

## CHAPTER II

### REVIEW OF RELATED LITERATURE

#### 2.0.0. INTRODUCTION

Review of related literature is the collection of studies over a period of time done on the selected subject. It is basically a secondary source. It helps to find the relationship between the variable and help to get the knowledge of unexplored areas which is yet to be studies or explored which eventually lead to find the research gap in the selected topic. According to Tuckman and Harper (2012) literature review provides ideas about variables of interest based on prior work that has contributed to an understanding of those variables. Prior work contributes to the development of new hypotheses. A careful and detailed review of literature help a researcher to get the clear conceptual understanding of the topic as well as the other methodological issues which emerges or exists. It is the most important step in conducting any research study and need to be done prior to the study so that a genuine research gap can be found the redundancy can be avoided.

From the various review of related literature and the national documents released related to this particular notion, it came to emerge that the term scientific temper is used synonymously with the term scientific attitude, scientific thinking, scientific habit of mind and scientific outlook. Hence in this chapter all the reviews related to these terms have been presented by breaking it into groups. Although the researcher couldn't come across any research study related to the term scientific outlook. Hence, except that all the terms have been covered in the review presented below. Basically, in this chapter the review is divided into four groups which are:

1. Studies conducted on scientific temper
2. Studies conducted on scientific thinking
3. Studies conducted on scientific habit of mind
4. Studies conducted on scientific attitude

#### 2.1.0. STUDIES CONDUCTED ON SCIENTIFIC TEMPER

**Pattnaik (1986)** did an empirical study of Scientific Temper. The objectives of the study were to establish scientific temper as a full-fledged concept, to transform the ideal type scientific temper into operational one for empirical testing, to find out whether formal science education

promotes higher degree of scientific temper, to identify factors associated with scientific temper, to determine their contribution to it and to examine empirically the nature of relationship between scientific temper and religious belief. The study was of exploratory and formulative type. For this he has taken 300 samples of post graduate students representing all post graduate departments of Poona University. Thus, the sampling was partly stratified and partially proportionate. A self-made scientific temper scale was used as a tool to collect data. For analysis chi square, t-test and bivariate correlation was used. Major findings were that students studying social sciences did significantly better on scientific temper than their counterparts studying natural and applied sciences, scientific information showed a low but negative correlation with scientific temper, TV watching helped viewers substantially in acquiring more scientific information than in developing scientific temper, Length of urban living though did not seem to be a strong correlate of scientific temper still it remained to be stronger than exposure to mass media and modernity was found to have a very high correlation with scientific temper.

**Singh (1987)** did a diagnostic study of scientific temper and secondary school teacher as a human component of educational system. The study was aimed at determining the value, worldview and teaching-learning scores and the relationships between them, for the higher secondary school teachers. Total 317 (235 male 82 female) higher secondary school teachers of Kanpur were selected by using stratified sampling method. A self-made questionnaire was used to collect the data. Descriptive analysis methods like mean, median, mode, mean deviation, SD, kurtosis and correlation were used for data analysis. The finding reveals that the scientific temper is positively correlated with the development of society. The distribution of value indicated that 55% of sample formed medium category, while 23% and 22% respectively were in low and high category; 18.9% and 24% of the teachers were in low and high category respectively in terms of world view. 18.9%, 53.67% and 27.5% teachers were placed in low, medium and high categories respectively in terms of teaching and learning; the value and teaching learning score tends to drop at a faster rate than the worldview score; the cumulative performance of sample is positively in favour of world view indicator.

**Dubey (1992)** conducted a study of the scientific temper and its measurement. The objectives were to develop a scale for measuring scientific temper along with its appropriate working definition and determination of its ingredients using factor analysis and to compare the incidence of scientific temper as judges by scores on the scientific temper test among different

groups and teachers and students, such as male and female, urban and rural, science and non-science students as well as teachers. Two stage stratified sampling method was used to select class XI science and non-science students and teachers. The study found that all group of students & teacher manifested scientific temper. Significant differences in scientific temper were noticed between male science teacher and non-science teachers, female teacher and male teacher, rural girls and urban girls, urban boys and urban girls and finally male science students and female science students. No significant difference appeared between female science and non-science teachers as well as science students and non-science students. The mathematical structure of tools and tasks as used in this study showed the existence of two factors, namely curiosity and aversion to superstitions.

**Pradhan (1996)** had done a cross cultural study of the understanding of science and scientific temper. The objectives of the study were to develop and validate an instrument on scientific temper, to study the level of scientific temper among different groups of pupils from India as well as Nepal, to study the effect of type of school, class level, geographical locale on level of scientific temper and to determine the relationship between levels of scientific temper and understanding of science. The sample consisted of 1315 class 10<sup>th</sup> and 11<sup>th</sup> students from India and Nepal by employing random sampling method. The finding showed that total sample has above average scientific temper; students from Nepal have higher level of scientific temper than the students from India, senior secondary students possess much more favorable scientific temper in comparison to secondary school students, no difference was found in level of scientific temper due to sex difference, urban and private school students had high level of scientific temper than the rural and government school students.

**Singh (1998)** did a study of scientific temper in relation to personality and environment. The objectives were to develop and standardise tool for measuring scientific temper, to investigate relationship between scientific temper and different dimensions of personality (extroversion, Neuroticism) and environment (school and home), to investigate the significance of difference in scientific temper and extroversion & neuroticism personality of rural and urban students. Normative survey method was employed for the study. Total 505 students (10+2 level) of Sonapat were selected using cluster sampling method. Mean, SD, t-test and correlation methods were used to analyse the data. The result revealed that there is a positive relationship between scientific temper and extroversion personality; there exists no significant difference between scientific temper and extroversion personality of rural and of urban student. There is

negative relation between scientific temper and neuroticism personality, no significant difference exists between scientific temper of urban and rural students. Dimensions of school environment viz., permissiveness acceptance control cognitive encouragement and creative stimulation have positive relationship with scientific temper. Rejection dimension of school environment have negative relation with scientific temper. Six dimensions only of home environment such as control, protectiveness, punishment, conformity, rewards and nurturance have positive and significant relationship with scientific temper, and the others like social isolation, deprivation of privileges, rejection and permissiveness, have negative relation with it.

**Tripathi (1999)** did a comprehensive study of environmental awareness, scientific temper & self-concept of students studying in central schools and other schools at 10+ level. The objectives were to compare the environmental awareness, scientific temper, self-concept of boys and girls of central schools, to compare the environmental awareness, scientific temper, self-concept of science and art students of central school, to compare the environmental awareness, scientific temper, self-concept of central and other schools having same and different syllabus. Survey design was used for this purpose. Stratified sampling techniques was used to select a total sample of 600 students. A scientific temper inventory made by Dr. Anita Singh and Dr. Harikesh Singh was used to collect the data. Mean, SD and t-test methods were used for the analysis of data. The result revealed that difference in environmental awareness and self-concept was there while no difference was found in scientific temper between boys and girls students of central school. Significant difference was found between art and science students in terms of scientific temper and environmental awareness of central schools. Art stream were better than the science students. No significant difference was found in environmental awareness and scientific temper of Central and other schools having same syllabus. No significant difference was found in environmental awareness, scientific temper and self-concept of central and other schools having different syllabus.

**Rajammal (2003)** studied efficacy of in-service training in developing scientific temper among primary children. The objectives were to develop training design for primary teachers, to organize training programme for primary teachers, to find out the effect of training programme on developing scientific temper among primary teachers and students. For this purpose, experimental method single group pretest post-test design was used. The teachers who were teaching standard V science in twenty primary schools were selected purposefully

on the basis of the sample of the students selected from the respective school. Primary students were selected based on stratified random sampling technique. 456 standard V students were selected from different strata. A self-made tool was used to collect the data. Mean standard deviation f-test and t-test were used to analyse the data. Findings revealed that the training programme was effective and it brought significant mean difference between pre and post assessment scores of primary teachers on scientific temper in science, the significant mean difference was found among pre, progressive and post assessment scores of primary school students on scientific temper in science.

**Nadeem & Wani (2005)** studied personality characteristics, vocational preferences, study habits and academic achievement of adolescent girls in Kashmir. The main objectives of study were to study the scientific temper, career preferences and academic achievement of rural school and urban secondary school students and to compare rural and urban secondary school students on scientific temper, career preferences and academic achievement. The sample was consisted of 400 (200 rural and 200 urban) secondary school students selected from Bandipora and Srinagar District respectively. The investigator has administered -Prof. N.A Nadeem & Showkat Rashid Wan's scale of scientific temper, Vivek Bhargava & Rajshiri Bhargava scale for career preference and academic achievement of rural and urban Secondary School students were collected from the official records of the respective schools. The raw data were analyzed by using percentage, Mean, SD and t-value. It was found that there were insignificant differences between rural and urban secondary school students on scientific temper. Further, it was found that significant mean difference existed between rural and urban Secondary school students on career preferences and urban students were found to be more inclined to their preferences as compared to rural secondary school students. The results revealed that the significant mean difference was found between rural and urban secondary school students on academic achievement. Further it was found that urban students had higher academic achievement than rural secondary school students.

**Gupta (2007)** has done a study of the understanding of science and scientific temper of Hindu and Muslim students with the objective to determine the levels of understanding of science and scientific temper among Hindu and Muslim students with respect to the type of school, class level, geographical locale and sex on levels of understanding of scientific temper, to determine the relationship between levels of scientific temper and understanding of science. The investigator had selected total 1000 sample - 400 Hindu and 260 Muslim students of 9<sup>th</sup> class

and 200 Hindu and 140 Muslim students of 10<sup>th</sup> class of government and private secondary school of Jhansi religion by random sampling technique. Mean, SD, t-test and correlation methods were used to analyse the data. Scientific temper scale developed by Pradhan was used to collect the data. Findings revealed that that levels of scientific temper among Hindu was more than the Muslim students and he had also observed that there was effect of geographical locale on scientific temper but there was no difference in scientific temper on the basis of sex.

**Nigam (2007)** had studied Effectiveness of jurisprudential inquiry model of teaching for developing scientific temper among IX<sup>th</sup> grade school adolescents in relation to their civic-sense, social competence and intelligence. The objectives of the studies were to see the effectiveness of jurisprudential inquiry model of teaching for the development of scientific temper among IX<sup>th</sup> grade school adolescents, to see the effects of civic sense, social competence and intelligence on development of scientific temper among IX<sup>th</sup> grade school adolescents when taught through jurisprudential inquiry model of teaching. Sample for the main study consisted of 60 students studying in IX<sup>th</sup> grade in Adarsh Bal Vidya Mandir Sanghat Kalan, Raiganj, Ghazipur, Uttar Pradesh. The single group pre-test, post-test design was adopted. A self-made scientific temper scale was used to collect the data. To analyse the data statistical techniques namely mean, median and t-test were used. Result of the study showed that exposure to 30 jurisprudential inquiry session brought significant positive change in the development of scientific temper, the effect of high civic sense on development of scientific temper of student was found not significant, the effect of high and low social competence on development of scientific temper of student was found significant, the effect of high and low academic intelligence on development of scientific temper of students was not found significant.

**Vyas (2010)** studied scientific temper of trainee teachers. Objectives of the study were to develop and standardise the scientific temper scale for the trainee teachers, to study the scientific temper of trainee teachers from a qualitative as well as a numerical (chi square) point of view, to study the scientific temper of trainee teachers with respect to gender (male, female), socio social class (reserved, unreserved), year of training (first year, second year), to discipline (science, social science), to study the combine effect of gender and year of training; social class and year of training; discipline and year of training; social class and discipline; gender and discipline on scientific temper of trainee teachers. 458 trainee teachers were selected through stratified random sampling method. Survey design was used. Component intensity score and

chi square were used to analyse the data. Self-made scientific temper scale was used as a tool to collect the data. The result revealed that no significance difference was found in scientific temper of trainee teachers with respect to gender (male, female), socio social class (reserved, unreserved), year of training (first year, second year) but significance difference was found with respect to discipline (science, social science).

**Bhatnagar (2011)** studied the scientific temper in relation to scientific creativity of senior secondary science students. The objectives were to compare scientific temper of senior secondary science students in terms of group, sex and locality, to compare scientific creativity of senior secondary science students in terms of group, sex and locality, to compare scientific temper of high and low scientific creative senior secondary science students, to find correlation between scientific temper and scientific creativity of senior secondary science students and to find the predicted value of scientific temper on the bases of scientific creativity as a predictor. Survey method was employed for the study. 300 senior secondary students of three divisions of the Rajasthan i.e., Ajmer, Jaipur and Bikaner were selected used stratified sampling technique. A self-made tool was used to collect the data. Formulas of percentile, mean, SD, t-test, product moment correlation and regression analysis were used as the statistical treatment. The study found equal on three dimensions of scientific temper i.e. scientific information; free from superstitions and curiosity. Boy and girl science students were found equal on free from superstitions, reasoning and logical ability, problem solving ability and scientific temper. Urban and rural science students were found equal on scientific information but free from superstitions, reasoning and logical ability, problem solving ability, cause finding ability, curiosity and scientific temper of urban students are found significantly higher than the rural students. There existed a very low but significant negative correlation between free from superstition and scientific creativity of senior secondary Science students.

