ways that others do not. They use divergent thinking and the process of inside to solve problems.

Galileo Galilee once said that in questions of science “The authority of a thousand is not worth the humble reasoning of a single individual while learning science the learners develops certain faculties through reasoning and experimentation.

Considering science from the intellectual point of view it is the most inexhaustible store house of knowledge. Science as a subject offers the widest range of knowledge to the learners. It has exposed the mankind to infinite avenues of knowledge in nature, living and nonliving, the world we perceive and also the world beyond human perception. There by makes us conscious of the unknown to be explored.
Science besides satisfying the intellectual curiosity of man and providing materials and media for intellectual exercise has disciplinary effects on the minds of individuals since science covers the widest range of knowledge, the learner wonders at the intricacies and mysteries of the universe, the known and the unknown. These tend to create a broader outlook in the life of the learners.

The fruits of science discoveries in any country are enjoyed by the people round the globe. Science is not concerned with caste, creed or color nor recognizes territorial barriers. Such a pattern inherent in science will definitely have an impact on the minds of the learners and is expected to help to develop broadmindedness in them.

The study of science has several other disciplinary values for instance science is an interest awakening subject. Its pursuit demands persistent efforts, diligence and patience. The gifts of science have been profitably used for making life comfortable and raising the standard of living but the use or abuse of the wonderful gifts of science depends on man and his mankind.

Science has opened innumerable avenues for pursuing different avocations. It gives opportunities for career making and pursuing professions and vocations. In fact if we refer to preparation of the individual for the future as one of the aims of education, then science as a subject is rightly serving this purpose.

Science gives opportunities for creative thinking and constructive imagination of the learners. The learner develops the habits of searching for the truth. The significant aspect of science is that whatever the student learns bears immediate application to the world around him. This is educationally very sound. Science education should provide opportunities for the development of scientific creativity, scientific attitude and scientific interest among the school children. In this age of scientific world, formation of scientific creativity, scientific attitude and scientific interest occurs at a faster rate which is associated directly with learning of science and this ultimately helps in the better academic achievement among the secondary school pupils.
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. The Secondary Education Commission has recommended that all secondary school pupils should study general science as a compulsory subject. This helps the pupils to gain a basic quantum of scientific knowledge as a part of his general education.

Frederic (1960) said ‘Science is a cumulative and endless series of empirical observations which results in the formation of concept and theories being subject to modification in the light of further empirical observation’. Science is both a body of knowledge and process of acquiring it.

Science Encyclopedia (1963) has emphasized:

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 fact but by the emergence of scientific method and of the scientific attitude.

The major items in the process of science as advocated are accessible to public investigation in contrast to purely private inspection. Science proceeds in a piecemeal manner even though it also aims at achieving a systemic and comprehensive understanding of various sectors or aspects of nature.

Science is not and probably never will be a finished enterprise and there remains very much more to be discovered about how things in the universe behave and how they are inter-related. Scientific attitude is a tendency to seek truth, think logically and there upon act reasonably, to develop scientific attitude among students to be eager and full of enthusiasm.

Science education should be strengthened so as to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, a courage to question and an aesthetic sensibility.
The National Council of Educational Research and Training NCERT (1971) conducted a workshop for pupils, who have developed scientific attitude. Accordingly a pupil with scientific attitude,

- Is clear and precise in his statements and activation
- Is willing to consider new ideas and discoveries
- Reacts favorably to efforts made to use science towards human welfare
- Arranges the apparatus materials etc. in their proper places at the end of the work.
- Suspends judgments in the absence of sufficient data.
- Is honest and truthful in recoding and collecting scientific data.

1.4 Science Education – scientific attitude;

Science education plays a very important role in developing scientific attitude among the pupils. Scientific attitude is the most important outcome of science teaching. Scientific attitude is a very significant concern of the process of science education.

In this connection Rethinking science education (1960) has mentioned the characteristics of scientific attitude as open mindedness, a desire for accurate information and confidence in procedure for seeking knowledge. Scientific attitude of students is an important area for research knowledge of the level of Scientific attitude held by students population, will be helpful in planning science education. Individuals having high scientific attitude are needed for the modern Indian society.

