CHAPTER III

REVIEW OF RELATED LITERATURE

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3.1 Introduction

Research takes advantage of the knowledge which has accumulated in the past as a result of constant human endeavor. It can never be undertaken in isolation of the work that has already been done on the problems which are directly or indirectly related to a study proposed by a researcher. A careful review of the research journal, books, dissertation, theses and other sources of information on the problem to be investigated is one of the important steps in the planning of any research study. Review of Literature is a comprehensive survey of the works which aims to review the critical points of current knowledge published in a field of study, or related to a particular topic of research, usually in the form of a bibliographic essay or annotated list of references in which attention is drawn to the most significant works. In scholarly journals that publish original research, the first section of each article is usually devoted to a review of the previously published literature on the subject, with references in the text to a list of works cited at the end. Literature review is a conceptually organized combination of a literature search results that provides a context for the research. It is neither a summary of the literature, nor merely description of the works, but it is a critical piece of information. It involves thorough study and analysis of available literature on the problem under study. Literature review helps the researchers to refine ideas, know specifications of research procedure, adds to the clarity and understanding of things to be done during research (Dellinger, 2005).

The review of related literature involves the systematic identification, location and analysis of documents containing information related to the research problem (Gay, 1996). A summary of the writings of recognized authorities and of previous research provides evidences that the researcher is familiar with what is already known and what is still unknown and untested. Since effective research is based on past knowledge, this step helps to eliminate the duplication of what has been done and provides useful hypothesis and helpful suggestions for significant investigation.
According to Cooper (1988) “a literature review uses as its database, reports of primary or original scholarship, and does not report new primary scholarship itself. The primary reports used in the literature may be verbal, but in the vast majority of cases reports are written documents. The types of scholarship may be empirical, theoretical, critical/analytic, or methodological in nature. Second, a literature review seeks to describe, summarize, evaluate, clarify and integrate the content of primary reports”.

Literature Review is important in:

a. Supporting the identification of a research topic, question or hypothesis.

b. Identifying the literature so that the researches will be able to contribute more and contextualizing the research with in that literature.

c. Building an understanding of theoretical concepts and terminology.

d. Facilitating the building of a bibliography.

e. Suggesting research methods that might be useful

f. Analyzing and interpreting results (Shastri, 2008)

In the present chapter, the literature review and studies in close proximity to the present study have been discussed. An attempt has been made here to review the researches that have been done in India and abroad. The points emerging from the review of the related literature have also been objectively discussed.

The studies and literature have been reviewed and classified under the following sections:

3.2 Studies Related to Scientific Temper

3.3 Studies Related to Self Regulation

3.4 Studies Related to Achievement in Science

3.5 Studies Related to Scientific Creativity

3.6 Studies Related to Science Interest

3.7 Studies Related to Social Sensitivity
3.2 Studied Related to Scientific Temper

Aasia and Akbar (2013) made a study on scientific temper and academic achievement of science and social science stream adolescents. The results were found that two groups differ significantly on curiosity and objectivity dimension of scientific temper scale. It further revealed that two groups do not differ on certain components of scientific temper like open-mindedness, rationality, and aversion to superstition dimension of scientific temper scale.

Amees and Nisar (2013) studied the “Comparative evaluation of scientific temper and academic achievement among adolescents in Jammu and Kashmir”. The findings of the study indicated that the scientific temper and academic achievement of the boy and girl students as well as the students from rural and urban areas and from government and private institutions differed significantly.

Hafiz (2013) compared scientific temper and academic achievement of Kashmiri and Pakhtoon students. Nadeem and Khalida’s Scientific Temper Scale (STPS) was administered on a group of 120 students. Mean, S.D and test of significance were calculated and the result revealed that there is no significant mean difference between Kashmiri boys and Pakhtoon boys towards the scientific temper.

Kumar (2013) attempted to study the relationship between levels of scientific temper and understanding of science. Sample of the study was selected from all the government and private secondary schools of Jhansi region. Results of the study indicated that 10th class students possess much more favorable scientific temper in comparison to 9th class students. It was also found that 10th class students possess higher level of value perspective, attitude towards science and world view perspective.

Mahanti (2013) attempted to situate the notion of scientific temper in the Indian context and exposed the nuances of how this concept has been developed. The study emphasized the importance of scientific temper in a country like India and the result of the study reported that scientific temper is an invaluable tool for the common people engaged in sound decision making not only about science but various issues of social importance.

Plessis (2013) explored the comparative perspective for functional application of scientific temper in Southern Africa. The study reported that instrumentalist
approach towards science does great damage as it does not recognize the potential of people trained in science and technology as problem solvers, innovators, entrepreneurs, business people, community leaders and artists and had a view that the introduction of the notion of a scientific temper in Africa is a necessary step towards the formation of national identities and the application of science in service to society.

Vijayam (2013) reported that the need to include lessons on rational thinking in the syllabi from the primary school level to the high school level from the part of government, promote science exhibitions more extensively. Also highlighted the importance of encourage divergent questioning among children about scientific principles for promoting scientific temper.

Jahagirdar (2011) noted that superstitions such as astrology are the enemies of scientific temper. Belief in astrology may lead to psychologically debilitating diseases or may inspire a person to unwarranted and unjustified adventures.

Rishu and Markandey (2011) attempted to study the scientific temper in relation to scientific creativity of senior secondary science students. Self made Scientific Temper test was used to measure Scientific Temper, having reliability 0.68 and validity range 0.68 to 0.72. The observed correlation between scientific information and scientific creativity, free from superstitions and scientific creativity, reasoning, logical ability and scientific creativity and cause finding ability and scientific creativity of senior secondary science students are found significant. Results also found that the observed mean difference between scientific information, curiosity and cause finding ability of senior secondary boy and girl science students are found significant.

Soma (2011) conducted a survey study on socio-economic status, nutritional condition and effect of science education on women’s attitude to life and scientific temper. It can be concluded from this study that science education for women has undergone remarkable improvement in recent years. But socio economic status, health and nutrition status, in respect of science education is rather scarce. In West Bengal, there is still much to be done for upliftment of their status in the society.

Yadav (2011) stated three main aspects of scientific temper, the application of logic, the avoidance of bias and preconceived notions and reported that scientific temper enables the individual to take decisions rationally.
Dhar (2009) identified the strategies for developing scientific temper among students at various levels of school education. Results of the study suggested that an effective method of fostering scientific temper is imparting knowledge of science through discovery approach in science class and also reported that, if the teaching of science deals with scientific method, it helps in developing scientific temper among the students.

Joshua (2007) conducted a study on relationship among scientific temper, Social maturity, study involvement and stress tolerance of students at Secondary level. Multiple regression analyses revealed that there is substantial and significant relationship found between scientific temper and combined effect of social maturity, stress tolerance and study involvement of secondary school students.

A study was conducted by Joy (2006) on scientific temper and academic achievement among the pupil of standard X. Scientific temper scale was used as tool for the study and results revealed that positive relationship between scientific temper and academic achievement of ninth standard students.

The research conducted by Singh (2004), on development of scientific temper in Indian schools. The study found that scientific temper and its components shows variation in their development from school to school. The study also revealed that museum and technology play a vital role in promoting scientific temper of students.

Joshua (2004) tried to find out the relationship between scientific temper and science achievement of secondary school students. The tool used in the study was scientific temper test. Findings of the study revealed that rural and urban school students differ in their scientific temper scores. Study also found that there exist a positive significant relationship between scientific temper and science achievement of secondary school students.

A study conducted on scientific temper of higher secondary school teachers by John (2003). Scientific temper test was used for the study. Sample of the study consists of 300 higher secondary school teachers. Findings of the study revealed that scientific temper of higher secondary school teachers is significantly related with academic performance.

Singh (1998) made a study on scientific temper in relation to personality and environment. A sample of 505 students, 303 Urban and 202 Rural was taken through
cluster random sampling technique from population of 21 senior secondary schools offering Science discipline at 10+2 level in district Sonepat. The findings showed that there is a positive relationship between scientific temper and extroversion personality. Dimensions of school environment viz. permissiveness, acceptance, control, cognitive, encouragement and creative stimulation have positive relationship with scientific temper.

Kumar (1998) examined the impact of select factors on achievement in science. Results found that science achievement, scientific temper and its components were developed through discussion and demonstration among secondary school students.

Krishna (1997) advocated the importance of using technology in the field of science teaching learning process for enhancing scientific temper. Also noted that in teaching science, ICT 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.

Jayant (1993) identified that experiment (E), observation (O) and deduction (D) are three main scientific process which leads to scientific temper in young minds. Study pointed out that EOD process enabled the children in developing critical thinking.

Dubey (1992) attempted to measure scientific temper of students and teachers. A two stage stratified sampling method to select class XI science and non science students. Findings of the study revealed that all the groups of students and teachers manifested scientific temper and significant differences in scientific temper were noticed between male science teachers and male non science teachers.