**Nadeem & Ridwana (2012)** found scientific temper and creativity among higher secondary school students. The aim of the study was to find out the scientific temper of boys and girls higher secondary school students on various dimensions. For the present study, the investigator had randomly selected 80 students (boys and girls) in the age group of 16 to 18 , from government and private higher Secondary schools Srinagar. The data for the present study was collected with help of scale constructed by Prof. N.A. Nadeem and Showkat Rashid Wani. Mean, SD, and t-test were used for the data analysis. The result revealed that girls showed better scientific temper than boys and positive relation between scientific temper and creativity

was found.

**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.

**Mudasir and Yatu (2013)** compared the scientific temper and academic achievement of Kashmiri and Pakhtoon students. The objectives were to measure the scientific temper and academic achievement of Kashmiri and Pakhtoon school going boys and girls, to compare the academic achievement and scientific temper of Kashmiri and Pakhtoon school going boys and girls. Data were collected on a sample of 120 students by administering Nadeem and Khalida's Scientific Temper Scale. Mean, SD and t-test of significance were employed. It was revealed, that there was no significant difference between Kashmiri and Pakhtoon students on the scientific temper variable. However, Kashmiri students showed better academic achievement than Pakhtoon students.

**Aasia and Akbar (2013)** did a study on scientific temper and academic achievement of science and social science stream adolescents. The objective was to compare the scientific temper and academic achievement of science and social science adolescents of eleventh standard from Baramulla district of Kashmir. Students from science and social science were selected by employing random sampling technique. Scientific temper scale by Showkat and Nadeem was used to collect data. Academic achievement of the selected sample has been taken as the percentage of aggregated marks in 9th and 10th standards. Mean, SD and t-test of significance were employed for data analysis. The two groups showed significant difference on curiosity and objectivity aspects of scientific temper scale. Further, it was found that two groups did not differ on open-mindedness, rationality, and aversion to superstition dimension of scientific temper scale. Study also indicated that two groups differ significantly on academic achievement.

**Aezum and Wani (2013)** did the comparative evaluation of scientific temper and academic achievement among adolescents in Jammu and Kashmir with the objectives to investigate the



scientific temper and academic achievements of adolescents, to investigate if there is a significant difference in scientific attitude and academic performance of students regarding gender, class and type of institution. The study was descriptive survey. For this they had taken 180 students (100 boys and 80 girls) of XI standard at Anantnag District of Jammu & Kashmir through stratified random sampling method. The data were collected using a scientific attitude questionnaire made by Dr D. N. Dani and analysed using mean, SD and t-test. The findings of the study indicated that the scientific attitude and academic achievement of the boy and girl students (gender) as well as the students from rural and urban areas (locality) and from government and private institutions differed significantly. Boys were found to be a more efficient scorer than girls. Adolescents from urban areas were found to be more efficient than rural ones. Adolescents belonging to Private colleges showed better mean score than government colleges.

**Anbuchlevi (2014)** studied effectiveness of experiential learning strategies in teaching of environmental education with reference to scientific temper and environmental responsibility of B.Ed. teacher trainees. The objectives were to develop an experiential learning strategy to teach the environmental education to the B.Ed. trainees, to assess the level of achievement of B.Ed. teacher trainees in the environmental education, scientific temper and environmental responsibility who learnt through experiential learning strategy and the conventional lecture method, to find out if there is any significance difference in achievement in the environmental responsibility between the B.Ed. teacher who learnt through the experiential learning strategy and the conventional lecture method with respect to the personal variables, to find out the effectiveness of experiential learning strategy over the conventional method in teaching of environmental education to the B.Ed. teacher trainees, to find out if there is any significant correlation between the variables achievement in environmental education and scientific temper; scientific temper and environmental responsibility and achievement in environmental education of the B.Ed. teacher trainees. Experimental study was undertaken for the above purpose. 160 (80 experimental 80 control group) B.Ed. teacher trainees from STET college of education for women Sundarakkottai and Arunamalai college of Education Melavasal through purposive sampling technique were taken. A self-made scientific temper scale was used to collect the data. Mean, SD, t-test and correlation were used for data analysis. The finding revealed that there is significant difference between the control and experimental group B.Ed. teacher trainees in their achievement in environment education, scientific temper and environmental responsibility, significant difference was found between the control and

experimental group B.Ed. teacher trainees in their achievement in environment education, scientific temper and environmental responsibility with respect to undergraduate educational qualification, postgraduate educational qualification, Language optional subject, Science optional subject, Social Science optional subject, newspaper reading, utilization of radio, TV and internet. Positive correlations were found between achievement in environment education and scientific temper, scientific temper and environmental responsibility, environmental responsibility and achievement in environment education.

**Maqbool, Mudasir and Zehta (2014)** did a comparative study of scientific temper of government and private secondary school students. The objective of the study was to find out the scientific temper of government and private secondary school students. The investigator had randomly selected 200 students (100 government and 100 private) from secondary school students. The data was collected with the help of N.A Nadeem and Showkat Wani's scientific temper scale. Mean, SD, and t-test were used for analysis. It was found that there is significant difference between government and private school students on curiosity, objectivity, rationality, aversion to superstitions dimensions of scientific temper scale.

**Bhat and Netragaonkar (2014)** found scientific temper and academic achievement of first and non-first generation learners in Kashmir. The objectives were to study the scientific temper of first and non-first generation learner, to study the academic achievement of first and non-first generation learners, to compare first and non-first generation learners on scientific temper, to compare first and non-first generation learners on academic achievement. The study consisted sample of 800 adolescent students through random sampling technique. The previous two years academic achievement served as academic indicator of the students. Nadeem and Showkat's scientific temper scale was used to collect the data. Mean, SD, t-test revealed that there was significant difference between first and non-first generation learners on scientific temper and academic achievement. Non-first generation learners were found to have better scientific temper and academic achievement as compared to their counterparts.

**Bhatta, Nagarathinam & Kumar (2015)** had explored the scientific temper of climate change coverage in Indian newspapers. The newspapers were selected on the basis of which one has the maximum number of editions and have a substantial circulation. It included the articles coverage in three mainstream English language newspapers published from New Delhi, Mumbai and Chennai. News were taken from year 2005 to 2010 including opinion and editorial pieces. Each of the papers was sampled for the terms Climate Change, Global Warming,

Greenhouse Gas, and IPCC (Intergovernmental Panel on Climate Change). 993 out of 1104 news items were selected. The result showed that there had been very little attempt to involve science and scientists in the reportage. Majority of the news reports had used politicians as primary claim makers and had been sourced from the United Nation or IPCC reports. In comparison the number of reports using scientists as the primary claim makers and sourced from peer-reviewed journals was very low and had remained almost constant over the years.

**Joshua (2015)** had studied Effectiveness of a scientific temper package on certain cognitive and variables of students at secondary level with the objectives to analyse the perception of teachers on scientific temper of secondary school students, to develop and validate a scientific temper package for 8<sup>th</sup> standard students following Kerala state syllabus, to find out the effectiveness of scientific temper package and activity oriented method of teaching for secondary school students and to compare the effectiveness of scientific temper package and activity oriented method of teaching for secondary school students with respect to scientific temper, self-regulation, achievement in Biology, scientific creativity, science Interest, social sensitivity. 120 teachers and 800 students of secondary school of Kerala district were selected randomly as samples for her experimental study. A self-made scientific temper test as a tool was used to collect the data. Mean, Median, SD, Kurtosis, Chi Square, Percentage analysis, t-test and ANOVA method were used to analyse the data. The results showed that Secondary school teachers perceived that majority of secondary school students have low scientific temper, the existing level of scientific temper of majority of secondary school students was average score of the test and the scientific temper of secondary school students taught using scientific temper package was significantly higher than that of those taught using activity oriented method of teaching.

**Kaur (2015)** studied scientific temper among academically high and low achieving adolescent girls. The objective were to identify the high and low achieving adolescent girls, to measure the scientific temper of high and low achieving adolescent girls, to compare high and low achieving adolescent girls on composite score of scientific temper, to compare high and low achieving adolescent girls on curiosity, objectivity, open mindedness, rationality and aversion to superstition dimension of scientific temper. For this survey study random sampling technique was used to draw the sample from various high schools of district Srinagar. The sample for the study consisted of 120 school going adolescent girls (60 high and 60 low achievers). Nadeem and Showkat's scientific temper scale was used to collect the data.

Statistical techniques of Percentage, Mean, SD. and t-test were used to analyse the data. The findings of the study revealed that there existed a significant difference between high and low achieving adolescent girls on composite score of scientific temper, two groups differ significantly on curiosity, objectivity and rationality dimension of scientific temper scale. The results of the study further revealed that there existed no significant difference between high and low achieving adolescent girl on open mindedness and aversion to superstition dimension of scientific temper.

**Basu & Aslam (2015)** studied scientific temper and academic achievement of rural and urban secondary school students. The objectives were to study the scientific temper and academic achievement of rural and urban secondary school students; to compare rural and urban secondary school students on scientific temper and academic achievement. The sample for the study consisted of 400 secondary school students (200 rural and 200 urban students) selected by random method. Scientific Temper Scale developed by Prof. N.A Nadeem and Showkat Rashid Wani was used to collect the data. Mean, SD and t-test were used for data analysis. Result findings suggested most of the students were having above average level of scientific temper; no significant mean difference between rural and urban secondary school students on curiosity, open mindedness objectivity dimension of scientific temper; significant mean difference between rural and urban students on rationality dimension of scientific temper and urban students were found to be more rational than rural secondary level students; significant mean difference between rural and urban students on aversion to superstition dimension of scientific temper and difference was found to be significant and rural students were found to be more averted to superstitions thoughts than urban secondary students; no significant difference between rural and urban secondary school students on scientific temper was found while the significant mean difference between rural and urban students on their academic achievement was found. Urban students have higher academic achievement as compared to rural secondary school students.

**Andrabi (2015)** studied scientific temper emotional intelligence, socio economic status and academic achievement among tribal and nontribal adolescents of Kashmir. The objectives were to compare tribal and non-tribal students on the selected variables, viz. scientific temper, emotional intelligence, socio-economic status and academic achievement and to identify the significant predictors of academic achievement and their extent of predictability for the total sample, tribal and non-tribal sample, male and female samples, the tribal male sample, the

tribal female sample, the non-tribal male sample, the non-tribal female sample. The study adopted survey approach with the total sample of 664 students selected by stratified random sampling technique from government schools of Anantnag and Kupwara districts of Kashmir. Scientific Temper Scale developed by Prof. N.A Nadeem and Showkat Rashid Wani (2008) was used to collect the data. For the analysis mean, SD and t-test were used. He found that the adolescents' overall development is significantly influenced by their social and political status in the society and that non-tribal adolescents were much better in socio-economic status, possess more scientific temper, emotionally intelligent and had higher educational achievement than their respective tribal counterparts. Prediction results obtained by multiple regression analyses revealed socioeconomic status as the most potential predictor of academic achievement of both tribal and non-tribal adolescents but scientific temper was significantly predicting the academic achievement of non-tribal adolescents only, gender wise comparison also revealed socio-economic status as the significant predictor of academic achievement in female adolescents whereas academic achievement of male adolescents is predicted by socio-economic status and scientific temper both, the result of multiple regression analyses showed that the socio-economic status and scientific temper were the significant predictors of academic achievement of the adolescents of Jammu and Kashmir.

**Anand and Kumar (2015)** did a study on scientific temper among the B.Ed. trainees in Ramanathapuram district. The objectives were to measure the level of scientific temper among B.Ed. college trainees and to find out whether there is any significant difference in the scientific temper among trainees in terms age, sex, religion, educational qualification, course of study, residence, family type. The study was of survey type. 490 B.Ed. teachers were selected with the help of stratified sampling technique. Scientific temper inventory by Krishnan. K and Bhuvaneshwari. G (1989) was used to collect the data. Mean, SD and t-test were used to collect the data. The study revealed that scientific tempers of the B.Ed. trainees were found to be above the average level and there was no significance difference in scientific temper with respect to age, sex, religion (Hindu & Christian), Family type. Although significance difference was found between in scientific temper with respect of religion (Hindu and Muslim), educational qualification, course of study (science and arts), residence (hostellers and day scholars).

**Bhat (2017)** did a comparative study scientific temper and academic achievement of Gujjar and Non-Gujjar students. The objectives were to measure the scientific temper and academic achievement of Gujjar and Non-Gujjar students of Kashmir valley, to compare the scientific

temper and academic achievement of Gujjar and Non-Gujjar students of Kashmir valley and to find the correlation between scientific temper and academic achievement. The study was of survey type. 240 sample subjects (120 Gujjar and 120 Non-Gujjar) students were selected randomly. A scientific temper scale developed by Nadeem and Showkat was used to collect the data. For the analysis mean, SD and t-test were used. The study showed a significant mean difference between Gujjar and non-Gujjar students on scientific temper and on academic achievement. The study also found that there was a significant positive correlation between scientific temper and academic achievement.