To develop scientific attitude the teachers should always remember that without a questioning mind and a spirit of inquiry, studies in science will only
mean acceptance of dogma and will never lead to the development of scientific attitude in the learners. The students should be made to practice and observe science so that they get the opportunity to feel and develop the components of scientific attitude in their minds.

1.5 Concept of Scientific Attitude:

One of the major aims of science education is to develop scientific attitude among the learners in a proper way in such condition no teacher or person can perform the function of imparting science to the students without understanding the proper meaning and true nature of scientific attitude. In view of some experts scientific attitudes can best be defined as open mindedness or a desire for getting or gaining accurate kind of knowledge. It also implies gaining confidence in procedures for seeking knowledge and the expectations that by making use of verified knowledge, and solutions of all the problems will be find out.

Open mindedness, intellectual honesty and critical mindedness are considered to be some of the main features of such kind of attitudes. A person with scientific attitude keeps himself aware of the latest developments done in the field of science and on the basis of such knowledge makes use of most recent and authoritative method for gathering information relating to the problem.

To develop scientific attitude among pupils the teachers should always remember that without a questioning mind and a spirit of enquiry the attitude cannot be developed. The students should be made to practice and observe science so that they get the opportunity to feel and develop the components of scientific attitude in their minds.

What is Scientific Attitude?

Scientific attitude is the adoption of a particular approach to solve problems to assess ideas and information and to make decisions using particular approach; evidence is collected and evaluated objectively so that the idiosyncratic prejudice of one making the judgment should not intrude in decision making. No source of
relevant information is rejected before it is fully evaluated and all available evidence is carefully weighed before the decision is made. If evidence is considered to be insufficient then the judgment is suspended until there is enough information to enable a decision to be made. No idea, conclusion decision or solution is accepted just because a particular person makes claims but it is treated skeptically and critically until its soundness can be judged according to the weight of evidence which is relevant to a person who is willing to follow such a producer (and who regularly does so) is said to be motivated by the scientific attitude.

According to Burnet (1944) scientific attitude is scientific mindedness in the words of Noll (1933) it is the habit of scientific thinking and the Educational Policies Commission (1966) define it as the spirit of science. It is most often characterized by a list of component attitudes (scientific attitude) such as objectivity, open mindedness and willingness to suspend judgment if there is insufficient evidence there is general agreement among investigators that a person who has scientific point of view (1) Looks for natural causes of events (2) Is open minded towards the work and the opinions of others and towards information related to this problems (3) Bases opinions and conclusions on the adequate evidence (4) Evaluates techniques and procedures used and information obtained (5) Curious concerning the things he observes.

Heiss 1958 stated that the development of the scientific attitude and the ability to use the method of science are the major goals of science instruction.

The major contribution of science lies in the inculcation of scientific attitude among its learners through its study. The credit of development of scientific attitude however goes to the scientific method adopted by science both in its development and application.
1.6 Meaning of Scientific Attitude:

Scientific attitude can be defined as “Open mindedness a desire for accurate knowledge confidence in procedures for seeking knowledge and all the expectation that the solution of the problem will come through the use of verified knowledge”.

Development of scientific attitude among its learners is one of the main objectives of science teaching. It is not through science teaching that scientific attitudes get developed in the learners but it is through the scientific method adopted for importing information of scientific facts and statements that lead to such development.

1) Development of scientific attitude among the learners is so important for science teaching that sometimes experts say that only those subjects should be taught properly and effectively. It is invariably concerned with open mindedness, concerned with desire for accurate knowledge, confidence in the procedures for seeking knowledge and has a faith in the use of verified knowledge to fetch solution of the problem, rationality, curiosity, objectivity, aversion of superstitions and so on.

2) Scientific attitude is the conceptual criteria in terms of which academic development may also be elaborated.

