CHAPTER I
INTRODUCTION

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INTRODUCTION

"You must be made to understand the beauty of doing Science, the pleasure of doing Science and the ultimate bliss of Science that improve the quality of life of humankind"

(Kalam, 2007)

1.1 Background of the Problem

Science is the way of understanding the world, a perspective and a pattern of thinking that begins early in one’s life. It is a great human enterprise that is not only endless and faceless but also stable and fluid. The role of science promises to be greater in the future because of the ever more-rapid scientific progress. Our society is becoming increasingly dependent on science and technology. Science has provided us remarkable insights into the world we live in. The scientific revolutions of the 20th century have led to many technologies, which promise to herald wholly new eras in many fields. Over the last few decades, computers and communication technologies had a significant impact on the ways in which an individual should learn, teach, communicate and gain access to information. In recent years, media assume an increasingly important role in every aspect of instructional planning and designs. Science and technology have profoundly influenced the course of human civilization.

Science has several rewards, but the greatest is that it is the most interesting, difficult, pitiless, exciting and beautiful pursuit that mankind has devised so far. In fact, if one were to consider the best art produced in the last century it can be termed as “Science”. India has the third largest scientific and technical manpower in the world. Science and technology, however, is used as an effective instrument for growth and change. It is being brought into the mainstream of economic planning in the sectors of agriculture, industry and services. The contributions and achievements of Indians in the fields of science and technology, architecture, and culture are widely acknowledged. India’s achievements in space today are the result of the foresightedness of Sarabhai, one of the greatest sons of India. India today is considered as one of the prominent countries conducting many space activities. India’s achievements in space technology contribute to its missile technology, including the Agni-V, GSLV Mark – III, advancements of fields like biotechnology,
electronics, space and atomic energy. Achievement that is worth mentioning is India’s accomplishments in the electronics field. India has been doing great in terms of micro-electronics, telematics, software and high performance computing developments. India has been able to do many great things since its official freedom from the British dominance.

Science education has an important role to play in the all-round cultural and societal development of human kind and for evolving a civilized society. The essence of scientific spirit is to think globally and act locally, since scientific knowledge is universal in nature while the fruit of science have some site specificity. Science untangles the threads that create the tapestry of our living world. It tries to work out how the threads merge in the overall ecological networks creating and maintaining the human kind and also contributes to the thought process of human beings. Probably, it can also be the spirit that can possibly reverse the steady downward trend of our world’s health and wealth. All societies in the world have ways to educate their young members to ensure that they become full participants in society, are able to contribute and develop it and so become more human (Savater, 2004). Science education introduces the valued aspects of the culture of society as well as important cultural aspects of the members of that society. It has its own structure, ways of thinking and working. It has its own beauty, awe and wonder and offers a powerful way of looking at the world (Chalmers, 1999).

Science instruction is the foundation for scientific and technological advancements of society. In the midst of overall anxiety of the modernization drive, education especially Science Education should automatically get a strategic priority. Traditional teaching methods are employed, teachers mainly focus on how to deliver knowledge and the lecture is centred on the content of the course. Students are treated as a sponge, ready to absorb knowledge. Despite that the conventional methods of teaching have been more or less similar around the world; the adaptation of teaching strategies and styles to different social, economic and educational contexts has been always an issue for consideration. The tremendous growth of technology and computer applications affected almost every aspect of everyday life, worldwide. This is also the case in the field of education; the latter has changed dramatically by endorsing applications that help students improve their written and verbal abilities as
well as help them develop new skills that broaden their potentials. The up-and-coming trends changed the present scenario and adopted the constructivist approach which is moral and more focus on innovative activities and knowledge acquisition. Active learning involves students and helps them to have an in-depth understanding of the course through induction of practice; in other words, the inductive teaching has better results than productive teaching (Adler, 1999). Activity based instruction could be the most solid fundamental idea in our educational world. It allows students to work in a setting that moves, is motivational, and usually stirs the mind instead of allowing structural boredom of the same old way of teaching. It allows the student a chance to look at an idea that may be abstract to begin with, only to have Maslow's highest stage of need to creep in and take over as the aesthetic needs comes blossoming out of us as a group. It isn't just teacher based. It is learner based, and the course that the teacher is teaching will flow into all sorts of ideas and take on a personality of all its own.