**Ridwana (2017)** has conducted a study of personality characteristics, scientific temper, vocational preference and academic achievement of rural and urban secondary school students. The objectives of her study were to study the personality characteristics among rural and urban secondary school students, to study scientific temper among the rural and urban secondary school students, to study the vocational preferences of rural and urban secondary school students, to study the academic achievement of rural and urban secondary school students, to compare rural and urban secondary school students on personality characteristics, to compare rural and urban secondary school students on scientific temper, to compare rural and urban secondary school students on vocational preference and to compare rural and urban secondary school students on academic achievement. For this descriptive survey study was used. 300 secondary school students randomly were taken as a sample. A scientific temper scale developed by Nadeem and Showkat was used to collect the data. Percentage, mean, SD, t-test were used for the statistical analysis. The findings were that significant difference was found between rural and urban secondary school students on personality characteristics, among secondary school students (rural and urban), most of the students fell in above average and high category of scientific temper where most of the rural students have high and in urban most of the students had above average scientific temper; rural and urban secondary school students differed significantly on curiosity, open-mindedness, objectivity and rationality dimension of scientific temper. Rural secondary school students were better in all of these dimensions than urban secondary school students.

**Nautiyal (2017)** had done research on a study of the relationship of teacher education program with scientific temper and attitude towards creative teaching of prospective teachers in relation to some selected variables. The objectives were to find out whether entry level prospective teachers and exit level prospective teachers differ in their scientific temper, to find out whether

entry level prospective teachers and exit level prospective teachers differ in their scientific temper with respect to gender, subject wise groups (Arts and Science), caste category wise groups (General and Reserve). Single group experimental design was used in the study. 145 prospective teachers from a B.Ed. college of Dehradun under the jurisdiction of HNB Garhwal University were selected through saturated sampling technique. A scientific temper scale by Dr. Leela Pradhan was used as a tool to collect the data. Frequency distributions, numerical determinants of normality, like mean, median, mode, SD, standard errors of mean, median, skewness, kurtosis and t-test were used for data analysis. The finding revealed that the scientific temper of entry level prospective teacher was significantly differ with exit level prospective teacher, scientific temper of arts steam prospective teacher differed while science stream prospective teachers did not differ from entry level to exit level.

**Kapri (2017)** studied a study of scientific temper and scientific creativity of secondary school students. The objectives of the study were to compare scientific temper of senior secondary science students in terms of gender, to compare scientific creativity of senior secondary science students in terms of gender, to find correlation between scientific temper and scientific creativity of senior secondary science students. The study was carried out on a randomly selected sample of 60 students of science belonging to class 11th, selected from 2 senior secondary schools of Faridabad district of Haryana. Self-made tool of Scientific Temper was used to collect the data. Descriptive statistics, t- test and pearson's correlation were used to analyse and interpret the data and to test the hypotheses. The results revealed that there was significant correlation between scientific temper and scientific creativity of secondary school science students. There was no significant difference between mean score of scientific temper of boys and girls of senior secondary schools. The girls of senior secondary schools were found better in scientific creativity than the boys of these schools.

**Yadav (2018)** explored scientific temper as need of an hour. The objectives were to study the levels of scientific temper among students of standard VIII and to study the effect of gender on scientific temper of student studying in standard VIII. The study had adopted descriptive survey method. Sample of 200 students studying in municipal schools of Ahmedabad city were selected by random sampling technique. A self-made tool for measuring Scientific Temper was used to collect the data. Mean, SD, t-test methods were used for statistical analysis. The result revealed that a greater number of students had average scientific temper and scientific temper of boys and girls do differed significantly. Girls had high scientific temper than boys.

**Thakur and Bhan (2019)** studied scientific temper among secondary school students with respect to their gender. The main aim of this research was to investigate the scientific temper among secondary school students with respect to their gender. The research method was descriptive survey study. The sample included 100 secondary school students (standard 9<sup>th</sup>) of Shimla district selected by the random sampling technique. Singh's (1998) questionnaire was used to test the scientific temper of students and t-test was used to analyse the data. The findings of the study showed a significant difference on Scientific Temper with respect to Gender. The study revealed that Male Students had high scientific temper than female students.

**Jahanger and Dar (2019)** did scientific temper of rural and urban senior secondary school students. The objectives of the study were to study, the scientific temper of rural and urban secondary school students, to compare rural and urban secondary school students on scientific temper. The sample consisted of 300 (150 rural and 150 urban) senior secondary school students, selected randomly. The data was collected by using N.A. Nadeem and Showkat Rashid Wani's Scale of scientific temper. The investigator used various statistical techniques viz, mean, SD, t-test to analyze the data. The statistical data revealed that most of the students fell above average category and there was no significant mean difference between rural and urban student`s on open mindedness while significant difference found on Curiosity, objectivity, rationality and the aversion of the superstition dimension of scientific temper.

**Eswari and Manickavasagan (2019)** did a study of achievement of higher secondary students' In Physics in relation to scientific temper. The objectives were to find out the level of higher secondary students' achievement in Physics and scientific temper, to find out if there exist any significant differences between the sub-samples of the higher secondary students under various categories with respect to their achievement in Physics and scientific temper, to find out if there exist any significant relationship between achievement in Physics and scientific temper of higher secondary students. Sample of 600 higher secondary students were selected by using random sampling technique from various schools belonging to Puducherry Region. Survey method was employed for the study. A self-made scientific temper scale was used to collect the data. Descriptive, differential and correlation analysis were used for data analysis. Results showed that the level of achievement in Physics and scientific temper of the entire sample was average. Further there was significant difference found among the gender, locality and type of school with respect to their achievement in Physics expect type of family and there was no significant difference found among the gender, locality and type of school



with respect to their scientific temper of higher secondary students except the type of family. As per the achievement in Physics was concerned, the sample of gender, locality and type of school was significantly different. A positive relationship was also found between achievement in Physics and scientific temper of higher secondary students.

**Dar & Ghani (2019)** did a comparative study of social intelligence, scientific temper and the academic achievement of children of working and non-working mothers of Kashmir. The objectives were to explore the differences, if any, in Social Intelligence and its dimensions, scientific temper and its dimensions and academic achievement between children of working and non-working mothers of Kashmir, to examine the relationship of social intelligence and its dimensions, scientific temper and its dimensions with academic achievement among children of working mothers and non-working mothers of Kashmir. The sample for the study was 400 including 200 children of working mothers and 200 children of non-working mothers by using random sampling technique. N. K. Chadha and Usha Ganesan social intelligence Scale (1986) and N.A Nadeem's and Showket Rashid's scientific temper scale were administered for the collection of data. Mean, SD, t-test and coefficient of correlation methods were used for data analysis. The result of the study highlighted that there existed no significant difference between children of working and non-working mothers of Kashmir on social intelligence and scientific temper. On the other hand, it had been found that children of non-working mothers were having similar academic achievement; a significant and positive correlation was found between the academic achievement and curiosity, open-mindedness, objectivity, rationality, and aversion of superstitions and overall scientific temper of children of working and non-working mothers of Kashmir.

**Sharma (2020)** studied science and scientific temper. The purpose of the study was to understand science teachers, as well as teacher educators' understanding of science (nature, methods, and values of science) and scientific temper. The study was of qualitative type. The sample consisted of eight school science teachers and two teacher educators. The study revealed that science is failing in developing scientific temper because we are more oriented towards content knowledge, teachers could not explain how doing science helps in inculcating scientific temper, science teachers hold some alternate ideas and misconceptions about science and scientific temper and have not rationalized the aim of science education and the science teachers in the study tried to prove their belief as scientific — they tried to make some connections of their belief with the scientific knowledge they hold, even when science

education is focused mostly on content knowledge.

**Priya (2020)** studied enhancing scientific temper through creative dramatization. The objective of the study were to study the effectiveness of creative drama on scientific temper among upper primary school students, to compare the effectiveness of creative drama method and prevailing activity oriented method of instruction on scientific temper of upper primary school students based on the post test scores, to compare the effectiveness of creative drama method on scientific temper with regards to the different aspects such as scientific literacy, rational thinking, spirit of enquiry and cause effect relationship. Experimental method with pretest posttest non-equivalent group design was chosen for the study. Total group of 80 students of 7<sup>th</sup> standard was selected for the study. Mean, SD, ANCOVA and t-test methods were used for the data analysis. The results of the research study showed that creative drama method was found to be effective in enhancing scientific temper among upper primary school students, creative drama method was found to be superior in enhancing different aspects of scientific temper such as scientific literacy, rational thinking, spirit of enquiry and cause and effect of relationship.

**Nisa (2020)** had done a comparative study on emotional intelligence, scientific temper, social awareness and skill employability awareness of undergraduate Students in three regions of Kashmir division. The objectives of the study were to study and compare the emotional intelligence, scientific temper, social awareness, skill employability awareness of undergraduate students with reference to gender & locale and to compare the undergraduate students of North, Central and South districts of Kashmir division on their emotional intelligence, scientific temper, social awareness, skill employability awareness. Survey method was adopted for this study. A total of 720 undergraduate students were selected through stratified random sampling method. Scientific Temper Scale of Nadeem and Rashid (2007) was used to collect the data. Methods such as percentage, mean, SD, t-test and ANOVA were used to analyse the data. The study revealed that Majority of the undergraduate students of Kashmir division possessed moderate level scientific temper; Female undergraduate students were having more scientific temper as compared to male undergraduate students of Kashmir division; Urban undergraduate students were having more scientific temper as compared to rural undergraduate students and undergraduate students of south districts possessed more scientific temper followed by North & Central undergraduate students of Kashmir division.

**Gopalkrishnan & Galande (2021)** explored study titled scientific temper and nehruvian influence: how the millennials are handling the mythologization of science in India. The objectives of the study were to understand the level of scientific temper among the millennials (Gen Z); to find the difference between students with science and non-science background in school with respect to scientific temper and to study the contextual understanding toward scientific temper and the consumption of peer oriented social media and instant messenger apps. The study has adopted mixed method. For this purpose, 135 students of age group of 18–22 years were selected as sample through simple random probability sampling technique. Chi square method was used to analyse the data. This result showed that scientific temper was found to be independent of education background (science and non-science), social media consumption, news consumption on social media and messenger app consumption. The test showed that the young millennials from the sample had high scientific temper irrespective of their education (science and non-science), consumption of news, social media or instant messenger apps.

**Kaur and Vadhera (2021)** had predicted students' achievement in science from selected affective factors. The objective of the study was to find out the variance on students' achievement in science at secondary level accounted for selected affective factors of scientific temper, science motivation, science anxiety and emotional stability of secondary students and to predict the students' future achievement in science. Data were collected from 1134 students of class X using stratified random sampling using strata of school types, with 532 boys and 602 girls from 34 schools of Aizawl district of Mizoram, a north-eastern state of India. Scientific Temper Scale by Showkat and Nadeem (2008) was used. The technique of partial and multiple correlations had been used to analyse the data. The result revealed that 11.4% of the variance in the predicted dependent variable (Science Achievement) is significantly determined by the independent variable Scientific Temper (ST) while for the overall it stands for 18 %. It suggested that although this variance was low but indeed had a significant impact on student's achievement in science subject.

**Biswal and Pandey (2021)** had studied Scientific Temper among secondary school students. The objectives of the study was to study the levels of scientific temper among secondary school students and to study the scientific temper of secondary school students with respect to their gender. Descriptive survey method was adopted for this purpose. 272 IX standard students were taken as the sample by using convenient sampling method. A self-made scientific temper

scale was used as a tool. Mean, SD and Mann Whitney U test were used for statistical analysis of data. The findings of the study revealed that an above average level of scientific temper was found among secondary school students and no significant differences were observed between the mean scores of secondary school boys and girls in scientific temper.

### **2.2.0. STUDIES CONDUCTED ON SCIENTIFIC THINKING**

**Pritchard (2005)** studied everyday and scientific thinking: How children adjust to contexts. The research was of qualitative type in which children aged 7 to 8, 10 to 12 and adults were asked to generate and evaluate explanations for a variety of phenomena in social and biological/physical domains—that lend themselves to both informal and formal explanations. 90 people participated in the interview, 30 from each of three age groups. In each age group, one-half of people were randomly assigned to either the everyday condition or the scientific condition. Results suggested that adults, and to a lesser extent, children do subscribe to different reasoning norms for the two contexts and that they alter their explanations to fit both context and domain. Biological/physical topics were found to support more aspects of scientific thinking than did social, which children seemed to discount as a science topic. Finally, the results suggested that people engage in scientific reasoning only when cued. Thus, unless people were provided information about how they should think, researchers cannot be certain the kind of thinking their tasks elicited.