3.2.1 Studies Related to Components of Scientific Temper

a. Studies related to Scientific Literacy

Fan and Geelan (2013) enhanced student’s scientific literacy in science education using interactive simulations. Study suggests that Information technologies, on computers and other devices, offer potentially valuable ways to supplement these teaching approaches. Results of the survey study found that podcasts, RSS
technologies and E-learning are the important sources for developing student’s scientific literacy.

Erdogan (2012) analyzed 9th grade physics, chemistry and biology curriculum, which were implemented by the ministry of education since the academic year 2008-2009, in terms of scientific literacy themes and the balance of these themes and also to examine the quality of statements about objectives. The findings of the study showed that nature of science should be more emphasized in science curriculum to help each of citizens in the country become lifelong learners and have an adequate level of scientific literacy.

Glauteur (2011) examined the relationship between scientific inquiry and creativity in poetry at Rome in the first century. Study reported that scientific inquiry itself constitutes a dynamic and multifaceted area of creative literary activity in Imperial Rome.

King (2011) explored the relationship between information and communication technology and scientific literacy. The findings suggested that demographic characteristics have been accounted for, students with prior experience with ICT, who browse the internet more frequently, and who are confident with basic ICT tasks earned higher scientific literacy scores. Study also pointed out that students are using computers in schools, towards attaining learning outcomes, may have a stronger effect on scientific literacy than how often computers are accessed.

Lyons (2011) explored the impact of a novel inquiry based astronomy laboratory curriculum designed using the backwards faded scaffolding inquiry teaching framework on non science majoring undergraduate student’s view of the nature of scientific inquiry. The results of the study reported that a scaffolded, inquiry based, introductory astronomy laboratory curriculum purposefully designed and scaffolded to enhance student’s understandings could be effective in enhancing undergraduate non science majoring student’s views of certain aspects of NOSI.

Andy (2010) advocated that student participation in argument develops communication skills, metacognitive awareness, critical thinking, an understanding of the culture and practice of science and scientific literacy. Study was based on three domains to determine structural patterns of the various argument interventions: nature
of the argument activity, emphasis of the argument activity and the aspects of science included in the argument activity.

Debbie (2010) pointed out that scientific literacy skill in secondary school students developed mainly through discussion, reading and writing. Study revealed that curricular materials especially science textbook is a prime factor for improving scientific literacy skills.

Hsia (2010) analyzed the effect of congruency between preferred and actual learning environment perceptions on student’s science concepts, attitude toward science and the understanding of the nature of science in an innovative curriculum. A pre-post treatment experiment was conducted with 34 tenth graders in Taiwan. ANCOVA analysis showed statistically significant difference between groups in terms of students post test scores on scientific literacy with the student’s pre-test scores as the covariate.

Patrick (2009) conducted a study on reading, writing and inquiry about science in Kindergarten. Study reported that a Scientific Literacy project (SLP) in one of the important approaches to science instruction. Study also found out that Scientific Literacy is positively related to science learning.

Spektor (2009) explored the impact of scientific communication skills instruction on student’s performance in scientific literacy assessment tasks. Study found that, instruction of skill integrated in to scientific topics, the opportunities to implement the skills in different context, the role of performance tasks as ‘assessment for learning ‘are important and necessary for improving student’s scientific literacy.

Silva (2008) conducted a study on the influence of teaching biology on scientific literacy of secondary school students. Study revealed that basic concepts, knowledge and techniques of science are considered as the promoting factor for scientific literacy.

Millar (2006) conducted a study on design and implementation of a scientific literacy approach in school sciences. Study reported that advanced teaching methods were positively related to Scientific Literacy of tenth grade students.

Sharma (1990) investigated the incidence of scientific literacy, attitudes towards science and the personality traits of certain groups of students and teachers.
Main objective of the study was to find out the level of scientific literacy of different groups of students and teachers. Study found that total sample had higher level of scientific literacy than the theoretical mean.

b. Studies Related to Scientific Attitude

Chaninan (2013) aimed to develop the interdisciplinary SoSTI (science of sound in traditional Thai musical instruments) course for Thai non-science upper secondary school students to study the students’ attitudes toward science before and after studying from the course. The results of this study presented that, after completing the SoSTI course, the students’ attitudes toward science comparing before and after studying the SoSTI course were not significantly different at the 0.05 level.

Dale (2013) analysed the effect of high schools' gender organization on Korean tenth-grade students’ science achievements, and their attitudes towards science. The questionnaire responses and the transcribed interview sections were analysed using One-way ANOVA, followed by Post Hoc analysis, constant comparison, and content analysis. Results indicated that the male and female students from the co-ed school had significantly higher science achievement and positive attitudes towards science.

Sunday and Gbore (2012) explored the effect of attitude and interest of students on academic performance in science. Multiple regression was used to analyze the hypothesis raised for the study and the outcome showed that science interest possessed the strongest strength for predicting performance than attitude among the students in their different ability level group.

Anita (2010) examined high school student’s scientific attitude after participating in a robotics competition. Study used the Test of Science Related Attitudes (TORSA) to measure student’s attitude toward science. Results indicated that students who participated in the robotic competition had a more positive scientific attitude and science related areas in four of the seven categories as, social implications of science, Normality of scientists, attitude toward scientific inquiry and adoption of scientific attitude.

Sharma (2010) attempted to study the problem solving ability and scientific attitude as determinant of academic achievement of higher secondary students. Study reported that present school science curriculum is able to develop only average level
of scientific attitude and problem solving ability among higher secondary students and a positive relationship exists among achievement, problem solving ability and scientific attitude.

Wang (2009) described the development and application of an instrument to identify various dimensions of the learning environment, as perceived by elementary and middle school students in Taiwan. Study indicated that the student’s scientific attitudes were associated with the dimensions of understanding and interaction of

Ozmen (2008) investigated the effect of computer assisted instruction on conceptual understanding of chemical bonding and attitude toward chemistry. The results of the study suggests that teaching learning of topics in chemistry related to chemical bonding can be improved by the use of computer assisted teaching materials.

Moore (2007) assessed the scientific interest and scientific attitude of 557 students in grades 6,9,12. A split half reliability coefficient of 0.805 was computed for the entire group of 557 respondents. Study revealed that 70% of the students comes under average scientific attitude category. It could be interpreted that most of the students under the category of average Scientific Attitude.

Sorge (2007) assessed the differences in scientific attitude of students from age nine to fourteen including changes across the elementary-middle school transition in rural area in New Mexico. Analysis of data found a significant relationship between age and attitude toward science (Scientific attitude mean scores: Age 9 = 4.9, Age 14 =3.42, F (5, 1068) = 46.88, p < 0.001). Students of ages nine, ten and eleven did not differ significantly from each other in scientific attitude.

Braund and Driver (2005) studied students’ attitudes and interest to practical science in order to compare both sides of the primary and secondary transition. To determine attitudes to practical science the researcher administered an open-ended questionnaire. Chi-square tests were used to test for significant differences between Year 6 and Year 7 students. Findings suggested that there is significant differences exist between Year 6 and Year 7 students’ attitudes and interest to practical science.

Akubuiro and Joshua (2004) investigated the influence of self concept and scientific attitude on academic achievement in science of secondary school students in Southern Cross River State of Nigeria. The study revealed that the student’s academic
achievement in science was significantly predicted by their attitude and academic self concept.

Hamrich and Livingston (2000) evaluated the impacts of the science enrichment program on minority, fourth grade girls’ scientific attitude, interest and achievement in science and mathematics in inner-city Philadelphia. The science enrichment program consisted of an in-school constructivist and gender-sensitive science program and city rivers exploration summer camp. The study found that no significant change in girls’ pretest and posttest scientific attitudes (Science attitude mean scores: Pretest = 3.88, Posttest = 3.96).

Ghosh (1986) conducted a critical study of scientific attitude and aptitude of the students. F test, correlation and t test were used for the study. Findings showed that there was a positive relationship between scientific attitude and scientific aptitude of students. Results also revealed that boys did not possess better scientific attitude than girls.

Shinde (1982) studied the relationship between the extent of involvement in scientific activities, scientific attitude and achievement in science of secondary school students. The sample comprised of 1600 students at secondary level of Maharashtra selected on a random basis from all the regions of the state. The study revealed that the correlation between the scientific attitude scores and non formal science activity scores was negligible and not significant.

c. Studies Related to Scientific Thinking

Bayrak (2013) identified primary students’ conceptual understanding and alternative conceptions in acid-base. Data for this study were collected using a conceptual understanding scale prepared to include the concepts used in the subject of "acids and bases", which is a part of the unit "structure and properties of matter" taught in the eighth grade science and technology course. Analysis of results showed that students find difficulty about conceptual thinking and understanding. They have some alternative conceptions related to in acid-base.

Ashkar (2011) analysed the effect of animated movies on student’s scientific thinking outcomes and motivation to learn. Applying the quantitative methodology, two pre and post questionnaires were administered. Findings indicated that the use of
Review of Related Literature

animated movies promoted student’s explanation ability and their understanding of scientific concepts.

Kapetains (2011) studied the phenomenological examination of perceived skills and concepts necessary for teaching scientific thinking. It was found that lack of vertically aligned curriculum is a major constraint to teachers. It was also observed that availability of the resources through the school and consistent support provides effective science programmes are the factors that inhibit developing scientific thinking among pupils.