The growth of science is fast and vigorous but the progress of science education is still lagging behind. Science education especially, in schools have not generated the critical spirit of budding young potential scientists and this will lead to disastrous consequences to the scientific and technological temples of this country (Bhargava & Chakrabarti, 2007). Unscientific ideas and thoughts, which adulterated believes one grow with and practice during one's life time. Amanda (2004) reported the existence of strong superstitious belief among higher secondary students. Women's death due to Black Magic treatment was reported in the Decan Herald (2014). Similar case was also reported in the same about the death of an 18 year old college girl due to Black Magic ceremony (The Hindu Daily, 2014). This is a relevant example for the unscientific prevailing in the educationally forward society. It is highly unfortunate that in the land where Vedic astrology was born, most people, even a lot of astrologers, have a lot of misconceptions and blind beliefs about several basic facts of astrology. Misconceptions about Mangaldosha, RakshasaGana, Kalasarpadosha and Sadesati have a lot of far reaching effects in the society full of superstitions, especially in marriage matters. Female infanticide, sooth saying, Deep-seated fear of hell fire etc are the social evils highly prevalent in India. The scientific age is riddled with intriguing contradictions and human-made follies. The technology-driven consumer culture and entertainment industry has fueled the growth of primitive superstitions, misconceptions about eclipse, myths and new age beliefs. The need to
promote a rational discussion on science, technology and equitable social
development has never been so pressing.

‘Human kill human’- although the quality of life has improved over the past
decades due to new technological advances but the damages made to the earth weigh
more. Damages included increase in pollution and change in climatic patterns. There
can be drastic changes in the climatic pattern due to the increase in the carbon dioxide
released into the atmosphere, which is the main cause of global warming. Human
activities are comprised of many things which can destroy as well as endanger the
environment and nature surrounding us. Humans have destroyed and endangered
more species on the planet than any other species or group, with our continuous
pollution and lack of respect for the environment. With the goal of teaching science
are the unique development challenges and successes regarding a range of
environmental problems, including climate change, waste management, unsustainable
consumption, degradation of natural resources, and extreme natural disasters.

As Yashpal (2005) has noted, “science will also have to come forward in
changing our thoughts and eradicating various social evils, including casteism,
extremism…” One of the goals of the science education is to encourage students to
have Scientific Temper for the effects of students’ learning. The most important
objective of school science instruction is to make the pupils aware of the scientific
methods of the procedure and to inculcate Scientific Attitude of mind (Das, 1992).
“Problem solving in science involves the use of scientific habits and attitudes which
include, careful observations, accurate interpretation of these observations, and
skillful recording and communicating of them. It includes the habit of withholding
judgment, questioning sources of information, consulting many sources and other
familiar aspects of Scientific Temper” (Narendra, 1971). Through scientific education,
science has to penetrate societies and communities to get rid from age old traditional
superstition. Blind obedience to religious and judicial authorities is not only against
the spirit of science and value education but also a great obstacle in achieving the
constitutional goals of India as well as international peace and co-operation (Surendra,
2002). The Scientific Attitude encourages one to look at the universe without the
distorting blinkers of superstition. Such a person can intelligently appreciate the
wonders of nature with a sense of awe blended with humility, and yet understand that
in the midst of incredible harmony and beauty in the universe, there is heart-rending ugliness and evil as natural by-products of cosmic evolution.

India, in Nehru’s vision, could become a great country if the people adopted such a ‘Scientific Temper.’ In teaching science, it is more important to help students to understand the scientific approach to life and develop a Scientific Temper than it is to impart scientific knowledge or train them in specific scientific techniques. Scientific Temper goes beyond objectivity and fosters creativity and progress. More of Scientific Temper would spread, and domain of religion would shrink, then the exciting adventure of fresh and never ceasing discoveries, of new panoramas will open out and new ways of living will emerge making it richer and more complete (Rakesh, 2003). The attributes of Scientific Temper like, honesty, truthfulness, humility, perseverance, positive approach to failure, are essentially some of universal human values which are as important for happiness of an individual as also for the society. Scientific Temper referred to a mentality or an outlook rather than a specialized body of knowledge. It addressed itself to Universalist concerns of “values of life” rather than to narrow and specialized questions of scientific research and application (Roy, 2007). Research study indicated that not only attitude toward science and Scientific Temper are closely related to achievement in science, the relationship between students’ attitudes and their achievement is not simply a correlation but causation in nature (Lee, 2013). Scientific Temper is one human attitude which allows one seek and experience worldly matters, secular, religious and spiritual knowledge transcending one’s own understanding, convictions, biases, and the like limited individual abilities and capabilities.