**Thitima & Sumalee (2012)** studied scientific thinking of the learners learning with the knowledge construction model enhancing scientific thinking. This study aimed to examine scientific thinking of the learners who were learning with the knowledge construction model enhancing scientific thinking. The research design was the developmental research type II (Richey and Klein, 2007) which emphasized on the study of the process of design and model development. The target group consisted of 50 students who were studying in grade sixth during the second semester at demonstration school of Khon Kaen University Mordindeang Thailand studied using knowledge construction model for enhancing scientific thinking, developed by the researcher. The model had 11 elements which were: 1) Problem Base, 2) Resources, 3) Collaboration, 4) Coaching, 5) Scaffolding, 6) Science Clinic, 7) Cognitive Tools, 8) Thai Local Wisdom Room, 9) Scientific Thinking Room, 10) Science Laboratory, and 11) Scientific Thinking Practice Room. Qualitative approach like analytic description, interpretation and summarization was applied to analyzed the data. The scientific thinking interview form was used as an instrument for collecting data which was unstructured

interviews form. The result revealed that the learners' scientific thinking was found 4 aspects of abilities: inquiry, analysis, inference, and argument and that the scientific thinking is caused by instructional design.

**Foss (2014)** did a study of visual, critical, and scientific thinking dispositions in a 3<sup>rd</sup> grade science classroom. Research questions examined the disposition to think critically through the arts in science and focused on the perceptions and experiences of 25 students with the Visual Thinking Strategy (VTS) process. This was a qualitative case study. Data were collected from classroom observations ( $n = 10$ ), student interviews ( $n = 25$ ), teacher interviews ( $n = 1$ ), a focus group discussion ( $n = 3$ ), and artifacts of student work ( $n = 25$ ); these data included perceptions of VTS, school culture, and classroom characteristics. An inductive analysis of qualitative data resulted in several emergent themes regarding disposition development and students generating questions while increasing affective motivation. The most prevalent dispositions were open-mindedness, the truth-seeking disposition, the analytical disposition, and the systematicity disposition. The findings about the teachers indicated that VTS questions in science supported gradual release of responsibility, the internalization of process skills and vocabulary, and argumentation. It also offered descriptive research that links visual arts inquiry and the development of critical thinking dispositions in science at the elementary level. A science curriculum could be developed, that emphasizes the development of thinking dispositions through the arts in science, which in turn, could impact the professional development of teachers and learning outcomes for students.

**Causey (2016)** explored scientific reasoning in preschool children. The purpose of this qualitative study was to explore four- and five-year-old's scientific thinking as they participate in physical knowledge activities called design challenges in an urban summer enrichment program in the Southeastern United States. The researcher collected data using informal observations/field notes, photographs, and video to assess 17 preschoolers. Findings revealed that children are capable of thinking scientifically as early as ages 4 and 5. Additionally, the preschool students' scientific thinking was conceptualized within four levels (Thinking, reasoning, analyzing, and communicating) of development. As a result, the four-phase model of theory building in preschool children was generated. It recommends specific curriculum selection and teacher responses in support of the four phase model of theory building.

**Dey (2017)** did a Study on effectiveness of Inquiry Training Model (ITM) in teaching life science on the criteria of creative inquiry, scientific thinking and scholastic achievement. The

objectives were to orient the students-teachers with ITM based teaching in life science and to find out their theoretical knowledge, attitude towards the ITM and Willingness to implement the model of teaching, to study the impact of ITM of teaching among the gender, locality, medium of instruction and boards of education of the secondary students on the criterion of creative inquiry, scientific thinking and scholastic achievement, to study the relationship between the readiness of student-teachers and impact of their classroom teaching through ITM on creative inquiry, scientific thinking and scholastic achievement. The study was of quasi experimental type. 200 student-teachers and 600 class IX students of West Bengal were selected by random sampling technique. Three measuring tools theory checkup for the student-teachers regarding understanding of ITM, attitude scale and willingness scale for the student-teachers towards ITM were adapted for the student-teachers and three tools used for the students are creative inquiry scale for students, style of learning and thinking scale for students and scholastic achievement test for students. The result revealed that the impact of orientation towards the development of attitude towards the ITM was found better for the male student teachers, the impact of orientation towards the development of willingness to implement the ITM and theoretical knowledge of the ITM was found equal between the male and female student-teachers. No difference was found on the impact of teaching through ITM on the criterion of developing creative inquiry and scholastic achievement with respect to gender and medium of instruction while difference was found in terms of locality and board of education, No difference was found on the impact of teaching through ITM on the criterion of developing thinking style with respect to gender, medium of instruction, locality and board of education.

**Singh (2019)** did a study of scientific thinking of secondary school students. The objectives were to study the levels of scientific thinking of secondary school students, in terms of percentage, to study the scientific thinking of government and private secondary school students, to study the scientific thinking of boys and girls of secondary schools, to study the scientific thinking of rural and urban secondary school students. The sample of the study consisted of 640 class X students of 12 high schools of Hardoi District (U.P.) by employing random sampling method. The scientific thinking, style questionnaire (S.T.S.Q.) has been constructed and standardized by Dr. P.N. Singh and Dr. Ranjana Arora in English version was translated by the investigator in Hindi of the students in school. Finding reveals that 18%, 54% and 28% secondary school students belong to high, average and low levels of scientific thinking respectively, the scientific thinking of private and government students and boys and girls are similar, the scientific thinking of urban students is higher than the rural students.

**Hyytinen, Toom & Shavelson (2019)** studied enhancing scientific thinking through the development of critical thinking in higher education. The aim of this study was to understand the characteristics of critical thinking based on current research, and what it means for teaching students to think critically in the higher education from the viewpoint of scientific thinking, to outline the role of curriculum and assessment in developing and implementing critical thinking in classrooms and academic programmes, to suggest future teaching research and practice in higher education. The study concluded that critical thinking makes possible the assessment, evaluation, synthesis and interpretation of relevant scientific theories and empirical knowledge. Critical and scientific thinking is the most important skill for the 21<sup>st</sup> century which needs to be integrated into throughout the curriculum. For this teachers need to have a clear understanding of what critical thinking is and why it important to teach and finally the need to understand similarities and variations in the pedagogical competences to teach critical and scientific thinking among academics in different disciplines and support teachers in developing these competencies.

### **2.3.0. STUDIES CONDUCTED ON SCIENTIFIC HABIT OF MIND**

**Coll and Taylor (2004)** explored probing scientists' beliefs: how open-minded are modern scientists? The research question was just how open-minded are modern scientists? The Exeter questionnaire used by Preece and Baxter (2000) to examine superstitious beliefs of high school students and preservice science teachers was used as a basis for a series of in-depth interviews of scientists across a variety of disciplines. The interviews sought to understand the basis on which scientists form beliefs and how they judge evidence for various propositions, including those from the Exeter questionnaire and other contentious beliefs introduced during discourse. The scientists are dismissive of traditional superstitions like bad luck associated with black cats and inauspicious numbers such as 13, seeing such beliefs as socially grounded. There is a strong socio-cultural aspect to other beliefs and personal experiences, and strongly held personal beliefs are influential, resulting in the scientists keeping an open mind about contentious beliefs like alien life and the existence of ghosts. Testimony of others including media reports are deemed unreliable unless provided by credible witnesses such as 'educated people' or 'experts', or if they coincide with the scientists' personal beliefs. These scientists see a need for potential theoretical explanations for beliefs and are generally dismissive of empirical evidence without underlying explanations our male participants much more sceptical than their female counterparts, with the exception of the proposition that aliens have visited Earth in the past – with more males than females believing this latter proposition. The two

most widely held beliefs found here in both the questionnaire responses and other discourse during the interviews were that some houses are haunted by ghosts and that aliens have visited Earth in the past.

**Coll, Taylor & Lay (2009)** did a study on scientists' habits of mind as evidenced by the interaction between their science training and religious beliefs. The study explores the ideas consisted of an inquiry into how scientists rationalise conflicts between scientific theories and religious beliefs which are not in agreement with consensually-accepted scientific theories. 20 scientists from different scientific disciplines and levels of seniority were interviewed using as a basis an instrument containing a series of religious-based item statements that a panel of scientific and religious experts considered were in agreement with a variety of religious doctrines yet in disagreement with current scientific thinking, or for which there is at present no supporting evidence from a variety of scientific disciplines. These statements acted as an interview protocol and formed the basis for interactive discourse, which was audio- taped, transcribed verbatim and participant-validated. These data provide a window into scientific thinking as practiced by modern scientists, and helps develop a picture of these scientists' 'habits of mind'. The findings suggested that these scientists, unlike their stereotype, held idiosyncratic views of what constitutes good scientific evidence and sound, credible testimony.

**Çalik & Coll (2012)** investigated socio scientific issues via scientific habits of mind: development and validation of the scientific habits of mind survey. In this paper they described the Scientific Habits of Mind Survey (SHOMS) developed to explore public, science teachers', and scientists' understanding of Habits of Mind (HoM). The instrument contained 59 items, and captures the seven SHOM identified by Gauld. The SHOM was validated by administration to two cohorts of pre-service science teachers: primary science teachers with little science background or interest ( $n=145$ ), and secondary school science teachers (who also were science graduates) with stronger science knowledge ( $n=145$ ). Face validity was confirmed by the use of a panel of experts and a pilot study employing participants similar in demographics to the intended sample. To confirm convergent and discriminant validity, confirmatory factor analysis and evaluation of the reliability were calculated. Statistical data and other data gathered from interviews suggested that the SHOMS proved to be a useful tool for educators and researchers who wish to investigate HoM for a variety of participants.

**Çalik, Turan and Coll (2013)** had studied a cross-age study of elementary student teachers' scientific habits of mind concerning socio scientific issues. The two research questions were:



Are there differences in student teachers' SHOMs based on their grade? and Are there differences in student teachers' SHOM based on their programme of study? The study was of survey type and the sample consisted of 1,600 Turkish student teachers from science education, mathematics education, primary teacher education and social science education programmes. The findings suggested that the teacher education programmes needed to help student teachers grasp better scientific thinking as measured via scientific habits of mind if they were to engage more effectively in decision-making and discussion of socio scientific issues in their classrooms.

#### **2.4.0. STUDEIS CONDUCTED ON SCIENTIFIC ATTITUDE**

**Patel (1997)** studied scientific attitude and its correlates among secondary school students of Baroda with the objectives to measure the scientific attitude of secondary school students of Baroda, to study the nature of distribution of scientific attitude scores of secondary school students of Baroda, to study the relationship of scientific attitude score with socio-economic status, achievement in Science, general achievement of students and to compare the scientific attitude of students with respect to gender and locality. Descriptive survey method was adopted for the study. For this he had taken 596 students of class X as a sample through cluster sampling technique. A self-made scientific temper scale was used as a tool to collect the data. Mean, SD, Percentiles, Skewness, Kurtosis, correlation and ANOVA methods were used to analyse the data. Finding showed that the scientific attitude of secondary school students of Baroda was average, there existed a significantly positive correlation of scientific attitude with SES, achievement in Science and general achievement of the student, boys and girls significantly differed with respect to their scientific attitude and the mean scientific attitude of girls was more than that of boys and the urban and the rural students significantly differed with respect to their scientific attitude and the mean scientific attitude of urban students was more than that of rural students.

**Ahmed (2007)** saw the effect of scientific aptitude and scientific attitude on academic achievement of secondary school students in Science. The objectives were to study the effect of scientific aptitude on academic achievement in science among the IX standard students; to study the effect of scientific attitude on academic achievement in science among the IX standard students; to study the relationship between scientific aptitude and scientific attitude on academic achievement in science among the IX standard students; to predict the influence of scientific aptitude and scientific attitude on academic achievement in science and to study

the direct and indirect of independent variables (scientific aptitude and scientific attitude) on dependent variable that is academic achievement in science. Descriptive survey method was used. Total 1000 students from Bangalore city (North and South zone) were taken by using stratified random sampling method. A self-made scientific temper scale was used as a tool to collect the data. Descriptive statistics, differential Statistics, regression and path analysis were used to analyse the data. The result revealed that the secondary school students of unaided schools had higher scientific attitude when compared to the students of aided and government schools; Kannada medium students were higher in their scientific aptitude and academic achievement when compared to English medium secondary schools students; girls of secondary schools had higher academic achievement, scientific aptitude and aptitude when compared to boys; the increase in scientific attitude increases the academic achievement in Science of secondary school students; scientific aptitude (X1) contributed better than the scientific attitude (X2) on academic achievement of secondary school students in Science and the direct effect of scientific aptitude (X1) and scientific attitude (X2) on academic achievement in Science of secondary school students was found to be significant.