3) One of the major and essential aims of science education is the development of scientific attitude among its learners.
1.7 Importance of Scientific Attitude:

Scientific knowledge is expected to grow in a parallel way along with the growth in scientific attitude. It may not happen generally the influence of tradition sometimes might stunt the growth of scientific attitude such a lopsided growth may not be conducive to the growth of scientific knowledge. Since scientific thinking and scientific attitude are instrumental in expanding scientific knowledge, there is need to frequently assess the relative growth of scientific attitude particularly in the practitioners of science. Such an exercise requires valid and reliable tools for the measurement of scientific attitude at various levels including universities.

Standardizing a scientific scale for the academics and the research scholars at the level is not only desirable but would help in giving a needed thrust to the development of scientific attitude by identifying the area of deficiencies and by focusing the need for concentrated effort to wipe out such deficiencies hence the significance of present research.

Besides standardizing scientific attitude scale the research envisages to find out the relationships between various demographic factors of the academics and research scholars and the levels of their scientific attitude. If any demographic factor is identified as not being conducive to the development of scientific attitude in the subjects, the schools and colleges can take compensatory measures to overcome such deficiencies.
Development of Scientific Attitude:

In simple terms the measures through which scientific attitude can be developed among the students includes those through which their curiosity gets satisfied get rid of their superstitions. An important tendency which is found among all human beings and especially in children is curiosity. However this tendency should be nourished by the teacher encouraging to ask the teacher and should try to provide satisfactory responses to their queries and curiosities spirit of self exploration and investigation should be developed among them. This can be done with help of scientific method.

Some opportunities should be provided to the students by which they can experience complete freedom in the direction of scientific method. At uniform intervals provision of science exhibitions should be made in the schools and the responsibility of making all arrangements of such functions should be laid on the shoulders of students. It is also essential that for developing scientific attitude the science class room science laboratories and other places of science activities should be equipped with a sense of scientific temper and spirit of the scientific environment.

Characteristics of Scientific Attitude:

A person can be described as man of scientific attitude if he possesses the following characteristics.

- He has spirit of curiosity.
- Believes in cause and effect relationship.
- Is open minded and has love for truth.
- Adopts scientific method in his thinking and working.
- Is free from superstitions and prejudices.
Scientific Attitude:

Scientific attitude is invariably concerned with open mindedness, concerned with desire for accurate knowledge, confidence in the procedures for seeking knowledge and having a faith in the use of verified knowledge to fetch solution of the problems, rationality, curiosity, objectivity, a version of superstitions. Scientific attitude is the conceptual criteria in terms of which academic development may also be elaborated. (School science 34) Thurston (1929) defined attitude as the “Sum total of mans inclination and feelings prejudices and biases pure conserved notions, ideas, fears, threats and convictions about any special topic”.

Dictionary of Education (1972) defines scientific attitude as a “Set of emotionally toned ideas, about science and scientific method and related directly industrial development and modernization from his point of view scientific attitude which enables man to look upon society upon himself and upon the problem facing human race with an intellectual rigor that combines sympathy with objectivity in a finely blended proportions.

1.8 Scientific Interest:

Scientific interest is concerned with interest in conducting scientific activities for seeking accurate knowledge to conduct experiments to implement new ideas. It is concerned with the involvement of teachers in the scientific activities.

Recognizing the importance of scientific approach to life and society, Article 51A of our constitution, which deals with fundamental duties, makes it a duty of every citizen to develop a scientific temper, humanism and the spirit of enquiry and reform. The scientific policy resolution initiated by Nehru was adopted by the Government of India in 1958 intend to support science and technology in order to secure for the people of the country all the benefits that can accrue from the acquisition and application of science knowledge. In1970 National Committee on
Science and Technology (NCST) and in 1981, Science advisory committee to the cabinet (SACC), National Council for Science and Technology and Communication (NCSTC) was set up to stimulate and to promote scientific and attitudinal changes amongst the masses. Bharat Jyan Vigyan Jatha (BJV-92), National Organizing Council (NOC) and several state committees have been set up under the leadership of Prof. Yashpal to promote scientific temper, self-reliance and national regeneration. The Jatha is in progress taking the form of Mass action for National Regeneration (MANAR).