The activities include exposing students to the fascinating world of science through face to face interaction with eminent scientists, demonstration lectures by eminent experts from various fields and to provide opportunities for children to create science toys, watch fascinating experiments, science films and participate in delightful activities like aero modelling and sky watching. The teachers having critical thinking disposed to care that their beliefs be true and that their decisions be justified; that is, care to "get it right" to the extent possible. The aim of the teacher should be to build character and inculcate values that enhance the learning capacity of children, build confidence to be innovative and creative, which in turn will make them competitive to
face the future. These qualities collectively constitute the essentials required to be an effective science teacher to shine like a full moon among the twinkling stars in the blue skies of knowledge. A thirsty man has a drive to dig a well not only for his personal benefits but also to cool the throats of numerous passers-by. In the same way, a science teacher is expected to keep a tab on the scientific developments so as to be able to construe and answer the hard hitting questions of students born in this era of information explosion. The teacher’s role in the present scenario is to ignite the young mind by eradicating the superstitious beliefs and deep rooted unscientific ideas still prevailing among the youth by exploring the scientific mysteries in the right path.

Clearly what the above meant was that science would not just play a role in building scientific expertise but also help reject superstition, prejudice and injustice. According to Viswanath (2011), “science education has an important role to play in the all-round cultural and societal development of human kind and for evolving a civilized society”. Former President Kalam said, “Children must inculcate a Scientific Temper for pursuing knowledge to contribute towards making India one of the most developed countries in the world. An ignited mind is the most powerful resource on the earth, above the earth and under the earth. The current teaching methods need to be revamped with more practicals and experiments to inculcate Scientific Temper among students”.

1.2 Need and Significance of the Study

Humans have always been curious about the world around them. The inquiring and imaginative human mind has responded to the wonder and awe of nature in different ways. One kind of response from the earliest times has been to observe the physical and biological environment carefully, look for any meaningful patterns and relations, make and use new tools to interact with nature, and build conceptual models to understand the world. This human endeavor is “science”. Science is a dynamic, expanding body of knowledge covering ever new domains of experience. Conant (1951), an eminent scientist and an educator defined science as “an interconnected series of concepts and conceptual schemes that have developed as a result of experimentation and observation and are fruitful to further experimentation and observation”.
Science is a significant part of human culture and represents one of the pinnacles of human thinking capacity. To quote Albert Einstein, the goal of science education is “to produce independent thinking and acting individuals” (Duschl, 2007). The eventual aim of science education is to produce individuals capable of understanding and evaluating information that is or purports to be, scientific in nature and of making decisions that incorporate that information appropriately and furthermore, to produce a sufficient number and diversity of skilled and motivated future scientists, engineers, and other science based professionals. Learning of science in schools augments the spirit of enquiry, creativity and objectivity along with aesthetic sensibility. It aims to develop well defined abilities of knowing, doing and being. It also nurtures the ability to explore and seek solution to the problems related to the environment and daily life situations and to question the existing beliefs, prejudices and practices in society. Thus science is must for every child to learn as it gives an opportunity to learn how to learn (Sridevi, 2008).

Science education must focus on the quality of teaching and learning. The quality of the results, as a concept borrowed from the business sector which is much less complex and interactive than the education sector, is difficult to define with precision, since it combines values, attitudes, and achievements which form a part of the most complex areas of study in psychology, such as the cognitive, affective and psychomotor areas. Learning theories such as behaviorism, cognitivism, and social-constructivism are propositions or explanations on how quality science learning is acquired by a learner (Hassan, 2011). Therefore, while planning a lesson to provide a suitable learning environment, a teacher needs to bear in mind certain considerations based on the philosophical foundation of teaching and learning theories. Each theory has its strengths and weaknesses and thus may not be suitable for all occasion of learning. For example, behaviorism is based on the stimulus response model (classical conditioning) and reinforcement operant conditioning) that attempt to study behavior in observable and measurable way (Ormond, 2000). Behaviorism is thus often guides training for skills development.