**Pyari (2009)** did critical appraisal and correlates of scientific attitude and scientific aptitude of secondary school students. The objectives were to appraise the extent of scientific attitude and scientific aptitude of secondary school students of C.B.S.E., I.C.S.E. and U.P. Board of Examination; to compare the scientific attitude and scientific aptitude with reference to biographical and psycho-social variables of secondary school students; to determine the relationship between the scientific attitude and biographical, psycho-social variables of secondary school students; to determine the relationship between the scientific aptitude and biographical, psycho-social variables of secondary school students; to develop a regression equation for the scientific attitude on the independent variables identified by the researcher and to develop a regression equation for the scientific aptitude on the independent variables identified by the researcher. Ex-Post-Facto method of research was used. 1500 secondary school students studying in Agra were taken through random sampling method. Scientific attitude scale constructed by Dr. S. C. Gakhar and Dr. Amandeep Kaur (2004) was used to collect the data. Central Tendency, deviation, graphical representation and zero order correlation were used for data analysis. The result revealed that most students possessed average level of scientific attitude; No significance difference was found in scientific attitude with respect to mother education, science interest, science achievement, academic achievement, delay of gratification, task persistence, academic achievement motivation,

methodology of science teaching, study habits, SES, home environment while significance difference was found with respect to sex, different board of examination, caste, father education, cognitive style, scientific creativity, school environment; there exist relationship among psycho-socio biographical variables and scientific attitude and scientific aptitude of secondary school students; The predictor variables, which significantly determining the scientific attitude of secondary schools students, were methodology of science teaching, science interest, home environment, science achievement, scientific creativity, academic achievement, mother education, socio-economic status, delay of gratification and study habit, while the contribution of the predictor variables i.e. father education, academic achievement motivation, board, caste, sex, school environment, task persistence and cognitive style were not found statistically significant.

**Yadav (2011)** had conducted a study on relationship between environmental awareness and scientific attitude of high school students. The objectives were to study the factors affecting the environmental awareness of high school students, to study the factors affecting the scientific attitude of high school students, to study the relationship between environmental awareness and scientific attitude of high school students. A survey method was adopted by researcher. A sample of 300 high school students (boys and girls) were selected randomly from four intermediate colleges of district Ghazipur, affiliated to U.P. Board, Allahabad. Science Attitude Scale (SAS) developed by Grewal, A. (Mrs.) (1990) was used to collect the data. Mean, SD, t-test and correlation methods were used to analyse the data. Finding revealed that there was no relationship between environmental awareness and scientific attitude of high school girls students, there was no significant difference in scientific attitude with respect to religion, type of school, parents education and parents income while significant difference was found in scientific attitude with respect to sex, Residence (Rural/Urban).

**Price & Lee (2013)** studied changes in participants' scientific attitudes and epistemological beliefs during an astronomical citizen science project. In the study they investigated how volunteers' attitudes towards science and epistemological beliefs about the nature of science changed after six months of participation in an astronomy-themed citizen science project and how the level of project participation related to these changes. Two main instruments were used to measure participants' scientific attitude and epistemological beliefs and were administered before they registered for the program and six months after their registration. For analysis, they used pre- and post-test data collected from 333 participants who responded to

both tests. Among them, nine participants were randomly chosen for interviews. Participants' responses were analyzed using the Rasch Rating Scale Model. A self-made tool was used to collect the data. ANOVA method was used to analyse the data. Results showed that overall scientific attitudes changed positively. The change was strongest in attitudes towards science news and citizen science projects. The scientific attitudinal change was related to participant social activity in the project. There was a negative change in their evaluation of their knowledge. The interviews suggested that this is due to a greater appreciation for what they have yet to learn. Epistemological beliefs about the nature of science significantly improved from the pre- to the post-tests. Overall, it was found volunteers' participation in social components of the program was significantly related to their improvement in scientific literacy while other project participation variables (such as amount of data contributed to the project) were not.

**Choukade (2014)** discovered development of scientific attitude improvement programme for adolescents and its effectiveness with the objectives to assess scientific attitude of adolescents and to compare scientific attitude between urban and rural students, to analyze components of scientific attitude which need to be improved, to develop programme for improvement of scientific attitude among adolescents through identified components, to study the effectiveness of developed programme for improving scientific attitude, to find out the retention of the developed programme. A survey method was adopted for the study. For this researcher had taken 1377 students of Ahmednagar as a sample by using random sampling method. Scientific attitude scale constructed by Dr. S. C. Gakhar and Dr. Amandeep Kaur (2004) was used to collect the data. Mean, SD and t-test methods were used to analyse the data. The study concluded that there was significance difference in scientific attitude between rural and urban students, the developed programmes were found to be effective, scientific attitude improvement programme helped to retain the scientific attitude, scientific attitude improvement programme was useful in daily life and enhanced their critical and logical thinking.

**Govindrajan (2014)** did a study of scientific attitude among secondary school students in Namakkal district. The objectives were to find out the level of secondary school students to their scientific attitude; to find out the difference, if any, between boys and girls secondary schools students in respect of their scientific attitude; to find out the difference, if any, between government and private secondary schools students in respect of their scientific attitude; to

find out the difference, if any, between urban and rural secondary schools students in respect of their scientific attitude; to find out the difference, if any, between Tamil medium and English medium secondary schools students in respect of their scientific attitude. Normative Survey method was used. 300 secondary school students were selected using random sampling method. The investigator used a tool named Scale of Attitude towards Science Learning (SATSL) constructed and standardized. Mean, SD and t-test were used for data analysis. The result showed that there was no significant difference between male and female & Tamil and English medium school students in respect of their scientific attitude while there is significant difference between government and private & rural and urban school students.

**Sreekumar (2015)** checked the effectiveness of Concept Attainment Model of teaching on development of scientific attitude and retention capacity in Biology among secondary school students of Kerala. The objectives were to find out the difference in mean pre-test and post test scores of scientific attitude among secondary school students in experimental group and control group; to find out the difference in mean pre-test and post-test scores of scientific attitude among secondary school students in experimental group; to find out the difference in mean gain scores of scientific attitude among secondary school students in experimental group and control group; to find out the difference in mean pre-test and post test scores of retention capacity using standardized achievement test in Biology among secondary school students in experimental group and control group; to find out the difference in mean gain scores of retention capacity using standardized achievement test in Biology among secondary school students in experimental group and control group, to find out the effectiveness of Concept Attainment Model on retention capacity in Biology among secondary school students in experimental group and to find out the effectiveness of Concept Attainment Model on retention capacity in Biology among secondary school students in experimental group. Pre-test post-test non-Equivalent group design of quasi experimental method was selected for the study. Purposive sampling technique was used for taking sample of 80 students. A self-made tool was used to collect the data. The data collected were analyzed using appropriate descriptive and inferential statistical techniques like computation of percentages, means, critical ratios, Analysis of Variance and Analysis of Co- Variance. The study found that Concept Attainment Model was more effective than the existing method on scientific attitude as well as for the retention capacity in Biology.

**Chakraborty (2015)** did a study on scientific attitude of secondary school students of

Dibrugarh district of Assam. The objectives were to develop a scientific attitude scale for measuring the scientific attitude of secondary school students; to find out the level of scientific attitude, academic achievement and socio economic status of students studying in secondary schools of Dibrugarh district; to compare the scientific attitude, socio economic status and academic achievement of students studying in secondary schools of Dibrugarh district with respect of gender, locality, caste, medium of instruction and to find out the relationship between scientific attitude and parents' education, income, Socio-Economic Status, academic achievement of students studying in secondary schools. Normative Survey Method had been followed in the study. Total 609 students through purposive sampling technique were selected as the sample of the present study. A self-constructed scientific attitude scale was used to collect the data. Mean, SD, skewness, kurtosis, t-test, Analysis of Variance (ANOVA), Chi square and contingency and product moment coefficient of correlation were used to analyse the data. The result revealed that most of the students had low level of scientific attitude, significance difference in scientific attitude was found with respect to locality, caste and medium of instruction while no significance difference was found with respect to gender. Significant relationship was found between scientific attitude of students studying in secondary schools and educational level of their fathers and mothers, income, academic achievement and socio-economic status.

**Bagavathy (2015)** did a study on achievement in science with reference to scientific attitude, locus of control and problem-solving skill among high school students. The objectives were to find out level of scientific attitude, locus of control and problem-solving skills among high school students, to find out the scientific attitude among high school students in terms of gender, type of School, kind of School, medium of instruction, conveyance, father's occupation, mother's occupation, father's educational status, mother's educational status, parental monthly income, residence, type of study, type of facility available for study at home. The study was of survey type. 1200 class IX standard students studying in schools where samacheer kalvi prescribed by Tamil Nadu is taken for the study through stratified sampling technique. Science Attitude Scale (SAS) developed by Grewal, A. (Mrs.) (1990) was used to collect the data. Mean, SD, t-test, ANOVA and correlation methods were used to analyse the data. The finding revealed that majority of high school students (52%) were having scientific attitude at average level, no significant difference was found in the scientific attitude among high school students in terms of gender, type of school, kind of school, medium of instruction, conveyance, father's occupation, mother's occupation, father's educational status, mother's

educational status, parental monthly income, residence, type of study, type of facility available for study at home.

**Panneerselvam & Muthamizhselvan (2015)** studied the secondary school students in relation to scientific attitude and achievement in science with the objectives to study the differences in achievement in Science of boys and girls of IX standard, to study the differences in achievement in Science of boys and girls of IX standard students studying in different types of schools, to study the achievement in Science of IX standard students in relation to their different levels of scientific attitude. A survey method was adopted for the study. For this purpose, they had taken 600 IX<sup>th</sup> standard secondary school students of Vriddhachalam, Cuddalore district as a sample by using stratified random sampling techniques. Science Attitude Scale (SAS) developed by Grewal, A. (Mrs.) (1990) was used to collect the data. Mean, SD, t-test, ANOVA and correlation methods were used to analyse the data. The result revealed that the girls of IX standards had better achievement in Science than boys of IX standard, the students of IX standard studying in private schools had better achievement in Science than the students studying in government schools and scientific attitude had main effect on achievement in Science among students of IX standard. The student belonging to high group of scientific attitude performed better in Science than the students belonging to moderate and low group of scientific attitude.

**Shetty (2016)** checked the effectiveness of self-directed learning programme in developing secondary school students' self-directed learning, science process skills and scientific attitude. The objectives were to develop a self-directed learning programme based on Grow's staged self-directed learning model for teaching science to secondary school students; to study the effectiveness of self-directed learning programme based on Grow's staged self-directed learning model in developing self-directed learning in science among secondary school students; to study the effectiveness of self-directed learning programme based on Grow's staged self-directed learning model in developing science process skills, scientific attitude and academic achievement among secondary school students. Pretest and posttest non- equivalent group design was used for the study. Total 52 students, 30 in the experimental group and 22 students were taken through purposive sampling method. A self-made scientific attitude inventory was used to collect the data. The data were analysed using descriptive analysis (mean, SD, bar graph, pie chart) and inferential analysis (t-test, ANCOVA (Two-way), Wolf's formula). The result revealed that Grow's self-directed learning model (Self-Directed Learning

Programme) approach was found effective in developing academic achievement but not effective for developing self-directed learning, science process skills and scientific attitude on the whole. Also, it was found effective in developing open-mindedness and curiosity, the dimensions of scientific attitude. The treatment had maximum effect on academic achievement as well as on open-mindedness and curiosity, the dimensions of scientific attitude.

**Julius (2016)** did a study on relationship between family bonding and scientific attitude among high school students moderate level of scientific attitude. The objectives were to study the level of family bonding, scientific attitude and academic score among high school students, to study whether the students belonging to different groups based on personal variables viz. gender, order of birth, religion, standard of study, locale, and districts; family related variables viz: family type, number of brothers, number of sisters, number of aunts, number of uncles, number of grandparents they have as co-habitats, father's educational qualification, mother's educational qualification, father's occupation, mother's occupation, father's income and mothers income; school related variables viz. school type (boys, girls, co-education), type of management (government, government aided and private un-aided), medium of instruction (Tamil and English) and board of affiliation (State Board and CBSE) differ significantly in their: family bonding and its factors, scientific attitude and its factors, academic scores in Mathematics and Science. The study was of survey type. Total 1149 sample was collected through random sampling through technique. A self-made Science Attitude Scale (SAS) was used to collect the data. Mean, SD and t-test methods were used to analyse the data. The findings showed that 68% of students had moderate level of scientific attitude in which curiosity had the highest while rationality had the lowest percentage of mean score, scientific attitude of girls found higher than boys, Christian had low scientific attitude than Hindu religion, scientific attitude of student belong to nuclear family was found higher than joint family, Urban students had higher scientific attitude than rural students. Education of parents, type of school, presence of grandparents, medium of instruction and type of school board had a significant effect on scientific attitude of a student.