To cultivate scientific attitude and interest among children, NCSTC devises novel programmes under the auspices of NCSTC, National children science Congresses are being organized. The first congress was organized recently in New-Delhi.

**Concept of Scientific Interest:**

In the dictionary of Education (1959) scientific interest is defined as pronounced innate capacity ability in a given line of endeavors such as a particular art, school subject or vocation.

Thus scientific interest refers to individual’s inborn capacities or potentialities which are indicative in some special abilities.

Freeman (1965) has defined an interest as combination of characteristics indicative of an individual’s capacity to acquire some specific knowledge skill or set or organized responses such as ability to speak language to do mechanical work.

These interests refer to an individual inborn capacity to acquire proficiency in a given area of human endeavors.

Scientific interest is a complex of interacting hereditary and environmental determinants producing predispositions / abilities that we can identify to an extent certain not all characteristics possessed by individuals who succeed late in scientific endeavors.
Teaching is more than the presentation of facts. Teaching is the development of new ways of thinking, a development that reveals itself in increased skills with the problems of life in new habits of actions in more desirable attitude and aptitudes in benefiting personality and is an improved character.

Science can justify its place in the curriculum only when it prejudices important changes in young pupils, change their ways of thinking in their habits of action and in the values they assign to what they have and what they do.

**Role of Education:**

In developing scientific attitude and scientific interest among the individuals, the role of education is very important. But today our educational system is at the cross roads. The teachers and other educational functionaries need to play a dynamic role in promoting scientific attitude and ignite a congenial climate of scientific spirit. It is up to our schools to prepare the youngsters with scientific behavior input. But the present system of teaching, learning process is incompetent to achieve this. We teach science to our young children’s not as a process or a method but as a collection of information. The present education system has to be revamped as a system of more creative and stimulating the spirit of scientific process in teaching-learning process of thought, a method always appealing to experiment followed by logical education.

Cultivation of scientific attitude and interest should start from the early stages of education. The teachers at the primary level and education will be the first target group. No effort should be spared to orient our children with a scientific spirit and taste. We need to revamp the primary education drastically.

Institute of education of Devi Ahalya Vishwa Vidyalaya has initiated certain novel efforts. It has organized Bal vigyan and elementary school children science congresses periodically, involving teachers and researchers in science.
The National Policy of Education NPE in India of 1986 underlines the indispensable role of teachers in society and states that the status of teachers reflects the socio cultural ethos of society. “Teachers should be given every opportunity to serve effectively, NEP calls for improved methods of recruitment and better pay scales for teachers. It stresses accountability linked with incentives and involvement of teachers in educational programmes.

Teachers need to be further professionally motivated and through learned. Teachers need to be oriented in subjects like history and sociology in science and technology. This would help the teachers to have better knowledge about the social significance of science and technology.

NCERT, NISTADS Departments of humanities and social science in IIT’S can better use their resource base for this purpose.

Above all teachers also should do some introspection and resolve to dedicate themselves to the service of learners and society. Their life style should set a model to others in promoting scientific interest and scientific attitudes.

1.9 Importance of Scientific Interest;

Now a days, science educators realize that scientific interest plays a major role in the science enterprise and science teaching; unfortunately, few researchers have focused on exploring student’s scientific creativity and improving or fostering student’s creativity in science leaning. Therefore both theoretical and pedagogical significance has been pursued in the present study. Theoretically, this study attempts to determine correlation between scientific creativity, scientific attitude, and scientific interest in relation to their academic achievement. The research results may help to determine the significant predictors of scientific creativity and eventually find more appropriate ways to evaluate student’s scientific creativity. Also the research results may help the investigator to use a more holistic and integrative approach to assess students scientific creativity, their scientific interest
and scientific attitude. If the findings of this study show a strong correlation between scientific creativity and some of the variables, science teachers may view scientific creativity as an ability that can be taught rather than an innate, insightful, or fantastic ability.

The research results will help teachers understand better which factors may affect student’s scientific creativity most. Therefore scientific creativity, scientific attitude and scientific interest can be enhanced through various means in classroom science teaching.