Mahmood (2008) assessed the scientific thinking skills of senior secondary physics students. The survey cum experimental study was carried out with students aged 15-18. The main part of the study was the development and use of five teaching units and the findings revealed that the use of teaching units had improved scientific thinking of senior school students.

Fender (2007) studied the influence of parent role on children’s scientific thinking skills. Results revealed that the parent involvement is positively related to scientific thinking of their children.

Jeong (2007) conducted a study on students’ ability to collect and interpret evidence. Study revealed that scientific thinking skills involved in the collection, organization and interpretation of data.

Ozgul (2006) studied the preschool children’s school readiness related to scientific thinking skills. This comparative study was held in terms of variables such as age, gender and socio economic status. Study found out that age influence primary school readiness of preschool children in terms of scientific thinking skills.

Parikson (2001) conducted a study of teacher knowledge and understanding of design and technology for children in the 3-11 age groups. Study showed the relationship between teacher’s knowledge in subject and scientific thinking skills of students.

d. Studies Related to Scientific Method

Tsai and Chen (2013) conducted a quasi-experimental study, 118 seventh graders from four classes in one secondary school in Taiwan took part in the Science News Instruction (SNI). After eight weeks of instruction about Genetics and
Reproduction, all students were requested to present their written arguments to the selected science news article. The analysis of students' written artifacts revealed that the CK-SNI group performed significantly better on examining the data and claims made in the science news, producing warrants of higher quality to support their reasoning about the relationship between data and claims, and providing better reasons to refute the identified causal textual elements.

Yakmaci (2013) examined the changes in 19 preservice chemistry teachers' understandings of the structure of matter, including the aspects of the physical states of matter, the physical composition of matter, and the chemical composition of matter, before, immediately after, and months after they received a specific instruction. The results of the analyses were quite parallel to each other and showed that this specific instruction promoted the development of participants' scientific understandings of the structure of matter reasoning ability and reflection about the concepts.

Tein (2011) investigated the relationship among 68 high school student’s scientific epistemological beliefs, cognitive structures regarding nuclear power usage and their scientific reasoning regarding these issues. Study advocated that student’s beliefs about the justification of scientific knowledge were significantly correlated with their scientific reasoning quality.

Wong (2011) investigated the role of inscriptions in supporting student’s engagement in scientific reasoning practices. The study examined the curriculum and video record from one enactment of this course to analyze the affordances of particular representations for supporting conceptual understanding and scientific reasoning practices. Study pointed out that curriculum provided a series of inscriptive resources that were well suited for the conceptual and scientific reasoning.

Thoron (2010) assessed the effect of inquiry based agriscience instruction on student’s argumentation skills, scientific reasoning and student’s achievement. Content knowledge posttest scores were found to have moderate relationship with other post test ranging from $r = 0.34$ to $r = 0.54$. The treatment variable was found to have moderate or substantial correlation with four of the seven content knowledge posttests. Demographic variables that were collected contained negligible
relationships with posttest, argumentation skill scores, scientific reasoning scores and type of treatment such as inquiry based instruction and subject matter approach.

Janet (2010) assessed the influence of scientific method on student’s inquiry and teacher’s perceptions. Sample of the study was ninth grade environmental science class and results pointed out that scientific method affects scientific inquiry of ninth grade students.

Tang (2010) attempted to study the impact of scientific method in science classrooms. Study reported that the scientific method in science instruction takes the form of discrete, ordered steps meant to guide student’s inquiry.

Sung (2009) conducted a study on the conception of the nature of science, particularly scientific knowledge, scientific method of pre-service science teachers were captured by the myths of science questionnaire (MOSQ). Results revealed that reasoning ability and scientific knowledge scores are high level in teachers.

Chhikara (1985) investigated the relationship of scientific reasoning abilities with achievement of concepts in life science. Tools used in the study where battery of concept achievement test and battery of reasoning ability test. A definite positive relationship between conceptual achievement in life sciences and reasoning ability was found.

e. Studies Related to Scientific Perception

Mark (2013) examined the effect of agriculture faculty training in and practice of methodologies to explicitly teach critical thinking skills related to course content and subsequent change in student critical thinking disposition. Twelve instructors in 14 agriculture courses underwent a year–long program of instruction in effective critical thinking development. In addition, a step–wise regression on the data gathered at the end of the semester showed that grade point average was positively related to all three critical thinking dispositions and being in one's first year of college was negatively related to each dimension.

Joanna and Mathai (2011) examined 6 and 8 standard student’s everyday mathematics and science practice. Thirty Six students at urban and rural schools were interviewed and recorded their everyday mathematics and science usage. Study
reported that outside classroom activities based on science and mathematics positively affect the scientific perceptions of 6 and 8 standard students.

Canan (2010) attempted to justify the perceptions of high school students and teachers on nature on science. In this study, quantitative research approach supported by qualitative data, descriptive research method and survey technique were used. Study found that the knowledge of NOS was perceived differently by the teachers and the students in terms of ‘importance’ and ‘interest’.

Timo (2010) developed a strategy on student’s scientific perception. Strategy based on socio critical, problem oriented approach to science teaching. Study revealed that lesson plan oriented strategy positively influence on scientific perception of students.

Victoria (2007) assessed overall critical thinking ability in graduate and undergraduate students in special education at a south western university. ANOVA indicated a statistically significant difference between graduate and undergraduate students (N = 195) on the combined dependent variables: F (6,188) = 4.21, p = .001, Wilks’ Lambda = .882; partial eta squared = .118. Study concluded that the returning graduate student when compared to the undergraduate pre-service special educator is a more capable critical thinker.

Coca (1998) made an investigation of the relationship between critical thinking skills and academic achievement of five hundred higher secondary school pupils. The study showed significant positive relationship between the critical thinking skills and academic achievement.

Alexander (1990) tried to ascertain the influence of critical thinking, science aptitude and socioeconomic status on achievement in science. Findings of the study showed that high scores on critical thinking, scientific achievement and socioeconomic status favored achievement in science. Study also found that sex differences in achievement in science favoring males existed.

f. **Studies Related to Scientific Habit**

Gupta and Joshi (2013) attempted to explore the superstitious belief in relation to SES of adolescents. Superstitious attitude scale was used to assess the superstitious beliefs of the respondents. The results have revealed no significant gender differences
on Superstitious beliefs but respondents of low SES had reported significantly more superstitious beliefs than high SES respondents.

Safiollah and Akbar (2012) examined the effect of sociological factors on superstitions. The major findings of this study were women are more superstitious than men. As one grows older, the sense of inequality, alienation from the self and inclination to superstition increases.

Futrel (2011) examined the relationship between superstitious behaviors and trait anxiety. Participants were randomly selected from college campuses. Results found that a positive correlation between superstition and anxiety measure to be greater 0.10 and women had significantly higher scores in traditional superstitious beliefs.

Lauren (2009) found that significant differences in product satisfaction ratings due to superstitious beliefs only for those subjects who were relatively more sensitive to the disconfirmation of expectations. The results also indicated that a significant superstitious associations by disconfirmation sensitivity interaction.

Amanda (2004) examined two possible correlates of superstition, religiosity and locus of control. ANOVA suggest that levels of religiosity do not have a significant relationship with levels of superstitious or paranormal beliefs. The correlations of external and chance loci of control with higher superstitious beliefs may implicate a tendency for such individuals to view life as uncontrollable, hard to deal with, or affect their self-efficacy.

Richard (2004) attempted to develop theories about the function and origin of superstitious beliefs on the basis of the psychological correlates of such beliefs. Paranormal Belief Scale (PBS) was used to measure the superstitious belief and the PBS refers solely to negative superstitions (e.g., breaking a mirror will cause bad luck) and omits items referring to positive superstitions (e.g., carrying a lucky charm will bring good luck). Results showed that there was a significant interaction between gender and superstition type, but no interaction was found for neuroticism. A significant interaction was found between superstition type and life satisfaction. Overall, these findings indicate that the psychological correlates of superstitious belief vary depending on whether the belief is in positive or negative superstitions.
Srinivas and Ratnakar (1989) conducted a study on B.Ed pupils and found that anxiety and superstitions are negatively correlated with scientific attitude. They found that the groups with low level anxiety and with low superstitious belief have better scientific attitude.

Bushan (1985) conducted a study on certain psychological correlates of belief in superstitions. Study indicated that significant individual differences were found regarding belief in superstitions among secondary school students.

A study on relationship between anxiety, creative thinking ability and superstitious belief among high school pupils in Wisconsin by Arora (1976), found that high school pupils were not having superstitious beliefs. The study also indicated that there exists no significant relationship between creative thinking and anxiety among secondary school students.

### 3.3 Studies Related to Self Regulation

Ewijk and Werf (2013) investigated teachers’ beliefs, knowledge, and behavior in the context of self-regulated learning in primary schools. The teachers answered open-ended questions regarding their understanding of SRL and on their implementation of SRL in their classrooms. Teachers were found more positive towards a constructivist learning environment than towards SRL (i.e., strategy instruction). However, teacher beliefs towards SRL are the only predictor of teacher behavior.