Later on emerges the social-cognitive theory which proposed that both behavior and environment equally contribute to learning. For example, behavior can influence environment and vice versa. Mind is not just a reactant to neutral events but rather an active component that can conceive an idea, rethink over the same idea, can
function as the evaluator and executor of ideas depending on the person whose mind it belongs, situation and social setting (Mayer, 2008). Kolb learning theory is selected on education because it concerns with an integrated effective learning approach. The derivation of Kolb’s theory is based on the philosophical background of Dewey (personality psychology and affective dimensions), Piaget (knowledge of cognition) and Lewin (social influence and affective involvement on learning) (Schellhase, 2006). Thus, an effective teacher does not make use of one learning theory only but may employ different theories at various times depending on the nature of the expected learning outcome and students’ attributes to make learning effective (Ormond, 2000).

The affective variable of learning is important not only because achieving a certain level of affective skills is important by itself is sometimes critical towards acquiring the desired cognitive learning outcomes of education (Picard et al., 2004). Work by Schunk (1991) propose that the affective and cognitive dimension of learning are two elements that act in “reciprocity” that is, mutually interacting determinants of the success of the each other. So important is the affective dimension of learning that an affective attribute that motivates a student to learn in the first place is also the attribute that sustain their learning efforts in the long run.

The affective aspect of learning (feeling, emotion, and attitude) or behavioral trait tends to be relatively less appreciated in science education compared to the cognitive aspect of learning, although numerous studies support the importance of the affective dimension in facilitating the effective cognitive processes and the internalization of cognitive knowledge. Lack of appreciation of the affective dimension often results in undervaluing the students’ potential which leads to poorer realization of students’ achievement. Existing knowledge on learning indicates that effective teaching and learning for the cognitive domain can only be realized through the integration of the personal and affective needs of a learner. Thus the affective dimension of learning could be used to support the internalization of cognitive knowledge (Akasah & Alias, 2010).

The human behavioral aspect is conditioned by elders, their life style, education and the larger social environment like home, school etc. This behavioral conditioning leads to attitude formation. Attitudes are the particular ways in which a person thinks,
feels and acts and composed of beliefs, opinions and thoughts linked up with behavior and it influences the level of consistency. Anyone who likes to pursue a particular work objectively, first he or she needs to develop a scientifically attitude or an attitude conditioned by the spirit and methods of science, are capable of pursuing a problem in a scientific way. This attitude of mind which lie behind the method of acquiring reliable and practical knowledge is signifies the term Scientific Temper (Gunasekaran, 1995). “It is not a static concept, but a set of broad values that touches areas of human cognition and action beyond the boundaries of science and impinge upon the domain of extra-science” (Nehru, 1946). The Scientific Temper is basically characterized by the traits like a healthy skepticism, universalism, freedom from prejudice or bias, objectivity, open mindedness and humility, willingness to suspend judgment without sufficient evidence, rationality, perseverance and positive approach to failure. Normally, a person having scientific attitude, uses the method of science in his/her daily life decision making process, knowingly or unknowingly.

The first Prime Minister of India, Nehru relentlessly expanded the notion of Scientific Temper and strived to convince political and scientific leaderships to inculcate Scientific Temper among citizens. However, this discourse is rooted in the pre-Nehruvian era. Though the term Scientific Temper was not in use, many social reformers, scholars and scientists advocated the need to instill a spirit of scientific enquiry in the society. The tradition of scepticism and humanism had been part and parcel of Indian intellectual tradition. Such notion goes back to antiquity – Jain, Sankhya and Buddhist traditions have repeatedly emphasised the spirit of inquiry. It was during the Indian Renaissance that the notion of scientific inquiry was popularized and became part of Indian ethos. Nobel Laureate Amartyasen’s (2006) book ‘The Argumentative Indian’ also makes us realizes that Scientific Temper has been the hallmark of Indian thoughts since long. This demolishes the notion that Scientific Temper is a western concept brought to us by the colonizers. After independence, India’s political, scientific and technological aspirations were expressed in the Scientific Policy Resolution passed by the Indian Parliament in 1958. It committed the nation to build a scientifically tempered and technologically advanced society.
The inculcation of Scientific Temperament was added as a fundamental duty under Article 51 (A) (H) by the 42nd constitutional amendment, to develop the Scientific Temper, humanism and spirit of inquiry and reforms”. For developing Scientific Temper among the students, a number of efforts are being made by the government and as well as several Non government organizations. The National curriculum framework has also pointed out that sciences, like the systems of mathematics, have their own concepts, often interconnected through theories, and are attempts to describe and explain the natural world. Scientific inquiry involves observation and experimentation to validate predictions made by theory or hypotheses, which may be aided by instruments and controls. As per the NCF (2005), learning of science in schools augments the spirit of enquiry, values and objectivity along with aesthetic sensibility and also recommended the development of Scientific Temper, generative thinking and creativity among the students. The National Focus Group on ‘Teaching of Science’ suggested prevention of marginalization of experiment based learning in school science curriculum.