**Meenakshi and Vasimalairaja (2016)** found a scientific attitude among secondary school students. The objectives of the study were to find out the level of scientific attitude of secondary school students and to study the significant difference in scientific attitude of secondary school students based on gender and type of school. The investigator has adopted survey method for the study. A sample of 300 belongs to 8<sup>th</sup>, 9<sup>th</sup> and 10<sup>th</sup> standard students



were selected by using simple random technique in Virudhunagar district. A self-made Scientific Attitude Inventory (SAI) was used as a tool to collect the data. Mean, SD, t-test methods were used to analyse the data. The results of the study revealed that secondary school students had high level of scientific attitude and there was no significant difference in mean scores of scientific attitude with respect to gender and type of schools.

**Ahuja (2017)** conducted a study of scientific attitude in relation to science achievement scores among secondary school students with the objectives to study gender differences among boys and girls at secondary school level with respect to scientific attitude and science achievement scores, to find out the correlation between the scientific attitude and science achievement among secondary school students and to study science achievement scores in relation to the different levels of scientific attitude of boys and girls at secondary school level. Descriptive survey design was adopted for the study. A total of 208 students of secondary school students in Delhi were selected as a sample by using random sampling method. Scientific attitude scale (2009) by Sukhwant Bajwa & Monica Mahajan was used as a tool to collect the data. Mean, SD, t-test, ANOVA and correlation methods were used to analyse the data. The finding revealed that there was gender difference, in the favour of girl students, with respect to scientific attitude and science achievement scores. A significantly positive correlation between scientific attitude and science achievement scores of students was found. Interaction effects also supported these findings.

**Revati and Meera (2017)** did an investigation of scientific attitude among secondary school students in Kottayam district of Kerala. The objectives of the study were to study the scientific attitude of secondary school students and to study the scientific attitudes among secondary school students based on gender, locality and type of management of school. Normative survey method was adopted for the study. The sample consisted of 180 secondary school students selected by random sampling method of Kottayam district. Scientific Attitude Scale developed by Dr. Shailaja Bhagwath (2003) was used to collect the data. Descriptive statistical such as mean, median, SD, chi square and t-test methods were used for the analysis of data. The study revealed that most of the students had average level of scientific attitude and students were identically distributed among each group based on Scientific Attitude and there was no significant difference in the scientific attitude of secondary school students based on gender, locality and type of management.

**Singh and Bai (2017)** did a study of scientific attitude of secondary school students in West Tripura district. The objectives of the study were to find out the level of scientific attitude possessed by the secondary school students and to find out the influence of following variables on scientific attitude of secondary school students with respect to gender, type of school, residence and medium of instruction. For this purpose, Descriptive survey method of research was used. A sample of 110 secondary school students were selected randomly from seven schools located in West Tripura district. Scientific Attitude Scale developed by J.K. Sood and R. P. Sandhya was used to collect the data. Mean, SD and t-test were used to analyse the data. The findings showed that secondary schools had an average level of scientific attitude, no significant difference was found between with respect to gender but the variables- residence, medium of instruction and type of school had significant difference in the level of scientific attitude. The students of urban secondary schools and English medium schools had slightly high scientific attitude than those of rural secondary schools and Bengali medium schools.

**Kundu (2018)** did a Critical Study of scientific attitude among the students of secondary schools. The main objective of this study was to study the level of scientific attitude possessed by the secondary school pupils and to study the level of scientific attitude of secondary school pupils with respect to gender, locality and school type. Descriptive survey design was adopted for the study. A total of 400 students were selected as a sample by using stratified sampling technique. Scientific Attitude Scale developed by J. K. Sood and R. P. Sandhya was used to collect the data. Mean, SD, t- test were used to analyse the data. Results showed that scientific attitude in secondary school pupils was average and there existed no significant difference in the attitude level between the schools regarding their gender but significant difference existed with respect to locality and type of school. Urban students had high level of scientific attitude than rural students and Private school students were better than government and government sponsored school students in their scientific attitude.

**Rasani (2017)** studied scientific literacy and scientific attitude among students at the higher secondary level. The objectives were to explore scientific literacy and scientific attitude among the girl students at higher secondary school level; to determine the difference in scientific literacy, scientific attitude, scientific aptitude, fluency, flexibility, originality and overall scientific creativity between Science and Non-Science girl students of higher secondary school; to analyse the difference in scientific literacy, scientific attitude, scientific aptitude, fluency, flexibility, originality and overall creativity between Trichy and Pudukkottai District

girls students of higher secondary schools; to analyse the difference in scientific literacy, scientific attitude, scientific aptitude, fluency, flexibility, originality and overall creativity between girl students of co-education higher secondary school and girls higher secondary schools; to analyse the difference in scientific literacy, scientific attitude, scientific aptitude, fluency, flexibility, originality and overall creativity among girls students of government higher secondary school, aided higher secondary school and private higher secondary school. The investigator adopted descriptive correlational research design. 540 girl's students from two districts namely Trichy and Pudukkottai were taken by using random sampling method. Pearson product moment correlation, differential, regression analysis and critical ratio and F-test were used to analyse the data. The findings revealed that there existed significant relationship among the dependent and independent variables taken for the study. Regression analysis reveals that scientific aptitude as contributing factor to dependent variables explicitly scientific literacy and scientific attitude. It was also explored through differential analysis that there was significant difference and students of science group from private coeducation school of Trichy district was found to be better.

**Erdogan (2017)** attempted a study is to determine science teaching attitudes and scientific attitudes of pre-service teachers of gifted students due to gender and grade level and also correlation among these variables. It was a survey study that the group is 82 students attending gifted education undergraduate level. Data was gathered by Scientific Attitude Inventory developed by Moore and Foy (1997), SAI II and Science Teaching Attitude Scale. Then data was analyzed by independent samples t-test, ANOVA, correlation and regression statistical methods. The result revealed that there was a significant difference due to grade level and there was a high correlation between scientific attitudes and science teaching attitudes.

**Thory (2018)** did a comparative Study of upper secondary level students of the faculty of science and arts in respect intelligence, scientific attitude and academic accomplishment. The objectives were to compare the scientific attitude of students of science and arts faculty of higher secondary level; to compare the scientific attitude of students of science and arts faculty of higher secondary level with respect to gender, intelligence and academic achievement; to compare the scientific attitude and academic achievement of students of higher secondary level; to compare the scientific attitude and intelligence of students of higher secondary level. The study was of survey type. 240 higher secondary students were selected by using stratified random sampling method. Scientific attitude scale constructed by Dr. S. C. Gakhar and Dr.

Amandeep Kaur (2004) was used to collect the data. Mean, SD and t-test were used to analyse the data. The result revealed that no significance difference was found between scientific attitude of students of science and arts faculty; significance difference was found between scientific attitude of students of science faculty with respect to gender; no significance difference was found between scientific attitude of students of arts faculty with respect to gender; no significance difference was found in scientific attitude and academic achievement as well as scientific attitude and academic intelligence of students of higher secondary level.

**Budiharti & Waras (2018)** did an analysis of student's scientific attitude behaviour change effects blended learning supported by I-spring Suite 8 application. The research was conducted using a model lesson study which consists of the stages Plan-Do-Check-Act (PDCA) and applied to the subject of learning is students at class XI MIPA 2 of Senior High School 6 Surakarta. The validity of the data used triangulation techniques of observation, interviews and document review. The study concluded that the use of blended learning supported media I-Spring Suite 8 is able to give the effect of changes in student behaviour on all dimensions of scientific attitude that is inquisitive, respect the data or fact, critical thinking, discovery and creativity, open minded and cooperation, and perseverance.

**Sari, Sudargo & Priyandok (2018)** tried to find a correlation among science process skill, concept comprehension, and scientific attitude on regulation system materials. The aim of this research was to analyze the correlation between science process skill and concept comprehension as well as scientific attitude. The research method was a descriptive correlational. The research population consisted of all students in class XI in one of senior high school in West Sumatra with a total population of 100 students. The sample consisted of 26 students which were taken by a cluster random sampling. The instrument consisted of a science process skills test, concept comprehension test, and scientific attitude scale. The data were analyzed using linear regression test. The results showed that there was a significant correlation between science process skill and concept comprehension. In addition, there was a significant correlation between concept comprehension and scientific attitude. Nevertheless, there was not a significant correlation between science process skill and scientific attitude.

**Suastra and Ristiati (2019)** tried developing critical thinking, scientific attitude, and self-efficacy in students through Project Based Learning and Authentic Assessment in Science teaching at junior high school. The aim of this study was to analyze the effect of Project Based Learning (PjBL) model on critical thinking, scientific attitude, and self-efficacy in students.

This study used a quasi-experiment of post-test only control group design. The subjects were 60 ninth grade students of public high schools in Singaraja in the academic year 2017/2018 selected randomly from the existing classes, in which 30 students were assigned to the experiment class and another 30 to the control class. The instruments used were critical thinking test, scientific attitude questionnaire, and self-efficacy questionnaire. The instruments had a high reliability. The data were analyzed descriptively and to test the hypothesis, MANOVA with the 5% significance level was used. The result showed that simultaneously critical thinking, scientific thinking, scientific attitude, and self- efficacy of the students who learned with PjBL and authentic assessment significantly differed from those who learned with PjBl and conventional assessment. The group of students who learned with PjBL and authentic assessment had a high mean than that of those who learned with PjBL and conventional assessment. In other words, authentic assessment was effective in enhancing critical thinking, scientific attitude, and self-efficacy of the students in science teaching.

**Gumilar, Wardhini & Lisdiana (2020)** did the implementation of guided inquiry learning models on the concept mastery, scientific attitude, and science process skill. The purpose of this research was to analyze the mastery of the concepts in fourth grade in inquiry learning guided; to analyze the attitude fourth grade students in inquiry learning guided; to analyze the science process skills in fourth grade in inquiry learning's guided; to analyze the different in mastery of concepts, science process skills and scientific attitudes between other students in fourth grade who learn using conventional learning with inquiry learning's guided. The type of research was quantitative quasi-experimental research method with nonequivalent control group design. The population of the study consisted of all fourth-grade students. The sample had been selected through a purposive sampling technique. The techniques of data collection using non-test techniques, including interview guidelines, observation guidelines, and documentation. The result of the study showed that the application of the guide inquiry approach influences the mastery of concepts were increasing in the N- gain value in the medium category; the application of the guide inquiry approach influences the mastery of concepts were increasing in the N-gain value in the medium category; the application of the guide inquiry approach influenced the science process skills, namely an increase in the N- gain value inquiry in the medium category; guided inquiry approach could improve mastery of concepts, scientific attitudes and science skill of science. No significant difference was found in mastery of concepts, scientific attitudes and science process skills of students after the guided inquiry approach has been applied with the media in the school environment.

**Dewi et al. (2020)** saw the effectiveness of multicultural education through traditional games based inquiry toward improving student scientific attitude. This study aimed to analyze the effectiveness of inquiry-based multicultural learning using traditional games in improving the student's character. This study was an experimental study with design non-equivalent control group design. The sample was taken by purposive sampling. The research instrument used was the observation sheet characters. The data were analysed with quantitative and descriptive analysis. Quantitative analysis of the validity, reliability, two variance analysis test (homogeneity grade sample), the data normality test, calculate the N-Gain, different tests of significance in the development of a scientific character. Descriptive analysis was used to describe the increase of scientific character in every aspect of each meeting. The results showed that multicultural education through inquiry-based traditional games can improve students' scientific character.

### 2.5.0. OVERVIEW

Total **78** Studies had been reviewed for the present study. Out of these total 78 studies, **41** studies (Pattnaik, 1986; Singh, 1987; Dubey, 1992; Pradhan, 1996; Singh, 1998; Tripathi, 1999; Rajammal, 2003; Nadeem & Wani, 2005; Gupta, 2007; Nigam, 2007; Vyas, 2010; Bhatnagar, 2011; Nadeem & Ridwana, 2012; Plessis, 2013; Aezum and Wani, 2013; Aasia and Akbar, 2013; Mudasir and Yatu, 2013; Anbuchlevi, 2014; Bhatta, Netragaonkar, 2014; Maqbool, Mudasir and Zehta, 2014; Anand and Kumar, 2015; Joshua, 2015; Basu & Aslam, 2015; Andrabi, 2015; Kaur, 2015; Nagarathinam & Kumar, 2015; Bhat and Kapri, 2017; Bhat, 2017; Ridwana, 2017; Nautiyal, 2017; Yadav, 2018; Dar & Ghani, 2019; Thankkur and Bhan, 2019; Jahanger and Dar, 2019; Eswari and Manickavasagan, 2019; Sharma, 2020; Priya, 2020; Nisa, 2020; Gopalkrishnan & Galande, 2021; Kaur and Vadhera, 2021; Biswal and Pandey, 2021) were directly related with the **scientific temper** while the rest of the studies were related with the terms used synonymously with the scientific temper like scientific thinking, scientific habit of mind and scientific attitude. Total **7 studies** (Pritchard, 2005; Thitima & Sumalee, 2012; Foss, 2014; Causey, 2016; Dey, 2017; Singh, 2019; Hyytinen, Toom & Shavelson, 2019) were related to the **scientific thinking**, **4 studies** (Coll and Taylor, 2004; Coll, Taylor & Lay, 2009; Çalik, Çalik & Coll, 2012; Turan and Coll, 2013) were related to **scientific habit of mind** and **26 studies** (Julius, 2016; Yadav, 2011; Patel, 1997; Choukade(2014; Budiharti & Waras, 2018; Bagavathy, 2015; Sari, Sudargo & Priyandok, 2018; Price & Lee, 2013; Erdogan, 2017; Panneerselvam & Muthamizhselvan, 2015; Suastra and Ristiati, 2019; Gumilar, Wardhini & Lisdiana, 2020; Dewi Saputri, Nurkhalissa & Akhlis, 2020; Govindrajan, 2014;

Sreekumar, 2015; Chakraborty, 2015; Meenakshi and Vasimalairaja, 2016; Ahuja, 2017; Revati and Meera, 2017; Singh and Bai, 2017; Kundu, 2018; Thory, 2018; Shetty, 2016; Rasani S., 2017; Ahmed, 2007; Pyari, 2009) were done in the area of **scientific attitude**. Out of all these, very few studies had been done in qualitative type while most of the studies were of survey type and considerable amount of studies had been done in experimental type.