1.10 Role of Teacher in Fostering Scientific Creativity, Scientific Attitude and Scientific Interest;

Excellence in any area of learning is a direct consequence of the commitment, willingness and professional preparedness of the teachers concerned. The Education Commission 1964-66 has observed that of all factors that influence the quality of education, the quality competence of teachers is undoubtedly the most significant, once the teachers provide basic initial inputs, they can achieve a lot, through their ingenuity and efforts. The role of such teachers becomes very comprehensive. The pupils like teachers with the following attributes. (Journal of Indian Education 6).

- Arise pupil’s ideas.
- Give less direction commands and orders.
- Are more indirect in their classroom behavior.
- Ask more question while guiding the content oriented classroom discussions.
- Integrate pupil’s ideas into classroom discussion.
- Are involved in more creative models of teaching.
- Are well familiar with emerging information technology.
The world is rapidly changing and expanding. As a result, the face of today’s classroom is also changing. No longer do students come from relatively common backgrounds. Increasingly, many children in large cities, in other countries, urban setting are significantly different and separate from the national mainstream. The challenge for teachers is to include and support these students and inspire them with their rich teaching experience that can help to know their abilities and can participate and succeed in learning.

The twenty first century is almost upon us, an ever expanding array of science and technology offers us better health improved travel and communication and exciting instructional and recreational devices. In twenty-first century this country will need increasingly number of citizens with special training in science and technology perhaps only small percentage of our students will choose to be scientists, engineers, physicians or technicians, but all of them will need teachers who recognize a better way to teach science to understand a rapidly changing world.

Teachers can make the difference in each student’s present and future encounters with science. The teacher plays an important role in developing the right attitude towards science. To develop scientific attitude it is important that science teaching itself provides satisfaction. The ultimate success of seeking truth in highly contending the teacher should know that children learn to follow the ways that succeed and give satisfaction.

**Significance of Science Teacher:**

We no longer accept the fact that the teacher is one who “Teaches”. Today a true teacher is one who learns and inspires. Effective learning is possible when the teacher possess certain competencies to make learning simple and interesting.
The role of teacher has been highlighted by various eminent educationists.

“Teachers should be filled with a modernist-attitude, with a progressive, with a forward looking direction. Unless they themselves have it, they cannot make their students forward looking.

- Dr. Sarvapalli Radhakrishnan.

“A teacher has to help in the transmitting of higher values to his pupils, through his personality and through the goods of culture which are his instruments. A teacher has to help the bud into full bloom and not to make paper flower to satisfy his whim. The growth of a morally autonomous personality is the aim and end of his endeavour”

-Jawaharlal Nehru.

Scientific attitude is a tendency to seek truth, think logically and there upon act reasonably. To develop scientific attitude among students, the teacher has to be eager and full of enthusiasm.

The teacher needs to have the following:

- Ask more questions while guiding the content oriented class room discussion.
- Possess requisite skills to respond to pupil’s ideas, talks and questions.
- Integrate pupil’s ideas into class room discussion.
- Are involved in more creative models of teaching in the classroom.
- Familiar with emerging information technology, for better teaching.

Teacher who wishes to foster scientific creativity and scientific attitude in children must discover the individual child’s interest’s talents and establish environment that promotes their expression. Teacher should develop sensitivity to observe traits and indicate creativity. These traits include flexibility, originality, openness, risk taking, curiosity, imagination, independence and tolerance of ambiguity.
It is therefore important to provide children and young people with every possible opportunity for discovery and experiment aesthetic, artistic, scientific, cultural and social as well as appealing introductions to the creation of their contemporaries or earlier generations.

The desire to develop the imagination and creativity should also result in higher regard being paid to oral culture and knowledge derived from the child or adult expression.
1.11 NEED AND IMPORTANCE OF THE STUDY;

Science has become an integral part of our life and living. In the present context we cannot think of a world without science. The wonderful achievement of science have glorified the modern world and transformed the modern civilization into a scientific civilization.

Science is no longer the quintessence of knowledge and what is worth knowing but a way. It is a way of penetrating into unexplored and unmastered realms. The present generation rests on the firm foundation laid down by the scientists with their valuable contributions.