Leidinger and Perels (2013) have developed mathematics learning materials based on Zimmerman’s self-regulated learning model. Evaluation of the SRL-training materials is based on a quasi-experimental pre-post control-group design with a time series design. The evaluation reveals that when fourth graders (age 9-10) are given these SRL-training materials in regular mathematics lessons, they can maintain their self-reported self-regulated learning activities not only for the 6-week training phase, but for the next year as well.

Kohen and Kramarski (2012) conducted a study on self regulation of pre-service high school teachers by using reflective support. Pretest comparison of the two groups showed no significant differences in gender, age or teaching experience. Both groups (reflective support group and no support group) of pre-service teachers were assigned real-time teaching exercises in a video-digital microteaching classroom
simulation, approximately fifteen minutes in length. The RS group displayed greater interest and value of teaching \((d = 2.77)\), higher self-efficacy \((d = 2.65)\), and less teaching anxiety than the NS group.

Albert (2011) analysed the effect of metacognitive self regulation strategy on self regulation. Results concluded that no statistically significant differences were noted among ethnic groups. When the metacognitive self regulation items were examined for the sample, two items were found to have relatively lower levels of cognitive validity, where as one item received a comparatively higher cognitive validity rating.

Allen (2011) tried to investigate the relationship between students reading achievement and teachers self regulation patterns in grades K3. The study consisted of 276 teachers in grades k3 in a large Alabama school District. Reading achievement test and the self regulation inventory were used as tools for the study. Results of the study revealed that there was no significant relationship between teachers self regulation scores and reading achievement of students.

Collins (2011) investigated metacognitive and self regulation strategies to assist student’s scientific inquiry task. Students were split in to four experimental groups in order to determine the effect of goal setting, metacognitive prompts and student’s inquiry task. Results revealed that metacognitive prompts and instruction in goal setting did not have any effect on student inquiry scores.

Erlich (2011) conducted a study on developing self efficacy and self regulated learning in academic planning. One hundred twenty California community college students individually participated in a 30 minutes academic advising session. Significant mean increases were found between pre, post measures following counsellor interventions as well as a positive, reciprocal relationships existing between self efficacy and self regulated learning in academic planning.

Halloran (2011) studied the self regulation, executive function, working memory and academic achievement of female high school students. Students electronically completed questionnaires about their self regulated learning strategies. Results from multiple regression analysis revealed that, students working memory performance did not predict student’s report of self regulation, executive function,
working memory and academic achievement as measured by final grades and PSAT scores.

Lori and Carol (2011) studied the influence of schooling effects on preschoo ler’s self-regulation, early literacy and language growth. Results found that children’s development of self-regulation and vocabulary (i.e. language measure) was not associated with their experiences in either year of preschool. The study suggests that self-regulation, which is emerging as an important indicator of school readiness, in addition to children’s literacy skills. Gains in self-regulation were associated with age but not with early schooling experiences.

Magno (2011) assessed the relationship of scientific thinking, self-regulation in research and creativity in a measurement model. Scientific thinking scale, self-regulation research questionnaire was used for the study. The results for the overall model showed that scientific thinking, self-regulation in research, and creativity are significantly related to each other with path estimates 0.90 (between scientific thinking and self-regulation and research), 0.53 (between scientific thinking and creativity), and 0.44 (between self-regulation and creativity).

Peterson (2011) investigated the potential impact of student’s self regulatory attributes on their experiences with online classes. The six self regulatory attributes of subject specific self efficacy, goal orientation, internet self efficacy, study environment management, time management and help seeking were examined to determine which of these attributes were predictive of a student’s willingness to enroll in future online classes. The result of study suggests that the six self regulation attributes are a closely related group of variables that can impact student’s experiences with online classes.

Divya (2010) conducted a study on relationship between self regulation and conflict management of higher secondary school students. Sample of the study consists of 300 higher secondary school students in Kottayam District. Self regulation scale and conflict management inventory were used as tools for the study. Correlation co-efficient showed that positive significant relationship between mean scores of self regulation and conflict management of higher secondary students.

Kuo (2010) investigated the role of psychological factors of motivation, social control and self regulation, in the prediction of 10th grade academic achievement for a
large sample of 8th grade students. The students readiness inventory middle school was used to assess three broad PSFs based on ten scales, which were named motivation, social control and self regulation. The results showed that 8th grade females demonstrated greater motivation, social control and self regulation than 8th grade males.

Hung (2009) analyzed the effect of children’s behavioral and learning self regulation in the transition period. Results showed that parent as the child’s caregiver, was the only factor to correlate with children’s self regulation behaviour. Study also pointed out that there was a significant difference between children’s gender and their general, learning and overall self regulation behavior.

Matuga (2009) investigated potential changes in motivation, goal orientation, and self-regulation of high achieving secondary students as they complete an online university course. The cross-sectional study also investigated the relationship between the self-regulation, goal orientation, and academic achievement of high school students enrolled in online college science courses. Results revealed that low achieving students became more confident in their belief in their ability to self regulate their own learning as the semester progressed.

Ponitz (2009) studied on behavioral self regulation and its contribution to kindergarten outcomes. Results revealed that children with higher levels of self regulation in the beginning of the school year achieved higher scores in reading, vocabulary and math at the end of the school year. The study concluded that improving self regulation in children can improve academic achievement and behavioral responses.

Yang (2009) attempted to justify the relationship among self regulation, internet use and academic achievement in a computer literacy course. Undergraduate computer literacy classes were used as samples (n=39) for measuring the variables. Data were collected during three class periods in two sections of the computer literacy course taught one instructor. Results found that there were low correlations between self regulation and academic grades (r=0.18, p>0.05) and self regulation and internet use (r= -0.14, P> 0.05). But self regulation was highly correlated with self efficacy of students (r=53, P<0.05).
Cavanagh (2008) compared scientific creativity, self regulation and scientific thoughts of undergraduate students. Results of the study revealed that relationship between scientific thoughts and scientific creativity is significantly stronger for the graduate sample and study also revealed that scientific creativity positively correlated with self regulation and scientific thought of high school students.

Stoeger and Ziegler (2008) conducted a study on classroom based training of self-regulated learning with fourth graders pupils in German public schools. The results showed that the training is well suited to attain its immediate goals. Post hoc analysis revealed that learning goal orientation showed no connections to test performances ($r=-0.05$, $p>0.10$), pupils with higher approach or avoidance performance goal orientation achieved better results ($r=0.18$, $p<0.01$ resp. $r=0.15$, $p<0.01$).

Blair and Razza (2007) made an investigation of effortful control, executive function, and false belief understanding to emerging maths and literacy ability in kindergarten. Study showed that children’s self regulation behaviors in the early years predict their school achievement in reading and mathematics better than their IQ scores.

Ivcenvic and Mayer (2007) compared self regulation and creativity of high school students. Major tools used for the collection of data are self regulation scale and creativity test. Results of the study found out that scientific creativity is positively influence on self regulation of secondary level students and also revealed that the scholar creative type was high on self-regulation components such as risk taking than other creative types (conventional, everyday creative, artist).

Kind and Kind (2007) attempted to study the relationship among creativity, self regulation and scientific thinking of 5th grade students. The study used the survey method for the collection of the required data. The sample of the present study includes 420 fifth grade students. The data collected were analyzed using product moment co-efficient correlation and ANOVA. Findings revealed that creativity increases with self regulation and scientific thinking of 5th grade students.

Roy and Kathleen (2007) investigated the role of motivational drive in the context of self regulation of students. Study emphasized three main ingredients of the self-regulation process as standards, monitoring, self-regulatory strength and
motivation. Study reported that self regulation is one of the key factors for restrain selfish motivation for social acceptance.

Marianne (2006) attempted to find the relation between self-regulated strategies and individual study time, prepared participation and achievement in a problem based curriculum. The study focused on two self-regulated learning strategies, namely time planning and self-monitoring. Results from this study revealed that students who are better time-planners and who have better self-monitoring skills seem to be more efficient in allocating their individual study time (require less individual study time), prepare more appropriately for tutorial group meetings and score higher on cognitive tests.

Azevedo (2005) tried to find out the effectiveness of three scaffolding conditions on adolescents’ self regulated learning about the circulatory system. The method of the study was one hundred and eleven adolescents (n=111) were randomly assigned to one of three scaffolding conditions (adaptive scaffolding (AS), fixed scaffolding (FS), or no scaffolding (NS) and were trained to use a hypermedia environment to learn about the circulatory system. Findings revealed that learners in both the AS and NS conditions gained significantly more declarative knowledge than did those in the FS condition.

Dale (2005) compared student’s self-regulation and learning. Study investigated the effects of interventions designed to improve students’ self-regulatory skills and school achievement. The main objective of the study was to explore the development of self-regulatory skills and conducted interventions to improve student’s self-regulation. Study showed that combining training on self-regulation with problem solving instruction was especially effective in enhancing self-regulation and achievement.