Kalbag (1991) says that the scientific temper or scientific approach is a refinement of the process of thinking that comes naturally to every human being. Drawing on Nehru’s vision, and articulating most of his key themes, the Kothari Commission (1964-66) was set up to formulate a coherent education policy for India. According to the Commission, education was intended to increase productivity, develop social and national unity, consolidate democracy, modernize the country and develop social, moral and spiritual values. Other features included were the development and prioritization of science education and Scientific Temper. Kothari Commission felt that India’s development needs were better met by engineers and scientists than historians.

National Education Policy (1968), had also emphasized that with a view to accelerate the growth of national economy, the science education and research should receive high priority. Science and mathematics should be an integral part of general education till the end of school education. In 1986, Rajiv Gandhi announced a new education policy, the National policy on education (NPE) which was intended to prepare India for the 21st century. The key legacies of the 1986 policy were the promotion of privatization and the continued emphasis on secularism and science.
According to the National policy on education, 1986 the 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, the courage to question, and an aesthetic sensibility. NPE recommended that the science education programmes should be designed to enable the learner to acquire problem solving and decision making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life. It was emphasized that every effort would be made to extend science education to the vast numbers who have remained outside the pale of formal education. Such recommendations are basically aimed at promoting Scientific Temper and attitude among the children.

In 1992, a National Advisory Committee (NAC) was set up by the government under the chairmanship of Yashpal, former Chairman of the UGC to suggest ways and means to reduce academic burden on school students. The 11th five Fear plan had emphasized to sensitize teachers and others involved in nutrition, hygiene, cleanliness, and safety norms to rectify observed deficiencies, which is possible only when scientific temperament is developed among the people. Also emphasized on enlarging the pool of scientific manpower and make focused efforts to identify and nurture bright young students who could take up scientific research as a career.

Several studies in India as well as abroad established the significance of Scientific Temper in science education. Maqbool and Sofi (2013) found that the Scientific Temper and Academic Achievement of adolescents in science stream are better than those in social science stream. Similarly, Biju (2006), Joy (2006) and Joshua (2004) were found that, Scientific Temper is positively related to Achievement in Science and also significant to Academic Performance of secondary school students. Hence it is justified that Science education has an important role to play in the all-round cultural and academic performance of human kind and for evolving a civilized society. Sorge, (2007) revealed that Scientific Attitude is important to the educational community as a whole because attitude and interest are closely correlated with achievement.

Research work of Pell and Jarvis (2001) indicates that students’ attitudes impact both the quality of their work in school and their opinions of classes and jobs in science. Lack of scientific temper is the biggest impediment for the progress of
country, said former vice-chairman of National Knowledge Commission and former
director of Centre for Cellular and Molecular Biology Bhargava. A few research
studies identified certain barriers in enhancing Scientific Temper such as lack of
practical application of integrating technology to science education, lack of
guided discovery learning, cooperative learning environment and improvisational
science discourse (Nadirova & Burger, 2008).

The importance of developing Scientific Temper is very clearly established by
the fact that it is one of our fundamental duties to develop Scientific Temper and spirit
of inquiry amongst fellow citizens (Article 51 A). But in the current scenario, science
education is not able to fulfill the above set goals. The present system of science
education is far away from the above vision. Science teaching even at its best
develops competence but does not encourage inventiveness and creativity. Though
every effort are being made for developing Scientific Temper among the students
through school education system, as a science teacher the investigator experienced
several problems and challenges like, difficulty to raise the curiosity of the students,
inculcating the basic scientific skills, Lack of interactions between science
communicators and teachers and students, lack of well equipped science laboratories
and the existing system of examination and evaluation, which is inadequate to
develop Scientific Temper in students.

In today’s science class, rote learning is being encouraged, instead of that,
inquiry skills should be supported and strengthened. In order to make the society free
from quagmire of superstitions and obscurantist practices, inculcating Scientific
Temper among the citizens is of paramount importance for development of the nation
(Rakesh, 2003). This is best done during the childhood while the child is learning how
to respond to the vagaries of everyday life. It is therefore essential that the school
curriculum should respond adequately to this important need.