Modern society is characterized by rapid change and technological advance perhaps never in the history of mankind have so many changes occurred simultaneously and with such acceleration over so broad a spectrum of man affairs changes witnessed during the recent past are seen to represent an ever greater acceleration compared to those preview decades (Raina 1989)

The world is changing so fast that truths often mislead instead of help. No longer is it easy to apply past truths to the problems of the present and the future. To drop world “calls for new approaches to experience both in acquiring its and in using what we already have. Each individual must be equipped to size learning opportunities throughout life, both to broaden his / her knowledge, skill and attitudes and to adapt to a changing complex and independent world.

According to UNESCO – 1996
Science, besides satisfying the intellectual curiosity of man providing materials and media for intellectual exercise, has disciplinary effects on the minds of individuals. Since science covers the widest range of knowledge the learner wonders at the intricacies and mysteries of the universe, the known and the unknown these tend to create a broader outlook in the life of the learner.

In the words of Crutchfield( 1967)
If creative development were to have the same status in education as it does in the corporate setting, then children would be in a much better position to cope with these kind of challenges we are in the middle of ‘brains race’ which has made the process of education a matter of increasing importance to communities. To compete with other countries the state will need to encourage the individual to think creatively about as the yet unforeseen problems of society and world in the light of facts and concepts yet to be discovered.

Science was given a few decades back, a step motherly treatment and was considered to be a subject meant for less promising students, science now established as a compulsory subject right from the elementary stage and now one of the core subjects at secondary and higher secondary stage. It has taken a good many years of active and persistent effort to reach this position. The scientific attitudes and scientific aptitude play a major role in science education. Identifying the importance of science education the science policy resolution (1958) of the Government of India stated that 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 requirement. Science has become a compulsory subject in school curriculum and is trying to inculcate scientific attitude and scientific aptitude besides preparing the pupils for leading quality life.

As we enter the twenty first century, children and teachers must be able to progress and succeed in their rapidly changing learning or working environment. They need to learn new techniques, skills and knowledge for adapting to the changing environment.

World Education Report 98 UNESCO, said that the, world is changing in all spheres scientific, technological, political, economical, social and cultural. So educating the young to meet these challenges has become priority for every society.
Need of Scientific Creativity:

Creative expression is essential for leading happy life. Since the dawn of civilization man has experienced the greatest pleasure and bliss by adopting creative values in his life. In addition the future of our civilization depends upon the quality of creative imagination of next generation. Torrance 1965 outlines that creative thinking is indeed a powerful force. It has given us alphabet, printing, radio, T.V., computer, cell phones, space craft, music and literature.

It has given us our great advances in scientific discovery and medicine. It has also given us war, crime, terrorism and the smashed atom. Creativity enormously affects the scientific progress and commercial life of nations. Objectives proposed for science education always include the development of interests, values, attitudes and appreciation.

Science educators have long recognized that scientific attitudes are among the most important outcomes, which should result from science teaching. There is a general agreement among the investigators that an individual with scientific attitude looks for natural cause of events, is open minded towards the work and opinion of others, bases opinions and conclusions on adequate evidence is curious concerning the things, he observes accurate in observation, experimentation and presentation of data, suspends judgments until accurate information is available and looks for cause and effect relationships by showing intellectual honesty which is free from bias and prejudice averse to superstitions, maintains such ideals as honesty, patience persistence and thoroughness.

It has also been realized that without developing scientific attitude, any amount of knowledge in science contributes little to national development of scientific attitude through science lessons has been emphasized by science education.
Along with scientific attitude, scientific creativity and scientific interest are other major outcomes of science education. Scientific interest is concerned with the ability of future accomplishment in science. If an individual is endowed with better scientific aptitude he will be in a position to pursue science education with which he can climb the ladder of science with ease and effect. It is a necessary as scientific attitude will develop scientific interest in science education.