Raffaelli (2005) investigated the development of self-regulation from early childhood to adolescence by examining issues of structure, stability and change and by comparing developmental patterns for girls and boys. Results showed that girls exhibited significantly higher levels of self-regulation than did boys at all 3 time points. Individual differences in self-regulation were fairly stable across the 8-year span ($r = .47$ to .50).
Chung and Ro (2004) in their study proposed that creativity in the classroom was developed through active employment of scientific thinking through the activity centered decision-making process. They found in the study that creativity subscales on fluency, flexibility, and originality increased from pre test when scientific thinking was injected with the problem solving model.

Muraven and Slessareva (2003) studied the role of motivation and motivational conflict in depleted participants. Findings of the study revealed that incentives offered was found to be effective in developing self regulatory ability of depleted participants.

Pintrich (2003) examined the relations between self-regulation, motivation and learning. Students with better self-regulatory skills tend to be more academically motivated and display better learning. This study also supports the link between cognitive and motivational self-regulation

Wrosch (2003) examined the association between goal disengagement, goal re-engagement and indicators of subjective well-being. Goal disengagement and goal re-engagement scales were used for the study. The results showed that general goal disengagement and goal re-engagement tendencies positively related to subjective well-being. Goal reengagement was particularly strongly associated with emotional well-being ($\beta =37, p < .05$) among young adults who reported difficulties with disengaging from unattainable goals.

Chen (2002) studied the effectiveness of self-regulated learning strategies in a lecture-led concept learning environment versus a hands-on computer lab learning environment. Analysis exposed that effort regulation had a positive effect and peer learning had a negative effect on learning computer concepts. The findings on effective strategies for hands-on computer lab learning were inconclusive. Further it showed that effort regulation was the learning strategy that led to achievement in a lecture type of learning environment.

Zimmerman (2002) developed self regulated learning strategy for the acquisition of information and skills of secondary school students. The important self initiative activities included in the strategy are self observation, self evaluation and self improvement. Findings of the study revealed that student’s use of the self
regulated learning strategy was strongly associated with superior academic functioning.

Chung (2000) examined the tendency for the development of self regulated learning according to grade level. The objective of the study was to find out the best fitting model for self regulated learning and academic achievement of grade five. Model 1 was based on Biggs’s learning process model. Model 2 was based on pintrich structured model. The sample data collected from 1865 boys and girls of fifth grade elementary school students. Findings of the study pointed out that the best fitting self regulated learning model in the fifth grade elementary school students is model 2. Model 2 has the strongest effect on academic achievement and self regulated learning of students.

Scott (2000) examined the role of self-regulated learning in teaching and how to improve it in the class room situations. From the study it was pointed that self-regulated learning was promoted indirectly through classroom activities, cooperative projects and brain storming techniques.

### 3.4 Studies Related to Achievement in Science

A study was conducted on effectiveness of multi-sensory approach on achievement in science of students at secondary level by Simi (2012). The sample consists of 70 eighth standard students of Kottayam District. The study concluded that multi-sensory approach is more effective than issue based method on achievement in science among secondary school students.

A study was conducted on effectiveness of self directed learning strategy at secondary school level by Sremakal (2012). Analysis showed that self-directed learning strategy is more effective than issue based method on achievement in biology of secondary school level.

Brian (2012) explored the relationships between (1) the quality of state standards and science student achievement, (2) the public’s belief in teaching evolution and the quality of state standards, and (3) the public’s belief in teaching evolution and science student achievement. Results suggested that the attitudes that parents and teachers have towards science, particularly evolutionary science, have more of an effect on student achievement than do the quality of state standards.
Sunitha (2012) examined the effectiveness of multimedia package on achievement in science of higher secondary school students. Results of the study found that multimedia package is more effective than issue based method on achievement in biology among students at higher secondary school.

Dhatrak (2011) made a co-relation study of scientific attitude, creativity and science achievement of secondary school students. The conclusion of this study revealed low correlation between scientific attitude and creativity, no significant relation between creativity and achievement of students and negative correlation between scientific attitude and achievement of secondary school students.

Dosanjh (2011) analyzed the effects of three concept mapping strategies on seventh grade student’s science achievement in urban middle school. Three intact classes of seventh grade students were assigned to one of the three concept mapping strategies. The results of the study suggest that all three of the concepts mapping strategies are effective in increasing student’s achievement.

Jadhav (2011) investigated the effect of advance organizer model (AOM) on pupil’s achievement in physics. The sample consisted of the study were two hundred sixteen pupils from std. 9th at Azad College of Education. The study concluded that A.O.M. strategy is more effective than conventional strategy in enhancing achievement in physics of secondary school students.

Nasr (2011) made a study on attitude towards biology and its effects on student’s achievement. The important objectives of this study were, to find out the relation between attitude towards biology and students’ achievements in biology courses. Analysis of results indicated no significant difference between attitude towards biology and students’ achievements in biology courses (p<0.05, r = 0.12). Coefficient of determination showed that there is 0.014 between attitude towards biology and biology achievement.

Ademola and Olajumoke (2009) investigated a study on parental involvement as a correlate of pupil’s achievement in mathematics and science in Ogun State, Nigeria. From the results of this study, parental involvement accounts for 16.1% of the total variance in mathematics achievement of primary school pupils (R² = 0.161, p < 0.05) and 13.5% of the total variance in pupils’ achievement in science (R² = 0.057, p < 0.05). These percentages are significant at 0.05 level of confidence. It shows that
parental involvement is an important predictor of mathematics and science achievement.

Joseph (2009) made an investigation of effectiveness of multiple intelligence approach on achievement in biology of students. The experimental group was taught through the MIA and the control group was taught through CMDI. The analysis of covariance of pretest and posttest scores of students in experimental and control groups shows that there is significant difference between the means of the posttest scores of the two groups ($F_{yx} = 284.40; p<0.01$). This implies that the experimental group excels control group on the achievement in biology.

Keil (2009) conducted a study on improvements in students achievement in science and science process skills using environmental health science problem-based learning curricula. Students science process skills, as measured by the POPS test and analysis found that POPS scores of students enhanced through participation in EHSIC program in Odysseys. Statistically significant increase in science achievement scores was found in both male and female students.

Bancroft (2008) attempted to find out the effects of concept mapping on achievement in tenth grade biology students. Results revealed that the biology achievement of the students who learned through concept mapping technique is higher than that of the pupil learned through present method. Thus it is inferred that concept mapping followed in experimental group helped the students to achieve better than the present method of teaching.

Singh and David (2008) examined the relationships between opportunities to learn (OTL), science engagement and science achievement in students. The study try to found out the effects of OTL on students’ emotional, cognitive, and behavioral engagement in science and subsequently on science achievement controlling for family socioeconomic status. The results of this study revealed that students’ science achievement and the effects of various types of engagement are varied across classes and schools due to different opportunities and conditions.

Sabitha and Prakash (2005) studied the effect of cooperatives learning on achievement in biology. Two hundred students from three schools of Tumkur town of Karnataka were selected for the study. The tools used for this study were achievement values and anxiety inventory developed by the investigator. The study concluded that
cooperative learning had positive effect on achievement in Biology in terms of three domains that is knowledge, understanding and application.

Jacob (2004) studied the effect of deficits in scientific skills on achievement in science of the learning disabled at the primary school level. Normative survey method was adopted for the study. Results found that there is significant difference between learning disabled and non disabled (ND) with respect to their achievement in science ($CR = 54.07$, $p<0.01$), the higher mean value of ND children shows that they are better in achievement in science compared to LD children.

Rao (2004) attempted to study the effect of concept-mapping in science on science achievement, cognitive skills and attitude of students. The main objective of the study was to develop and implement concept mapping as a strategy in the selected few units of science for VIII standard students and study its effect on the achievement, concept attainment, and the process skills of students belonging to different intelligence groups. The analysis of data revealed that the experimental group students had performed better when compared to the control group on the achievement test, process skills and concept attainment test on the post test occasion.

Hancock (2003) studied about co-operative learning and peer orientation effects on motivation and achievement in science, found that the students with high peer orientation were significantly more motivated to learn and better achievement than students with low peer orientation.

Vamadev (2003) aimed to study the relationship between self concept (physical, social, temperamental, emotional, moral, and intellectual) and achievement in biology. Findings of the study revealed that self concept is positively and significantly related to achievement in biology and among its dimensions, educational and intellectual self concepts are positively and significantly related to achievement in biology.

Parvathy (2002) assessed the effectiveness of Activity oriented method in teaching biology in small groups and large groups of secondary school students. The $F$ value obtained from the ANCOVA of the pre test and post test scores of students of experimental group and control group was significant ($F_{y,x} = 68.24$, $p<0.01$) and concluded that Activity oriented method is more effective than
conventional method of teaching on Achievement in Biology of Secondary School level.

3.5 Studies Related to Scientific Creativity

Theresa (2013) assessed the creativity in science of postgraduate student-teacher counselors whose age range was 25-54 years old and teaching experience of 4-25 years and to find out whether age, gender, and teaching experience influence creativity. Results showed that ideative flexibility, ideative originality, ideative fluency, and creativity motivation scores to be 56.5%, 59.47%, 57.4%, and 68.81% respectively and the overall creativity score was 57.79%.