Most of the studies had adopted the **survey design**. In that some of the studies tried to find the **level** of scientific temper/ attitude among secondary students in which Pradhan (1996), Basu & Aslam (2015), Meenakshi and Vasimalairaja (2016), Ridwana (2017), Jahanger and Dar (2019), Gopalkrishnan & Galande (2021) and Biswal and Pandey (2021) found that most of the students had **above average** level of scientific temper. Singh (1987), Patel (1997), Pyari (2009), Bagavathy (2015), Julius (2016), Revati and Meera (2017), Singh and Bai (2017), Yadav (2018), Kundu (2018), Eswari and Manickavasagan (2019), Singh (2019) and Nisa (2020) discovered that most of the students had **average** level of scientific temper while Chakraborty (2015) found that most of the students had **low** level of scientific attitude. Pradhan (1996) did a cross cultural study and found that students from Nepal have higher level of scientific temper than the students from India and senior secondary students possess much more favorable scientific temper in comparison to secondary school students.

Few studies were done to assess the effect of various **demographic variables** on scientific temper/ attitude. Pradhan (1996), Tripathi (1999), Gupta (2007), Bhatnagar (2011), Govindrajan (2014), Chakraborty (2015), Bagavathy (2015), Meenakshi and Vasimalairaja (2016), Kapri (2017), Dey (2017), Revati and Meera (2017), Singh and Bai (2017), Kundu (2018), Singh (2019) and Biswal and Pandey (2021) found that there was no difference in scientific temper/attitude with respect to **gender** while Patel (1997), Pyari (2009), Nadeem & Ridwana (2012), Julius (2016), Ahuja (2017), Yadav (2018), and Nisa (2020) found that girls are better than boys and Yadav (2011), Aezum and Wani (2013), Thankkur and Bhan (2019) found that boys are better than the girls. Studies of Yadav (2011), Govindrajan (2014), Bagavathy (2015), Julius (2016), Meenakshi and Vasimalairaja (2016), Revati and Meera (2017), Dey (2017), Singh (2019) and Eswari and Manickavasagan (2019) revealed that no difference was there in scientific temper/attitude with respect to **type of school** while Pradhan (1996), Aezum and Wani (2013), Panneerselvam & Muthamizhselvan (2015), Rasani (2017), Kundu (2018) found that Private students had better scientific attitude than the government students and Ahmed (2007) found that unaided schools had higher Scientific Attitude when compared to the students of aided and government schools. Singh (1998), Nadeem & Wani

(2005), Bagavathy (2015), Basu & Aslam (2015), Revati and Meera (2017), Dey (2017), Jahanger and Dar (2019), Eswari and Manickavasagan (2019) found that there was no difference in scientific temper/attitude with respect to **locality** while Pradhan (1996), Patel (1997), Gupta (2007), Yadav (2011), Aezum and Wani (2013), Mudasir and Yatu (2013), Maqbool, Mudasir and Zehta (2014), Choukade(2014), Govindrajan (2014), Chakraborty (2015), Julius (2016), Ridwana (2017), Singh and Bai (2017), Kundu (2018), Singh (2019) and Nisa (2020) found that urban students did better than the rural students.

Further the review of related literature revealed no difference in scientific temper/attitude with respect to **board of school** (Tripathi, 1999; Pyari, 2009; Julius 2016), **Parent's education and parent's income** (Yadav, 2011; Bagavathy, 2015, Julius 2016), **medium of instruction** (Govindrajan, 2014; Bagavathy, 2015, Dey, 2017), **Parents occupation** (Bagavathy, 2015; Dar & Ghani 2019). The study done by Pyari (2009) shows that there was no significance difference in scientific attitude with respect to **mother education, study habits, Socio Economic Status, home environment**. Bagavathy (2015) found no significant difference in the scientific attitude among high school students in terms of **Conveyance, type of facility** available for study at home. No significant difference in scientific attitude with respect to **religion** was found by Yadav (2011) while Julius (2016) found that Christian had low scientific attitude than Hindu religion. Gupta (2007) found that levels of scientific temper among hindu was more than the muslim students.

With respect to factors affecting scientific temper/ attitude, it was found that factors like **caste** (Pyari, 2009; Chakraborty, 2015), **father education, cognitive style, school environment** (Pyari, 2009), **medium of instruction** (Chakraborty, 2015; Julius, 2016), **fathers and mothers, income, academic achievement and socio-economic status** (Chakraborty, 2015), **presence of grandparents and family size** (Julius, 2016) had significant effect on scientific temper/attitude. Futher Bhat and Netragaonkar (2014) found that **Non-first generation learners** were found to have better scientific temper and academic achievement as compared to **their counterparts**. Kaur (2015) found a significant difference in scientific temper between **high and low achieving** adolescent girls. Andrabi (2015) **non tribal were better than tribal students** in scientific temper. Bhat (2017) found significant difference between **Gujjar and non-Gujjar students** on scientific temper.

Very few studies were done on scientific attitude and the teachers or teacher trainees. Anand and Kumar (2015) found that scientific tempers of the B.Ed. trainees were found to be **above the average level** and there was no significance difference in scientific temper with respect to



**age, sex, religion (Hindu & Christian), family type.** Although significance difference was found between in scientific temper with respect of **educational qualification, course of study (science and arts), residence (hostellers and day scholars).** Dubey (1992) found significant difference existed between male and female teachers.

From review of some of the studies suggested that **social science also can help in the development of scientific temper** like Pattnaik(1986), Tripathi (1999), Aasia and Akbar (2013) found that Social Sciences did significantly better on scientific temper than their counterparts studying natural and applied Sciences while Thory (2018) did not find any significant difference between scientific attitude of students of science and arts faculty which showed that both the subjects results in the development of scientific temperament.

One of the major aims of teaching learning is the increase in academic achievement hence the studies conducted in this area showed that there existed a **positive correlation** between Scientific Temper/attitude and **academic achievement** (Patel, 1997; Ahmed, 2007; Panneerselvam & Muthamizhselvan, 2015; Andrabi, 2015; Ahuja, 2017; Bhat, 2017; Dar & Ghani, 2019). There also existed a positive relationship between scientific temper and **achievement in Science** (Patel, 1997), **achievement in Physics** (Eswari and Manickavasagan, 2019). Further the review of related literature also showed that the scientific temper is positively correlated with **development of society** (Singh, 1987), **extroversion personality** (Singh, 1998), **creativity** (Nadeem & Ridwana, 2012), **scientific creativity** (Kapri, 2017), **scientific aptitude** (Pyari, 2009; Rasani, 2017), **socio economic status** (Patel, 1997), **science teaching attitudes** (Erdogan, 2017) and **concept comprehension** (Sari, Sudargo & Priyandok, 2018). Although **no significance correlation was found between science process skill and scientific attitude** (Sari, Sudargo & Priyandok, 2018) which revealed that it is not necessary that if one knows about the concept or process of any scientific phenomena he/she would also manifest the scientific temperament. Kaur and Vadhera (2021) found that scientific temper had a little but significant impact on students science achievement of secondary students.

Some of the studies were attempted the **qualitative way** and explore scientific temper and attitude more comprehensively. Coll and Taylor (2004) found that the scientists are dismissive of traditional superstitions and the male counterparts are more sceptical than the female. Pritchard (2005) found that adult as well as children change their reasoning and thinking pattern as per the context and domain although in children it was lesser than the adult. Coll, Taylor & Lay (2009) found that scientists, unlike their stereotype, held idiosyncratic views of what constitutes good scientific evidence and sound, credible testimony. Price & Lee (2013)

discovered that the scientific attitudinal change was related to participant social activity in the project. Turan and Coll (2013) suggested that the teacher education programmes needed to help student teachers grasp better scientific thinking. Plesis (2013) concluded that instrumentalist approach towards science was more damaging than anything else for developing the nation in scientific advancement. Choukade (2014) revealed that scientific attitude improvement programme was useful for students in daily life and help to enhance their critical and logical thinking. Bhatta, Nagarathinam & Kumar (2015) found there had been very little attempt to involve science and scientists in the reportage in newspaper. Hyytinen, Toom & Shavelson (2019) concluded that critical thinking helped in the assessment, evaluation, synthesis and interpretation of relevant scientific theories and empirical knowledge. Sharma (2020) concluded that science is failing in developing scientific temper because we are more oriented towards content knowledge and their belief system hinders the successful implication of scientific content. Gopalkrishnan & Galande (2021) found that scientific temper is independent of education background (science and non-science), social media consumption, news consumption on social media and messenger app consumption.

From the review of literature it was found that most of the study had been done to **develop the strategies and program** for the development of scientific temper among students. Joshua (2015) developed **scientific temper package** for secondary students, Rajammal (2003) developed **in-service training program** for Primary teachers and children, Anbuchlevi (2014) had developed **experiential learning strategies** for B.Ed. Teacher trainee and Causey (2016) had develop **Four Phase Model (thinking, reasoning, analyzing, and communicating)**. They all found the formed programs and strategies effective in developing scientific temper and attitude. Many studies had used already existing models and method to develop scientific temper and found that those all methods and models were effective indeveloping scientific temper like **jurisprudential inquiry model** (Nigam, 2007), **Visual thinking strategy** (Foss, 2014), **Concept Attainment Model** (Sreekumar, 2015), **Blended Learning supported media I-Spring Suite 8** (Budiharti & Waras, 2018), **Project Based Learning (PjBL) model** (Suastra and Ristiati, 2019), **guided inquiry approach** (Gumilar, Wardhini & Lisdiana, 2020), **multicultural education through inquiry-based traditional games** (Dewi Saputri, Nurkhalissa & Akhlis, 2020), **Creative drama method** (Priya, 2020) but on a contrary Shetty (2016) found that Grow's Self-Directed Learning Model (Self-Directed Learning Programme) approach was not effective for developing Self-Directed Learning, science process skills and scientific attitude on the whole.

In terms of **research design** adopted for the study, total 45 studies had taken **survey design** (Dubey, 1992; Patel, 1997; Singh, 1998; Tripathi, 1999; Nadeem & Wani, 2005; Gupta, 2007; Ahmed, 2007; Vyas, 2010; Bhatnagar, 2011; Yadav, 2011; Nadeem & Ridwana, 2012; Aezum and Wani, 2013; Aasia and Akbar, 2013; Mudasir and Yatu, 2013; Bhat and Netragaonkar, 2014; Choukade 2014,; Govindrajan, 2014; Maqbool, Mudasir and Zehta, 2014; Kaur, 2015; Anand and Kumar, 2015; Basu & Aslam, 2015; Andrabi, 2015; Bagavathy, 2015; Chakraborty, 2015; Panneerselvam & Muthamizhselvan, 2015; Julius, 2016; Meenakshi and Vasimalairaja, 2016; Ahuja, 2017; Revati and Meera, 2017; Singh and Bai, 2017; Erdogan, 2017; Bhat, 2017; Ridwana, 2017; Kapri, 2017; Yadav, 2018; Thory, 2018; Kundu, 2018; Dar & Ghani, 2019; Thankkur and Bhan, 2019; Jahanger and Dar, 2019; Eswari and Manickavasagan, 2019; Singh, 2019; Nisa, 2020; Kaur and Vadhera, 2021; Biswal and Pandey, 2021) and one study was related to **diagnostic type** (Singh, 1987). 11 studies were related with **Qualitative type** (Coll and Taylor 2004, Pritchard 2005, Coll, Taylor & Lay 2009, Çalik & Coll 2012, Plessis 2013, Foss 2014, Bhutta, Nagarathinam & Kumar 2015, Causey 2016, Sharma 2020). 2 studies had adopted developmental study (Hyytinen, Toom & Shavelson, 2019; Thitima & Sumalee, 2012). Few studies were found of **correlational type** (Rasani 2017, Sari, Sudargo & Priyandok 2018; Kaur and Vadhera, 2021), **Tool development** (Çalik, Turan And Coll 2013), **Ex Post Facto Research** (Pyari 2009), **cross cultural study** (Pradhan 1996) and of **formulative explorative type** (Pattnaik 1986). Total 14 **Experimental studies** were conducted from 2013 till date amongst those 10 studies had adopted **nonequivalent research design** (Price & Lee, 2013; Sreekumar, 2015; Shetty, 2016; Budiharti & Waras, 2018; Suastra and Ristiati, 2019; Anbuchlevi, 2014; Joshua, 2015; Dey, 2017; Gumilar, Wardhini & Lisdiana, 2020; Dewi Saputri, Nurkhalissa & Akhlis, 2020) while four studies had taken up **Single group pre test post test** design (Rajammal, 2003; Nigam, 2007; Nautiyal, 2017; Priya, 2020). Gopalkrishnan & Galande (2021) had done **mixed method** study.