An effective method of fostering Scientific Temper is to impart knowledge of
science through experimentation and demonstration. In this method students get
involved directly in activities similar to how scientists operate in discovering new
knowledge. This is usually referred to as the discovery approach of teaching.
Discovery lessons developed for a variety of sciences, wherein through simple
experiments the students discover for themselves different scientific concepts, are
useful in this context. It is necessary, in this approach of teaching, that experiments or activities should be open ended with ample opportunities for students to explore and experiment with new ideas.

Scientific Temper has to be an inherent quality in the young minds and it should be cultivated in them as a matter of routine and the curriculum based attempts will not be always complete and this has to be a societal responsibility too. Great minds that the teachers have, they can contemplate this and devise methods to incorporate Scientific Temper in the young minds which will go a long way in the technological progress of this country. Therefore, it is justified, that for the wellbeing and progress of the nation, the research in science education is urgently addressed to the problem of developing Scientific Temper among students and this can be studied by assessing the impact of science teaching in terms of building up of Scientific Temper.

Conclusively it can be said that though the present education system has all provisions of developing Scientific Temper, but they are not being implemented the way they should be though activity based teaching learning methods are talked about but are seldom practiced in schools. The teaching learning is mostly school centered whereas for developing scientific attitude and scientific skills the education system should be made child centered. The principal component of education should be the development of scientific temper. The objective of school education is to develop an active and informed learner not a passive and unaware one. Effort should be made to encourage maximum use of innovative teaching learning aids/ instruction materials like audio visuals aids in science learning which in turn help in developing Scientific Temper among the students.

The above mentioned factors channelled the investigator to carry out the present study focusing on the enhancement of Scientific Temper, an essential ingredient for the survival of human being. Hence the investigator felt the need and presumes to study Scientific Temper of secondary school students by developing a Scientific Temper Package.
1.3 Statement of the Problem

Education is the process of human enrichment for the achievement of higher and better quality life. Our educational system at present focuses mainly on student’s academic performance and virtually no emphasis is given for their affective development. It is worthy to note that academic achievement alone would not guarantee a quality life for a child. Children need to master necessary scientific skills and competencies for leading an active and creative life. Educational institutions should help children to develop an insight into scientific awareness. Therefore, our schools should deliver adequate programs for fostering necessary skills in science among students at secondary level. The present study aims to experiment the Scientific Temper Package, and measures its impact on Scientific Temper and related cognitive and affective variables among secondary school students. Hence the present study is entitled, “Effectiveness of a Scientific Temper Package on Certain Cognitive and Affective Variables of Students at Secondary Level”.

1.4 Operational Definition of Key Terms

1.4.1 Effectiveness

It refers to the effect of the presentation of ideas or activities involved in a teaching unit that produces a favourable learning outcome.

1.4.2 Scientific Temper Package

Package refers to a set of related programs for a particular task. For the present study, it means properly planned instructions and activities intended to enhance Scientific Temper and related cognitive and affective variables of students.

Scientific Temper is the attitude of open, rational, questioning, curious mind that enables the individual to have a scientific outlook (Nayudamma, 1995). For the present study Scientific Temper is defined as the mental attitude which is behind the method of acquiring reliable and practical knowledge, it is free from superstition, prejudices, rigidness, close mindedness, irrationality, subjectivity and other parochial tendencies. Instruction based on Scientific Temper Package constitutes six components of Scientific Temper such as Scientific Literacy, Scientific Attitude, Scientific Thinking, Scientific Method, Scientific Perception and Scientific Habit.
Scientific Temper Package includes different strategies and activities based on these six elements.

1.4.3 Cognitive Variable

‘Cognitive Variable’ designates intellectual traits or characteristics that relate to knowledge acquired by reasoning and perception. In addition to this, the Cognitive Variable is the term for the higher mental processes by which people acquire knowledge, solve problems, and plan for the future (Strickland, 2001). Self Regulation, Achievement in Biology and Scientific Creativity are the three Cognitive Variables selected for the study.

1.4.4 Affective Variable

Affective Variable denotes psychosomatic traits or characteristics that relate to emotion produced by insight and way of thinking. It also defines the complexity and salience of interpersonal and intrapersonal traits for ideas, attitudes, feelings and behavior (Craighead, 2004). Scientific Temper, Social Sensitivity and Science Interest are the three Affective Variables selected for the present study.