Suat (2012) investigated the effect of an activity based explicit nature of science (NOS) instruction undertaken in the context of a ‘science, technology and society’ course on the prospective science teachers’ (PSTs’) understandings of NOS. The post assessment indicated a substantial development in the participants' conceptions about many aspects of science; however, little change took place for either conceptions related to the social and cultural influences on science or creativity and imagination in science.

Maya (2010) investigated whether personality is a valid predictor of creativity in science above and beyond demographic characteristics, such as career, age, gender and scientific discipline. Study pointed out that creative achievement in science is the personal ability to generate original, useful, and adaptive scientific theories or empirical findings and concluded that openness was significantly correlated with creativity in science.

Joson (2009) investigated correlates of scientific creativity and certain variables in middle school students. Study explored the dynamic interactions among scientific proficiency, intrinsic motivation, creative competence related to scientific creativity. The test of creative thinking drawing production was used to measure creative competence and the results showed that scientific proficiency and creative competence correlate with scientific creativity.

Jo (2009) studied the Koreans students’ creativity in science using structural equation modeling. The test of scientific creative thinking drawing production was used to measure creative competence. To assess scientific creativity one open ended
science problem test was used. The results showed that scientific proficiency and creative competence correlates with scientific creativity.

Anne (2008) studied the level of differentiation of self and stress on scientific creativity. Result of point-biserial correlation showed that subjects with higher levels of differentiation of self, as measured by the family systems personality profile, were more often associated with the highly creative group when expert judgments were used as the creativity criterion.

Hilar and Omer (2008) assessed the effect of scientific process skills training on students’ scientific creativity. Sample of the study was seventh grade level of an elementary school. Study showed that there is no significant difference between the scientific creativity scores of the experimental and control groups before scientific process skill training programme. But there is a significant difference between total scientific creativity scores of the experimental and control groups after the application of training programme.

James (2008) examined the effect of relationship between local scientific cultures, scientific disciplines, and scientific creativity. Findings of the study showed that positive significant correlation between scientific creativity and scientific cultures of middle school students. Significant gender differences were found for scientific disciplines and scientific creativity.

Shereen (2008) identified the most effective ways to enhance children’s creative expressions in the educational field. The Creative Behaviors in young children checklist and innovative creativity model developed and results showed that model was very effective for improving scientific creativity in children.

Umer (2008) attempted to find out the role of awareness in distributed collaboration on scientific creativity. Survey cum experimental method was used for the study. The first phase was survey study and second phase was experimental in nature. The results showed that groups with activity awareness support were more likely to be the most scientific creativity than groups without activity awareness support. 62% of the groups with activity awareness support were ranked in the upper tier of being creative versus 37.5% of the groups without activity awareness support.

Willem (2008) investigated the influence of mental process involved in generating creative products. Data was collected through a scientific creative ability
test. Study revealed that positive significant correlation between cognitive processes and scientific creativity.

Beghetto (2007) investigated factors related to student perception of scientific competence. One thousand two hundred eighty nine students from two middle schools and one high school in the United States were asked to respond to a questionnaire about the perception of scientific competence and creative self-efficiency. Data analysis found that scientific competence were positively related to creative self efficacy, through hierarchical regression analysis ($\beta = 0.33, P <0.001$).

Beghetto and Kaufman (2007) found that creative cognition related to ordinary cognition. A total of seventy five teenage students in China constituted as the sample of the study. Scientific creativity test for secondary school students developed by Hu and Adey was applied to measure scientific creativity. Study revealed that, creativity is a combination of both divergent (i.e. flexibility, fluency) and convergent thinking (i.e. elaboration, evolution).

Lee and Erdogan (2007) examined the effect of education on scientific creativity. Students from the experimental groups showed an increase in the level of scientific creativity scores ($F (1, 6.01) =9.50, P=0.022$). Study concluded that the innovative teaching strategy influenced the development of student’s scientific creativity.

Philip (2007) assessed the relationship between intelligence, scientific creativity, home environment, achievement motivation and science achievement of higher secondary school students. Achievement motivation scale, scientific creativity test and Ravens progressive Matrices were used for the study. The correlational studies revealed that achievement in science with verbal and non verbal scientific creativity is very high. Fluency, flexibility and originality of scientific creativity have strong relationship with achievement in Science. Study also found that there is positive significant relationship between scientific creativity and home environment which have close relationship with achievement in science.

Weiping and Chunjun (2007) studied the relationship between inter-disciplinary concept mapping abilities and scientific creativity. Inter-disciplinary concept mapping which was developing integrated knowledge constructs was a practical mental tool in understanding creative cognition. The score for scientific
creativity were analyzed canonical correlation and discriminate analysis. This study’s results showed that inter-disciplinary concept mapping ability predicted the variable scientific creativity.

Puccio (2006) reported that creative problem solving training programme found to be one of the most successful creativity programs in changing attitude, developing divergent thinking skills and enhancing problem solving performance. Study also found that creative process methods to stimulate scientific creative thinking in relationship to community programs and internal work.

Walker (2006) conducted a study on the impact of nurturing Creativity in language and science classrooms based on gender and inclusion in special education clusters for improving seventh grade student’s creative products. Study utilized a quasi experimental pretest post test design with two intact samples separated into treatment and control. Study showed that there was statistically significant difference between the control and treatment group. The treatment group displayed statistically higher post test scores compared to the control group after the intervention.

Leslie (2004) assessed the influence of analogies in science classrooms on scientific creativity. Study focused on student-generated analogies in science and offers a model for improving scientific creativity and concluded that student generated analogies improved scientific creativity and scientific thinking of eighth grade students.

Lin et al. (2003) analyzed the effect of CASE on scientific creativity. Creative problem solving education was applied in experimental group. The application varied from four weeks to eight weeks. The averages of pre test and post scores of the groups were compared by the t-test analysis. Results showed that, there is significant difference between the creativity scores of the experimental and control group (t= 3.83, P<0.05). Study reported that creative problem solving education programme is effective for scientific creativity of the students.

Simonton (2003) investigated scientific creativity from two contrasting invitro perspectives: Correlational studies of the creative person and experimental studies of the creative process. Here the same phenomenon is scrutinized using 3rd, in vivo perspective, namely the actual creative products that emerge from individual scientific careers and communities of creative scientists. This behavioral analysis supports the
inference that scientific creativity constitutes a form of constrained stochastic behaviour. Study reported that three perspectives regarding its product, person and process must be integrated to a unified view of scientific creativity.

Lee and Lee (2002) conducted a study on effectiveness of scientific process skill training to primary school students on scientific creativity. Study revealed that student’s scientific creative thinking skills were enhanced when SPS training was done by simple and creative activities.

Liang (2002) explored the relationship between student’s scientific creativity and selected variables including creativity, Problem finding, science achievement, attitude towards science and the nature of science. The major findings suggested that student’s scientific creativity significantly correlated with some of selected variables such as attitude toward science, problem finding and the nature of science.

Mary (2002) justified the effect of temperament on the individual’s selection of scientific or aesthetic arts creativity. Two multiple linear path models investigated possible causal relationships between temperament, achievement, creative process variables and scientific creativity or aesthetic arts creativity. The path models illustrated that temperament factors such as intense emotional reactions and perceived sensitivity to sound had effect on Scientific Creativity and aesthetic arts creativity.

Weip (2002) developed a scientific creativity test for secondary school students. On the basis of Torrance Tests of creative thinking, seven item scale for measuring scientific creativity of secondary school students was developed and validated through analyses of item response data of 160 students in England. The results indicated that for trial sample, the scientific creativity of secondary school students increases with increases in age and science ability is a necessary but not sufficient condition for scientific creativity.

Aktamis et al. (2000) developed a test for primary school students which measures scientific creativity and scientific process skills (SCSPS). The test administered to year seventh standard students in Turkey (N= 79). After suitable scoring, in order to find out if the test was valid, the expert ratings was used (N= 15). The analysis of the data showed adequate reliability and validity. SCSPS was used to find out the scientific creativity and students skills of scientific processes. The
analysis revealed that there is a positive connection between scientific process skills and Scientific Creativity of primary school students.

Katherina (2000) explored the relationship between performance on a scientific creativity test and participation in a science fair. Study reported the importance of science fair programmes and its influence on scientific thinking and creativity. Study concluded that participation in science fair programme significantly enhance scientific creativity of secondary school students.

Michael (2000) investigated the creative achievement of 320 high school students. Study found out that creative thinking is positively influence on creative achievement in science of high school students in Canada.

Srivastava (1992) attempted to investigate scientific creativity in relation to scientific aptitude and scientific attitude. Study found that science students of higher secondary classes having more scientific aptitude were more creative than those having less scientific aptitude. Boys having favorable scientific attitude were slightly better than those having unfavorable scientific attitude, whereas the girls with favorable and unfavorable attitude towards science did not differ.