Science also plays a major role in inculcating hope for continuous and progressive welfare. The strength of modern economy depends on the strength of its industry and industrial development. In turn it depends upon technology that in turn depends on the application of new scientific knowledge. At the same time the nation’s progress, welfare and prosperity also depend on a rapid, planned and sustained growth in the quality and extent of education and research in science and technology (Kothari Commission 1964-1966).

The rapid advancement of science and technology and increasing need for science and technology have made it all the more important to provide science based education in the schools. Science has now become the compulsory subject in the school curriculum, because of its multifarious value to the individual as well as to the society. Thus science has become an important area in education.

1.12 GENESIS OF THE STUDY;

Science has helped the man to acquire supremacy over nature. It has greatly affected the way the people view themselves and the world around them. The wonderful achievements of science have glorified the modern world and illuminated the human creative potential.

In ancient times most of the people believed that natural events and everything that happens to them are because of the actions of the God and spirits. But the ancient Greeks were among the first to use systematic observation and reasoning to analyze natural happenings. As scientific creativity, thinking
gradually developed, nature has seen less and less as the product of mysterious spiritual forces.

Science in literal sense means the pursuit of knowledge the world science comes from the Latin word ‘Scientia’ which means knowledge. The term science in the sense of knowledge was used for long to include the entire subject matter of study through it is correct it does not empty that all knowledge is science. This is very clear by the fact that all the branches of social science and humanities are universally excluded from the preview of science.

Thus the facilities to measure quantify and verify the object in question is the part of science. Its conclusion is universal. The body of knowledge is factual and verifiable and the results are data based.

The Columbia Encyclopedia defined science as 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 scientific attitude. Albert Einstein felt that science for relations which are thought to exist independently of searching individual.

Science is a body of knowledge and the process of acquiring and refineing knowledge. Science is an interconnected series of concepts and theories.

In today’s world the development of scientific creativity, scientific attitude and scientific interest among the secondary school children are fundamentally important for our social, economic and cultural well being. Unless we help the young talents to develop their innate desire to be creative and their capacity to create, fail to educate them as whole and complete individuals.

The individuals are bestowed with a unique talent this talent may lift them to their dream goal if they are nourished and guided. Many Newtons, Einstein,
Edisons are there in every school but their talents abilities have to be identified and encouraged in a proper direction.

It is often encountered that science is dominated by the outdated dogmatic, superstitions beliefs and practices, accordingly the elders and individuals of the society influence and guide the development of children in their own way, without any rationale. It is in this regard, the present study has been undertaken by the research investigator by formulating the problem in the following.

This is an attempt to show that scientific creativity, scientific attitude and scientific interest of secondary school students is directly or indirectly related to their academic achievement.

1.13 SCOPE OF THE STUDY;

The topic selected for the present research entitled “A study of scientific creativity, scientific attitude and scientific interest in relation to the academic achievement of ninth standard of Bijapur”, is mainly meant for the study of scientific attitude, scientific creativity and scientific interest of ninth standard students of Bijapur. Science has brought about revolutionary changes in every walk of our life. Its impact is visible everywhere and in every aspect of our existence, that is manifested in terms of vocational, social, economic, political, and cultural dimensions. Therefore in every country special attention is being given for the development of science.

Science therefore occupies a very important place in curriculum both at school and university stages of education in India. Science education is supposed to perform two fold tasks. Firstly, in individual perspective the cultivation of scientific temper, spirit of scientific enquiry, scientific attitude, scientific interest, scientific awareness, scientific outlook, disposition to reason logically, habit of judging beliefs and formation of opinions based on available evidences, readiness
to reject unfounded theories and principles have been emphasized in science education. And secondly, in the social perspective, science education has been aimed at equipping individuals to participate in the creation of a society which is free from poverty, hunger, diseases and such as evils, superstitions, blind belief, violence, exploitation, oppression, seclusion, isolation, rejection and so on.

The whole curriculum in science has undergone a revolutionary change in the light of globalization and information revolution with the broader objectives of providing every student with optimum knowledge and skills regarding the physical and biological world around in order to enable him to take intelligent decisions to solve personal as well as environmental problems.