1.4.5 Secondary Level

Secondary Level as used in the study refers to students attending Standards VIII, IX and X in schools of Kerala. For the present study, the investigator has selected students of Standard VIII following Kerala state syllabus.

1.5 Hypotheses of the Study

The hypotheses formulated for the present study are:

1. There is no significant difference in the existing level of Scientific Temper of Secondary School Students belonging to different subsamples based on
   - Gender: Boys/Girls
   - Locality of School: Rural/ Urban
   - Type of Management of School: Aided/Government

2. The Scientific Temper of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching.
3. The Scientific Temper of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching with respect to the Components

- Scientific Literacy
- Scientific Attitude
- Scientific Thinking
- Scientific Method
- Scientific Perception
- Scientific Habit

4. The Self Regulation of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching.

5. The Achievement in Biology of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching.

6. The Achievement in Biology of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching with respect to the following Objectives

- Remembering
- Understanding
- Application
- Analysis
- Evaluation

7. The Scientific Creativity of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching.
8. The Science Interest of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching.

9. The Social Sensitivity of Secondary School Students taught using Scientific Temper Package is significantly higher than that of those taught using Activity Oriented Method of Teaching.

1.6 Objectives of the Study

1. To analyse the perception of Teachers on
   b. The need for enhancing Scientific Temper of Secondary School Students.

2. To identify the existing level of Scientific Temper of Secondary School Students.

3. To compare the existing level of Scientific Temper of Secondary School Students belonging to different subsamples based on
   - Gender: Boys/Girls
   - Locality of School: Rural/Urban
   - Type of Management of School: Aided/Government

4. To develop and validate a Scientific Temper Instructional package for 8th standard students following Kerala State Syllabus.

5. To find out the effectiveness of Scientific Temper Package and Activity Oriented Method of Teaching for Secondary School Students with respect to
   - Scientific Temper
   - Self Regulation
   - Achievement in Biology
   - Scientific Creativity
   - Science Interest
   - Social Sensitivity
6. To compare the effectiveness of Scientific Temper Instructional package and Activity Oriented Method of Teaching for Secondary School Students with respect to

- Scientific Temper
- Self Regulation
- Achievement in Biology
- Scientific Creativity
- Science Interest
- Social Sensitivity

1.7 Methodology in Brief

Methodology involves the procedure adopted for the realization of the objectives of the study. It is briefly described below.

For the study, both survey and experimental methods were used. Using survey method, the perception of secondary school teachers on the existing level of Scientific Temper of secondary school students and their perception of the necessity of enhancing Scientific Temper of students were found out. The data was collected randomly from a sample of 120 secondary school teachers from different districts of Kerala, using Teacher Perception Questionnaire (prepared by the investigator). Survey method was also used to find out the existing level of Scientific Temper of Secondary School Students based on gender, locality and type of management of schools. For this, a sample of 800 secondary school students were selected from three districts of Kerala viz, Kottayam, Alappuzha and Pathanamthitta using stratified random sampling technique. Scientific Temper Test (Prepared and Standardized by the investigator) was the tool employed for the purpose.

Experimental method was utilized for testing the effectiveness of the prepared Scientific Temper Package (STP). The development of STP was based on the Instructional System Design using the Dick and Cary’s (2005) systems Approach Model. For the experimental study, five schools were selected from Kottayam, Alappuzha and Pathanamthitta districts of Kerala state, giving due weightage to gender, locality and type of management of schools. The sample for the experiment
consisted of 328 students of standard VIII from ten divisions of the five secondary schools (two divisions from each school) selected for the study. Five divisions (one from each school) were considered as experimental group and the other five divisions (one from each school) were considered as the control group. Both the experimental and control group consisted of 164 students each, these students were selected by considering the gender, locality and type of management of schools. The tools and materials used for the experimental part were the,