3.6 Studies Related to Science Interest

Savannah (2013) determined the relationship between student’s grade level, implicit views of science ability, science achievement and science interest. Differences by grade level were also explored. Participants in the current study consisted of a total of 1910 students from six elementary schools from one south-central Kentucky district that participate in Project GEMS (Gifted Education in Math and Science). No gender differences were observed in implicit theories of science ability or science interest. Females did evidence lower achievement in science than males.

Patel (2012) aimed to study scientific attitudes and interest of secondary school students of Ahmadabad district in relation to some variables. The results showed that level of signified interest found higher in girls that that of boys. Students of standard does not effect on the Science Interest. In this way the level of scientific attitudes also found higher in girls than that of boys.
Almare (2011) attempted to study the frequency, duration and time devoted to elementary science instruction and the association with science achievement and science interest. The results of a linear regression analysis suggested that the frequency and duration of third grade science was not associated with science interest in the eighth grade.

Eason (2010) assessed the impact on student learning and outdoor science interest through modular serious educational games. The game was tested by eighty one middle school students and sixty-nine completed pre post tests final scores were analyzed using a paired t-test. Findings showed that student learning and outdoor science interests improved through educational games.

Forester (2010) examined the relationships between participation in competitive science events, gender race, science self efficiency and science interest. Significant gender differences were found for science self efficiency and academic major choice. Study found that there were significant race differences for participation in specific types of science competitions and significant correlation between science interest and science self efficiency.

Joel (2010) examined the impact of certain strategies for student’s attitudes and interest in science. The schools were in the mid-Atlantic area of the United States and classes were predominantly white from middle and lower-middle socio-economic backgrounds. Results revealed that female student’s science interest scores were significantly lower than those of male students.

Noah (2010) studied the elementary student’s knowledge and interests related to active learning in a summer camp at a Zoo. Study reported that students interest in learning environmental science beyond the camp setting was related to their connection to the zoo camp experience, study concluded that students were knowledgeable in general science before and after the summer zoo camp and half were interested in learning science in school and pursuing a career in science in the future.

Santine (2010) attempted to find out the effects on interest, instruction and achievement on science of middle school students. The data were analyzed for main effects and interaction effects using general linear modelling procedures. Results indicated that students who received instruction in researchable questioning out-
performed those students who were not instructed on a measure of science question level, when students were interested in a science topic their question level was significantly higher than when they were not interested.

Groen (2009) studied the impact of pedagogical practice on student’s interest in elementary science classrooms. Results indicated that passive learning tasks, such as written work and note taking, became less popular as grade level increased, that female students maintained a greater interest in passive learning tasks than males, and that passive learning tasks had the greatest impact on predicting student interest in science.

Allen and Fraser (2007) used a mixed methodology to examine the correlations between grade four and five student’s and parent’s perceptions of the science classroom and attitudes, interest and achievement. The correlations observed that relationships exist between student’s perceptions and their attitudes. Students who perceived more investigation in science class had more positive attitudes to science inquiry. This finding suggests that students who participate in investigative activities may become more interested in science and the inquiry process.

Bulunuz (2007) examined the role of background experiences and an inquiry science methods course on interest in science and interest in teaching science. Study included many activities and assignments at varying levels of inquiry designed to teach content and inquiry methods. Pre-post surveys indicated that participants increased in interest in science and a number of variables reflecting more positive feelings about science and science teaching.

Daniel (2007) conducted a study on teacher enactment of an inquiry based science curriculum and its relationship to student interest and achievement in science. Results from data analysis revealed a positive relationship between the teacher’s attitude towards curricular change and their fidelity of implementation to the developer’s intentions or curricular enactment. In addition, strong positive relationships were also discovered among teacher attitude, student interest and student achievement in science.

Beisser (2006) conducted a two-year study of the impact of using Lego®/Logo technologies on science interest about gender competence and self-efficacy. Data was analyzed with t-tests to find significant pretest and posttest differences for boys and
girls and between boys and girls. Findings suggest that the use of technological systems by female students may positively impact their attitudes and interest in Science about gender competence with technology.

Koszalka and Darling (2005) conducted a quantitative study of the impact of using web and human resources in suburban, middle school science classrooms on student’s interest in science subject and careers. The study used a one-time cross-sectional observational method. The study found that students who used web resources had significantly higher science interest than those who did not (average 3.86 points higher on a 36 point scale, p<0.002). The findings suggest that the integration of both types of resources had a positive impact on science interest, their combined impact was particularly strong, especially with female students.

Luera and Otto (2005) compared inquiry-based model programs with traditional lecture-based science courses. An experimental study with a pre test post non equivalent group design was planned. Study found that the inquiry programs improved preservice teachers’ and student’s acquisition of science process skills content knowledge, laboratory skills, and self efficacy, attitude toward science and interest in science.

Naceur and Schiefele (2005) attempted to study the influence of student’s level of science topic interest on text recall. For the purpose of the study, science interest test was used. The t test was applied to find out the significance of difference between means in the different categories. The finding of the research suggests that the quality of learning environment (situational interest in classroom) has a substantial impact on individual interest.

Allen (2004) studied the attitudes toward science, interest in science, and curiosity as they relate to science Achievement of upper elementary students. A correlation matrix was constructed by multiple regression correlation analysis to examine the relationship among the dimensions. Analysis of data concluded that verbal, quantitative aptitude, attitude toward science and non verbal aptitude were found to have significant influences on science achievement and the dimension of attitudes toward science, interest in science, science curiosity, verbal aptitude, quantitative aptitude and nonverbal aptitude accounted for 51% of the variance in science achievement.
Capers (2004) examined the effects of a high school science intervention program on girl’s attitudes, interest and achievement in science. 84 girls, 44 ninth graders and 40 tenth graders, participated in the study. Study reported that girls participation in the program positively affect their interest in science subject.

Lynn (2004) examined the effect of within family differences on science readiness and science interest. A sample of 6817 pairs of twins was collected by computer comparison of names, address and birthdays for nearly 20000 high school juniors and seniors who took the American College Testing Program Battery in the 1975-1978 academic years. Study reported that differences within Families had no effect on science ability and science interest.

Palmer (2004) conducted a study on influence of interest in science method course on certain cognitive and affective variables of teachers and primary school students. Study found that background experiences of pre-service teachers predicted initial interest in science and that an inquiry based methods course increased both interest in science and confidence in teaching science.

Schiefele (2004) explored the relationship between interest, achievement, motivation and various dimensions of experience in mathematics, biology, English, and history. Normative survey method was employed in the study and interest of various subjects of students was collected with the help of interview schedule. Results found that interest not only predicts student’s grades in these subjects, but also predicts quality of experiences, intrinsic motivation, self-esteem, and skills.

Anayo and Onwumer (2003) explored the relationship between urban middle school student’s interest in science, perceptions of science teachers and achievement in science. Results reported that student’s interest in science is not a sufficient predictor of student’s achievement in science and the combined effects of student’s interest in science and perceptions of science teachers on student’s achievement in science were significant.

Hung (2003) conducted a survey on middle school student’s interest in environmental issues as they relate to science instruction. The questionnaire was administered by middle school science teachers to their students in science classes. Sixth grade, eleventh and eighth grade science classes from each of the four schools
participated in the study. Results found that science interest and attitude towards science positively related to school science programs and science instructions.

Judith (2002) analysed the impact of aptitudes, science program and classroom climate on student’s attitudes towards science and science interest. Sample of the study consists of 450 eighth grade students. Findings showed that most students displayed positive scientific attitude. Gender wise analysis concluded that, boys initially had stronger positive scientific attitude than girls, which difference disappeared at post test. Boys retained a greater interest in science class.

Pearce (2002) studied the correlation between playful involvement and science interest of elementary schools. The sample for the present study includes 350 elementary school students. Results found that, playful involvement and environment correlated with Science Interest in elementary schools.

Rathunde and Csikszentmihalyi (2000) investigated the relationship between adolescent’s level of interest and their talent-related growth in math, science, athletics and art by examining official transcripts, teachers ratings on student’s quality of attention, involvement with work, enjoyment of challenge, capacity for concentration and student’s self-assessments. Study found that adolescent’s interest in doing talent-related science activities was positively correlated with their achievements in school.

Crawford (2000) conducted a study that focused on interactions of a high school biology teacher and twenty students in ecology class. Study employed a complex model of inquiry-based teaching, which teachers and students collaborate to develop conceptual understandings through shared learning experiences. Pre test and post test results showed that collaborative inquiry method better than traditional lecture method in high school students. Study concluded that collaborate inquiry method facilitate science interest of students.

Shirma (1996) investigated the relationships between the science achievement of potentially gifted students and their verbal Reasoning Quotient, spatial ability, curiosity and science interest. Curiosity and science interest were measured by the Self-Appraisal of curiosity and science interest inventory. Findings of the study indicated that significant differences were found in curiosity levels and correlations of curiosity and interest with science achievement yielded significant positive coefficient.
Malviya (1991) attempted to measure attitude towards science and interest in science. The study showed that high scores on attitude towards science favor higher scientific interest. Age, sex, profession and socio economic status have no effect on attitude towards science.