The Education Commission of 1964-66 remarks that “If science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it could degenerate into a new superstition. What we need is improvement in the standard and quality of science education at all levels in the country”.

Scientific creativity, scientific attitude, scientific interests are the complex behavioral aspects of science. They have so many characteristics and can be attributed to as many situations as we discuss in science education. We can use it to study at various educational levels, say from primary to post graduate levels; we can use it to associate with various school subjects and its impact on learning and achievement of the school subjects; we can use it to relate with gender, residence, type of school, teaching and learning situation, physical facilities and so on.

The present study is concerned with the scientific creativity, scientific attitude and scientific interest in relation to the academic achievement of 9th standard students of Bijapur district. It also focuses on the medium of instruction, gender, locality and management of the school.

The present study is limited to the study of the scientific creativity, scientific attitude and scientific interest of ninth standard students only, and the study is limited to the Bijapur district only.
Science is a compulsory subject in the secondary school curriculum. As scientific creativity, scientific attitude and scientific interest have their impact on the academic achievement of 9th standard students, science is playing dominant role in almost all spheres of life. It is no exaggeration to say that, present science influences every field of our activities. The technological advances have explored and multiplied the possibility of affording sustenance and comforts to human beings. Thus from cradle to grave, scientific discoveries and inventions have inextricably woven themselves into the fabric of human existence.

### 1.14 Statement of the Study:

“A Study of Scientific-creativity, Scientific-attitude, Scientific-interest in relation to the Academic achievement of Ninth standard students of Bijapur”.

### 1.15 Objectives of the Study:

1. To study the scientific creativity, scientific attitude and scientific interest of male and female ninth standard students of Bijapur.
2. To study the scientific creativity, scientific attitude and scientific interest in relation to Academic Achievement of male and female ninth standard students of Bijapur.
3. To study the Scientific creativity, Scientific attitude and Scientific interest of male and female ninth standard students studying in Government, Aided and Unaided secondary schools of Bijapur.
4. To study scientific creativity, scientific attitude and Scientific interest of male and female ninth standard students studying in Rural and Urban schools of Bijapur.
5. To study the scientific creativity, scientific attitude and scientific interest of male and female ninth standard students studying in
Kannada medium and English medium in secondary schools of Bijapur.

6. To study and compare the Academic achievement of male and female ninth standard students belonging to Bijapur.

7. To study the Academic achievement of male and female students belonging to Government, Aided and Un-Aided secondary schools of Bijapur.

8. To study the Academic achievement of male and female ninth standard students belonging to rural and urban secondary schools of Bijapur.

9. To study the Academic achievement of male and female ninth standard students studying in Kannada medium and English medium in Government, Aided and Un-Aided secondary schools of Bijapur.

10. To study the interaction effect of scientific creativity, Scientific attitude and Scientific interest in relation to the academic achievement of ninth standard students of Bijapur.

1.16 Limitations of the Study:

Limitations are some controls or restrictions present during the course of research. Limitations of the study decides the boundaries for the study with the due efforts by the investigator, he/she cannot cross the boundaries. Some of the limitations of the present study are;

- The study is confined (restricted) to know and study the scientific-creativity, scientific-attitude and scientific-interest in relation to the academic-achievement of ninth standard students of Bijapur district only.

- The study is restricted to study the scientific-creativity, scientific-attitude and scientific-interest of ninth standard students of Bijapur district only.

The present study is limited to the sample drawn by the research investigator for the present study.
1.17 Over view of the study;

The research investigator carried out the research work and has presented the same in five chapters; each chapter is divided into different units as follows;

The First chapter deals with the Introduction, Need Importance and scope of the study, Objectives of the study, Genesis of the study, Statement of the study and Limitations of the study.

The Second chapter includes review of related literature, The investigator has documented the review of related studies of different researches concerned to the present study.

The Third chapter deals with the Operational definitions of the terms of the study, Variables, Tools used for the study, Population of the study, Sample of the study, Method of collection of the data and Statistical analysis of the data.

The Fourth Chapter deals with Analysis and Interpretation of the data.

The Fifth Chapter deals with Summary, Major findings and Conclusion of the study.