From the analysis of **sampling technique** taken it was realized that **37** studies had selected **random sampling method** (Pradha, 1996; Nadeem & Wani, 2005; Gupta, 2007; Pyari, 2009; Yadav, 2011; Nadeem & Ridwana, 2012; Aezum and Wani, 2013; Aasia and Akbar, 2013; Mudasir and Yatu, 2013; Price & Lee, 2013; Govindrajan, 2014; Choukade, 2014; Bhat and Netragaonkar, 2014; Maqbool, Mudasir and Zehta, 2014; Joshua, 2015; Kaur, 2015; Basu & Aslam, 2015; Sreekumar, 2015; Julius, 2016; Meenakshi and Vasimalairaja 2016; Ahuja 2017; Revati and Meera 2017; Singh and Bai 2017; Bhat, 2017; Dey, 2017; Kapri, 2017; Ridwana, 2017; Rasani, 2017; Sari, Sudargo & Priyandok, 2018; Yadav, 2018; Thankkur and Bhan,

2019; Dar& Ghani, 2019; Jahanger and Dar, 2019; Eswari and Manickavasagan 2019; Singh, 2019; Suastra and Ristiati 2019; Gopalkrishnan & Galande 2021) while one study had used saturated sampling technique (Nautiyal, 2017) and **2** studies had opted **cluster sampling method** (Patel, 1997; Singh, 1998). **15** studies had opted **stratified random sampling method** (Pattnaik, 1986; Singh, 1987; Dubey, 1992; Tripathi, 1999; Ahmed, 2007; Vyas, 2010; Bhatnagar, 2011; Andrabi, 2015; Anand and Kumar, 2015; Bagavathy, 2015; Panneerselvam & Muthamizhselvan, 2015; Thory, 2018; Kundu 2018; Nisa, 2020; Kaur and Vadhera, 2021). Biswal and Pandey (2021) have used **convenient sampling method** and only **7** studies had used **purposive sampling technique** (Rajammal, 2003; Nigam, 2007; Anbuchlevi, 2014; Sreekumar, 2015; Chakraborty, 2015; Shetty, 2016; Gumilar, Wardhini & Lisdiana, 2020).

Further analysis of the reviews revealed that in terms of **tool** taken for measuring scientific temper/attitude, **23** studies had used **self-made** scale and developed by their own scientific temper/attitude scale and standardized it (Pattnaik, 1986; Singh, 1987; Dubey, 1992; Pradhan, 1996; Patel, 1997; Singh, 1998; Rajammal, 2003; Nigam, 2007; Ahmed, 2007; Bhatnagar, 2011; Price & Lee, 2013; Anbuchlevi, 2014; Sreekumar, 2015; Joshua, 2015; Chakraborty, 2015; Shetty, 2016; Julius, 2016; Meenakshi and Vasimalairaja, 2016; Rasani, 2017; Kapri, 2017; Yadav, 2018; Eswari and Manickavasagan, 2019; Biswal and Pandey, 2021). Few of them had used **already existing standardized tools** like **Scientific Temper Questionnaire prepared by Singh 1998** (Thakur and Bhan, 2019), **Scientific Temper Inventory by Dr. Anita Singh and Dr. Harikesh Singh** (Tripathi, 1999), **Nadeem & Showkat Rashid Wan's scale of Scientific Temper** (Nadeem & Wani, 2005; Nadeem & Ridwana, 2012; Aasia and Akbar, 2013; Maqbool, Mudasir and Zehta, 2014; Bhat and Netragaonkar, 2014; Kaur, 2015; Basu & Aslam, 2015; Andrabi, 2015; Nisa, 2020; Kaur and Vadhera, 2021), **Nadeem and Khalida's Scientific Temper Scale** (Mudasir and Yatu, 2013; Bhat, 2017; Jahanger and Dar, 2019; Dar & Ghani, 2019), **Scientific temper scale by Leela and Pradhan** (Gupta, 2007; Nautiyal, 2017), **Scientific Temper Inventory by Krishnan.K and Bhuvaneshwari. G, 1989** (Anand and Kumar, 2015), **Scientific Attitude Questionnaire Dr. D. N. Dani** (Aezum and Wani, 2013), **Scientific Attitude Inventory developed by Moore and Foy (1997)** (Erdogan, 2017), **Scientific Attitude Scale constructed by Dr. S.C. Gakhar and Dr. Amandeep Kaur, 2004** (Pyari, 2009; Choukade, 2014; Thory, 2018), **Science Attitude Scale (SAS) developed by Grewal, 1990** (Yadav, 2011; Bagavathy, 2015; Panneerselvam & Muthamizhselvan, 2015), **Scale of Attitude towards Science Learning (SATSL) constructed and standardized by Likert** (Govindrajan, 2014), **Scientific Attitude Scale,**

**2009 by Sukhwant Bajwa & Monica Mahajan** (Ahuja, 2017), **Scientific Attitude Scale developed by Dr.Shailaja Bhagwat, 2003** (Revati and Meera, 2017) and **Scientific Attitude Scale developed by J.K. Sood and R.P.Sandhya** (Singh and Bai, 2017; Kundu, 2018)

From the **data analysis** perspective most of the studies (**47**) had used **Mean and SD** for descriptive analysis purpose (Singh, 1987; Singh, 1998; Tripathi, 1999; Rajammal, 2003; Nadeem & Wani, 2005; Gupta, 2007; Nigam, 2007; Bhatnagar, 2011; Nadeem & Ridwana, 2012; Mudasir and Yatu, 2013; Aasia and Akbar, 2013; Aezum and Wani, 2013; Anbuchlevi, 2014; Maqbool, Mudasir and Zehta, 2014; Bhat and Netragaonkar, 2014; Basu & Aslam, 2015; Andrabi, 2015; Anand and Kumar, 2015; Bhat, 2017; Ridwana, 2017; Nautiyal, 2017; Kapri, 2017; Yadav, 2018; Thakur and Bhan, 2019; Jahanger and Dar, 2019; Patel, 1997; Ahmed, 2007; Pyari, 2009; Yadav, 2011; Choukade, 2014; Govindrajan, 2014; Sreekumar, 2015; Chakraborty, 2015; Bagavathy, 2015; Panneerselvam & Muthamizhselvan, 2015; Shetty, 2016; Julius, 2016; Dewi Saputri, Nurkhalissa & Akhlis, 2020; Thory, 2018; Rasani, 2017; Meenakshi and Vasimalairaja, 2016; Ahuja, 2017; Revati and Meera, 2017; Singh and Bai, 2017; Kundu, 2018; Nisa, 2020; Biswal and Pandey, 2021). Few of the studies had used **percentage** (Patel, 1997; Nadeem & Wani, 2005; Bhatnagar, 2011; Joshua, 2015; Kaur, 2015; Ridwana, 2017; Nautiyal, 2017; Dar & Ghani, 2019; Nisa 2020), **median and kurtosis** (Joshua, 2015; Nautiyal, 2017; Patel, 1997; Chakraborty, 2015; Revati and Meera, 2017) for the descriptive analysis. While for the inferential statistics most of them (**51**) have used **t-test** (Pattnaik, 1986; Singh, 1998; Tripathi, 1999; Rajammal, 2003; Nadeem & Wani, 2005; Gupta, 2007; Nigam, 2007; Bhatnagar, 2011; Nadeem & Ridwana, 2012; Mudasir and Yatu, 2013; Aasia and Akbar, 2013; Aezum and Wani, 2013; Anbuchlevi, 2014; Maqbool, Mudasir and Zehta, 2014; Bhat and Netragaonkar, 2014; Joshua, 2015; Kaur, 2015; Basu & Aslam, 2015; Andrabi, 2015; Anand and Kumar, 2015; Bhat, 2017; Ridwana, 2017; Nautiyal, 2017; Kapri, 2017; Yadav, 2018; Thakur and Bhan, 2019; Jahanger and Dar, 2019; Eswari and Manickavasagan, 2019; Dar & Ghani, 2019; Priya, 2020; Ahmed, 2007; Yadav, 2011; Choukade, 2014; Govindrajan, 2014; Sreekumar, 2015; Chakraborty, 2015; Bagavathy, 2015; Panneerselvam & Muthamizhselvan, 2015; Shetty, 2016; Julius, 2016; Dewi Saputri, Nurkhalissa & Akhlis, 2020; Gumilar, Wardhini & Lisdiana, 2020; Thory, 2018; Erdogan, 2017; Rasani, 2017; Meenakshi and Vasimalairaja, 2016; Ahuja, 2017; Revati and Meera, 2017; Singh and Bai, 2017; Kundu, 2018; Nisa, 2020). Biswal and Pandey (2021) had used **Mann Whitney U-test**. Few of the studies have used **chi square** (Pattnaik, 1986; Joshua, 2015; Chakraborty, 2015; Revati and Meera, 2017; Gopalkrishnan & Galande, 2021),

**ANOVA** (Patel, 1997; Price & Lee, 2013; Sreekumar, 2015; Bagavathy, 2015; Panneerselvam & Muthamizhselvan, 2015; Gumilar, Wardhini & Lisdiana, 2020; Erdogan, 2017; Rajammal, 2003; Joshua, 2015; Kaur, 2015; Eswari and Manickavasagan, 2019; Priya, 2020; Nisa, 2020), **MANOVA** (Suastra and Ristiati, 2019; Rasani, 2017; Ahuja, 2017, Priya, 2020) **ANCOVA** (Sreekumar, 2015; Chakraborty, 2015; Shetty, 2016). 16 studies had used **pearson product moment correlation analysis** (Pattnaik, 1986; Singh, 1987; Singh, 1998; Gupta, 2007; Ahmed, 2007; Bhatnagar, 2011; Anbuchlevi, 2014; Kapri, 2017; Eswari and Manickavasagan, 2019; Patel, 1997; Pyari, 2009; Yadav, 2011; Chakraborty, 2015; Sari, Sudargo & Priyandok, 2018; Erdogan, 2017; Rasani, 2017). Kaur and Vadhera (2021) had used **partial and multiple correlations**. Only 4 studies had used **qualitative analysis** (Plessis, 2013; Bhatta, Nagarathinam & Kumar, 2015; Sharma, 2020; Budiharti & Waras, 2018).

## 2.6.0. IMPLICATION

After the substantive and methodological analysis of review it can be concluded that majority of the studies were done of survey type which revealed that students had average level of scientific temper/attitude although few studies also found high and low levels. It further revealed that demographic variables like gender, type of school, locality, board of school, medium of instruction, Parents occupation, Parents education, Parents income, religion and home environment did not really affect the scientific temper while presence of grandparents, school environment and family size did affect the development of scientific temper hence it should be taken care of while teaching. Scientific temper is usually considered to be developed thorough science and mathematics but the analysis of reviews showed that social science also has the capacity to do the same as well. The studies further showed with the increase of scientific temper/attitude, the academic achievement, extraversion personality, scientific creativity, scientific aptitude also increases while science process skill has negative correlation with the scientific attitude which suggests that it is not necessary that if a person holds a good knowledge of scientific processes, s/he will also have a good scientific temperament. Out of 76 studies, very few studies had been done in qualitative type while most of the studies are of survey type and considerable number of studies have been done in experimental type. Most of the researchers had developed their own tool which was of five-point rating scale. In sampling method, random and in analysis mean, SD and t-test were most frequently used.

Further the analysis showed that the intervention program did help in the development of

scientific temper but most of the researches were done either in science or a separate program is developed for this. The researcher couldn't come across any study in which the program is implemented in integrated way that too by taking up social science as well. Hence the researcher has taken up this study wherein the researcher had tried to develop certain generic strategies in an integrated approach to develop scientific temper among secondary school students as in this stage students started to think critically and rationally. For this the researcher had taken up three subjects of class 9<sup>th</sup> viz. Science, Mathematics and Social Science as various studies suggested that social science also has the potential to develop scientific temper as well.