1. Teacher Perception Questionnaire (Prepared by the Investigator)

2. Instructional Package based on Scientific Temper (Developed and validated by the Investigator)

3. Lesson Transcripts based on prevailing Activity oriented Method (Prepared by the Investigator)

4. Scientific Temper Test (Prepared and Standardized by the Investigator)

5. Self Regulation Scale (Prepared and Standardized by the Investigator)

6. Achievement Test in biology (Prepared and Standardized by the Investigator)

7. Scientific Creativity Test (Prepared and Standardized by the Investigator)

8. Science Interest Inventory (Prepared and Standardized by the Investigator)

9. Social Sensitivity Scale (Prepared and Standardized by the Investigator)

Before starting the experiment, pre tests were conducted by administering the Scientific Temper test, Self Regulation Scale, Achievement Test in Biology, Scientific Creativity Test, Science Interest Inventory and Social Sensitivity Scale in both the groups. After that the investigator herself conducted classes in both the groups. The experimental group was taught using the Scientific Temper Instructional Package and the control group was taught using Activity oriented Method. After the treatment, all the tests given as pretests were administered again to both the groups as posttests.

The major statistical techniques used for the study were the following.
i Descriptive statistics like mean, median, standard deviation, skewness and kurtosis of the selected variables.

ii. Percentage Analysis.

iii. Chi square test.

iv. Test of significance of differences between means of samples.

vi. Analysis of variance.

vii. Analysis of co variance.

1.8 Scope of the Study

The present study is a pioneering attempt in the discipline of Science to understand the theoretical and conceptual significance of Scientific Temper, which as a latest evolutionary step, enhances the knowledge base in the field of education, with its applied dimension. The study enriches existing knowledge in the area.

The major aim of the present investigation was to develop a package for enhancing Scientific Temper of secondary schools students. The package developed covers a broad range of enjoyable activities including games, discussions and stories for children. STP is beneficial for students in nourishing qualities that make them socially and academically effective. The activities included in STP assist students in enhancing their Self Regulation, Achievement in Biology and Scientific Creativity. Moreover, the package is effective in developing their Science Interest and Social Sensitivity. Thus, STP enables students to become both ‘school smarts’ and ‘people smarts’.

The Scientific Temper Test developed for the present study is a reliable tool for assessing the Scientific Temper of students. The study reveals the present status of Scientific Temper of secondary school students. It also indicates the opinion of secondary school teachers with regard to the need for intervention programmes for enhancing Scientific Temper of their students. The investigator hopes that the findings of the study would be much helpful for the concerned authorities for making refinements in the present educational system.

The findings of the study would help the curriculum framers, teachers, parents and policy makers in the field of education to understand the necessity and application
of this package in teaching Biology. The study also gives opportunities for a wide range of learning activities according to student’s interest and enhances Scientific Temper among Secondary School students in a quite natural way.

It is further hoped that the procedure adopted for the present study is adequate to throw light on the problem under investigation. It is hoped that the suggestions of the study may serve as guidelines for teachers and students to make teaching and learning a more enjoyable task. Despite the above mentioned facts, all possible attempts have been made to make the study as valid and reliable as possible. It is hoped that the results of the present study would be helpful in finding new frontiers in the field of education.

1.9 Limitations of the Study

In spite of all possible precautions taken up, certain limitations have crept into the study.

- At the time of experimentation there were certain limitations regarding active involvement of students due to their specific mood swings.
- Online interview with expert is a part of experimentation in the present study. Due to some technical difficulty it could not be conducted.
- Electricity failure sometimes interrupts the smooth conduct of the experiment.
- In order to study the group differences in the level of Scientific Temper, only gender, locality of school and type of management of school were considered. Other relevant factors like Socio economic status and cultural factors were excluded.

1.10 Organization of the Report

The report of the study is structured in six chapters.

Chapter 1

An introduction to the problem, need and significance of the study, statement of the problem, operational definition of key terms, hypotheses formulated, objectives of the study, brief description of methodology, scope of the study, limitation of the study and organization of the report come under this chapter.
Chapter 2

Pours light on Scientific Temper and the learning theories that support it. The chapter also provides an overview of cognitive and affective variables like Self Regulation, Achievement in Biology, Scientific Creativity, Science Interest and Social Sensitivity.

Chapter 3

The review of related literature supporting the study is given in this chapter.

Chapter 4

Methodology in detail like description of the tools employed for collection of data, variables used, sample selected for the study, data collection procedures and statistical techniques employed for analyzing the data are included in this chapter.

Chapter 5

The detailed statistical analysis and interpretations of the results of the data are presented in this chapter.

Chapter 6

This chapter contains a summary of the findings and major conclusions of the study together with educational implications and some suggestions for further research.

The report is followed by a fairly exhaustive Bibliography. The Bibliography is followed by a series of Appendices pertaining to the study.