Raveendranathan (1983) tried to compare the science achievement, science interest and mental health status of secondary school pupils in the English medium and Malayalam medium classes. Result of the study was the science achievement, science interest and mental health status of secondary school pupils in English medium classes was higher than those of pupils in Malayalam medium classes.

3.7 Studies Related to Social Sensitivity

Baldwin (2012) reported that variation within the genes of central neurotransmitter systems, particularly the serotonin (5-HTTLPR, MAOA-uVNTR) and opioid (OPRM1 A118G), are associated with individual differences in social sensitivity, which reflects the degree of emotional response to social events and experiences.

Lisa and Gursimran (2012) conducted an empirical study that investigated the effect of social sensitivity on the performance of project teams consisting of computer science and management information system students who worked on semester-long projects. The results revealed that social sensitivity is highly correlated with successful team performance.

Blashill and Jillon (2010) attempted to study the meditational impact of gender role conflict on the relationship between social sensitivity and depression in a sample of gay men. Correlational analyses revealed that the gender role conflicts, as well as restricting oneself from expressing emotions and difficulty in balancing work and family demands, were unique mediators in the relationship between social sensitivity and depression.

Woolley et al. (2010) explored the correlation between social sensitivity and effective teamwork. Main objective of the study was to find out the influence of collective intelligence and group interaction on group performance. Result from this study was that team performance was not driven by the intelligence of individuals on the teams; group cohesion, motivation, or satisfaction. Study also found that social sensitivity was significantly related to team performance and human group success.
Judith and Susan (2009) tried to find out psycho social correlation of interpersonal sensitivity. Results showed that though the effects were not strong, interpersonal sensitivity (IS) was significantly positively associated with seven of the self-rated positive trait categories; empathy, affiliation extraversion, openness, tolerance, and internal locus of control. IS was negatively correlated with neuroticism, shyness, and depression.

Chan (2008) suggested that social sensitivity is the primary factor for achieving good project performance. They argue that higher levels of social sensitivity within the team facilitate the application development skills and domain knowledge skills necessary to achieve good project performance.

Gerald (2007) investigated the correlation of social sensitivity, locus of control, empathy and peer popularity of adolescence. Based upon a social deficit hypothesis, linear age differences were observed in social knowledge, locus of control, and a trend in empathy. Some sex differences were found, but no sex by age interactions were observed. The predicted relationship between social competency and peer popularity was supported, but was different according to sex of the adolescent.

Isabel (2006) studied the influence of problem solving ability and cognitive task on social sensitivity of university students. Social sensitivity scale was used to measure the six components of social sensitivity. Result of the study proved that cognitive task is strongly correlated with the social sensitivity of college students.

Jennifer and Katherine (2006) assessed the role of personality in negative social consequences and quality of life. The purpose of the study was to determine whether a personality trait-dispositional social sensitivity is associated with the adverse social impact of acne. Results found that greater acne severity was significantly associated with poorer social outcomes and quality of life. For women, higher social sensitivity was independently associated with poorer outcomes, while for men higher social sensitivity interacted with acne severity and was associated with worse social outcomes and life quality.

Koenig and Eagly (2005) tried to find out stereotype threat in men on social sensitivity. The objective of the study is to find out stereotype threat in men on a test of a feminine ability called social sensitivity. The results of study suggested that, there
are instances in which a majority of men can be threatened in daily life and that men are not as good at decoding nonverbal cues as women is salient during social interactions; men may actually show a stereotype threat effect and read others’ nonverbal cues poorly, thereby creating communication problems.

Luis (2004) conducted a study on social sensitivity of outcome measures for treatments of generalized social phobia in Spanish adolescence. Statistical analyses indicated that all the measures were sensitive to the effects of the treatment for generalized social phobia, with individuals scoring significantly more impaired at pre treatment than at post treatment and follow up. The findings of the study strongly supported that all of the scales were found to be sensitive to treatment effects in socially anxious adolescents.

Mary and Kimberly (1999) assessed the influence of social situation on peer conflict behaviors of preschoolers. Results indicated that preschoolers have a remarkably varied array of conflict behaviors and that much of their conflict behavior

Cohen and Riordan (1999) investigated a study on a new test of social sensitivity. Detection of faux pas in normal children and children with Asperger syndrome: All children were assessed for verbal mental age (VMA) using the British Picture Vocabulary Scale and for an aspect of non verbal mental age using the WISC-R Block Design Task. Results concluded that the ability to detect faux pas developed with age and that there was a differential developmental profile between the two sexes (female superiority). Children with Asperger Syndrome (AS) or High Functioning Autism (HFA), selected for being able to pass traditional 4- 6 year level (first and second order) false belief tests.

Baron et al. (1998) suggested that engineers, mathematicians, physicists, and computer scientists were typically less socially sensitive than their peers in the humanities, arts, and social sciences. They suggest that people in these technical disciplines have more difficulty decoding what others are thinking and feeling.

John and William (1992) focused on the importance of social relationships, socioeconomic status and health practices with respect to mortality among healthy Ontario males. A social relationships index comprised of marital status, number of children, family contact and participation in voluntary associations had a strong association with mortality (adjusted relative risk of 0.30, 95% CI 0.11–0.83,
Salovey and Mayer (1990) pointed out that social sensitivity is an element of emotional intelligence and it’s to enhance other’s moods and peer relations. Study also revealed that interpersonal cooperation reduces emotional disturbances of students.

Carlson (1981) studied male psychiatric patients' social sensitivity and self-awareness in a human relations training program. The two variables were significantly related and also found that self-awareness was not related to group acceptance. Results indicated that a decrease in patient's symptoms but not as a function of social sensitivity or self-awareness.

Mcmanus (1974) focused on the study of social sensitivity in young children. The result was divided into two sections; the first was the measure of the accuracy of the emotional recognition and the second was the measure of tendency to selectively attend or not attend to emotional meaning. The results indicated that the degree of accuracy depended up on the specific emotion portrayed and on whether the actor was an adult or a child. Despite the high level of accuracy, the social sensitivity did not spontaneously mention much emotion.

Murray (1970) investigated the aspect of social sensitivity of Negro high school pupils and to compare the relative measures of social sensitivity of these students with students in selected high school pupils of Indiana. The main elements of scale consisted of democratic rights of individuals, democratic processes, and tolerance toward Negroes, liberalism, conservatism, war and peace. Results revealed that 23.5% students have high level of social sensitivity, 13% belong to low level and 63.5% students of high school have an average level of social sensitivity.

Rothenberg (1970) described a method of measuring children’s social sensitivity and investigates the relationship between social sensitivity and specific measures of interpersonal competence, intrapersonal comfort and intellectual level. Social sensitivity was measured using a series of four tape-recorded stories depicting two adults in happy, angry, anxious, and sad interactions. Results concluded that there was no significant effect on social sensitivity due to sex, ordinal position, or size of...

Vincent and Elizabeth (1966) attempted to justify the development of social sensitivity in elementary school children. Study concluded that, children at the entire grade levels tested expressed considerable concern for people in far off places with
the greatest growth occurring between grades two and four. A great majority of children at all grade levels perceive the United States as "rich" and in little need of financial help.

Loban (1953) assessed the level of social sensitivity among adolescence. The hawthorne group test of cruelty compassion was also used as a check on the other measures. There were more highly sensitive girls than boys. No relationships were found between sensitiveness and intelligence, race, position in family, church attendance or denomination.

3.8 Conclusion

The review of related literature empowered the investigator to have extensive information on the characteristics, current trends and instructional strategies for the enhancement of scientific temper. It made possible for the investigator to frame the objectives, to formulate the hypotheses, prepare appropriate tools and select suitable methods for the study. The importance and need for scientific temper and studies based on existing strategies is an eye opener to the investigator to develop a new instructional package to enhance the scientific temper of secondary school students. It also gives the idea on proper interpretation of data and drawing valid conclusions based on findings.

A thorough analysis of the related literature was made use of in exploring the significance of the construct ‘scientific temper’ in the life of human beings, especially students. Related studies have exposed the crucial role of scientific temper on many areas of student’s development. Scientific temper was found to have relevance on both the academic and behavioural outcomes of students. The search on literature reflects that scientific temper are significantly related to variable like scientific creativity (Rishu & Markandy, 2011), science achievement (Joshua, 2007; Joy, 2006) and self regulation (Magno, 2011; Chung & Ro, 2004). This motivated the investigator to include these variables in the present study.

Studies like Mahanti, (2013) and Sing, (1998) considered the importance of scientific temper in science learning and also help to develop personality of students. Research studies confirmed that modern instructional strategies had the potential to enhance scientific temper of students (Dhar, 2009; Sing, 2004; Kumar, 1998). These studies revealed that traditional teaching methods should pave the way to modern
instructional strategies for bringing out increased achievements and better results. The review of related literature revealed that no such studies were conducted on secondary school students in Kerala. It is worthy to note that research based on scientific temper in India is still in its budding state. The state of research on scientific temper in India is not up to the desired level. All these factors motivated the investigator to carry out the present study entitled, effectiveness of a scientific temper package on certain cognitive and affective variables of students at secondary level.