

CHAPTER VI

SUMMARY AND CONCLUSION

6.0.0. INTRODUCTION

Education is an essential aspect of a person's life. It not only aids in the acquisition of knowledge but also incepts curiosity in human beings. Curiosity has always aided in pivoting our lives for a better tomorrow, from the discovery of fire to the discovery of artificial intelligence. It is this curiosity that has aided the birth and progress of science; the era of science and technology began. In the modern world, science has radically changed men's material environment. It has led to material and nonmaterial development. The development of science and technology has fostered a new intellectual temperament known as the Scientific Temper. Scientific temper is one of the abilities that aids humans in rational and logical thinking by adhering to the scientific method, thereby making a person scientifically literate. Scientific temper not only helps in searching for the truth but is an integral part of one's overall thinking and action. It generally means accepting the truth in its real form without subjecting it to any kind of influence (Kaur & Vadhera, 2018). It is the most important factor in the nation's growth. This is the reason that Pt. Jawahar Lal Nehru introduced this term in India in 1946 and put forth all his efforts in this very direction. He has quoted well the importance of science and scientific temper in the following lines—*"It is science alone that can solve the problems of hunger and poverty, of sanitation and illiteracy, of superstition and deadening custom and tradition, of vast resources running to waste, of a rich country inhabited by starving people". Scientific temper is something that adheres to the scientific method in its pursuit of truth, which primarily includes observation, experimentation, and analysis of findings for verification.* Various educationists and scholars have defined scientific temper in various ways from time to time (Pattnaik, 1986; Kalbag, 1991; Hemlata, 1988; Krishnan and Bhuvaneshwari, 1990; The Seventh Five Year Plan, 1985–90; Singh, 1998; Kaur & Vadhera, 2018; Draft Scientific Social Responsibility Policy, 2019). The conclusion of all the definitions implies that scientific temper is an individual's ability to use the scientific method as an important part of their thinking process in all their day-to-day activities. It is usually an affective construct and has a direct or indirect linkage to one's personality (Kaur and Vadhera, 2018). Based on related reviews and after analysing the nature and definitions of scientific temper, the researcher identified a total of 8 components, which are: Healthy Scepticism, Objective Intellectual Honesty, Rationality, Perseverance, Freedom from superstition, Curiosity, Open-Mindedness, Observation of

scientific temper. All these components are interconnected, and they cannot be perceived in isolated terms. They constitute a cohesive, interrelated, and well-integrated whole.

Pt. Jawaharlal Nehru introduced the term scientific temper in his much-acclaimed book, *Discovery of India*, in 1946. Although Bertrand Russell in 1923, in his book *On Education*, mentioned it for the very first time as one of the major aims of education. Even Indian civilization has been known for its scientific advancement in the world since ancient times. In Nobel Laureate Prof. Amartya Sen's book *The Argumentative Indian*, he also mentioned this very fact by mentioning that scientific temper has been the hallmark of Indian thoughts since long (Sen, 2006). The very first policy catering to this very notion, called the Scientific Resolution Policy, was launched in 1958. Realising and witnessing its advantages in 1976, India became the first country to include in its Constitution the "Scientific Temper spirit of inquiry and reform [Article 51-A (h)]. Four years later, in July 1981, at the Nehru Centre in Bombay, the statement of scientific temper was released. This document articulated the need to inculcate the values of scientific temper in Indian society to rid the country of its socio-economic ills at that time. The statement has invoked a lot of criticism in a certain circle of academia (Prasad, 1982; Chadha, 2005). In 2011, an attempt was again made to revisit the 1981 Statement of Scientific Temper named "Scientific Temper Statement Revisited 2011: The Palampur Declaration". It recognised that the Scientific Temper remained largely confined to rhetorical statements. Sadly, even social scientists did not make an effort to refine this concept or operationalise the concept for measuring/gauging scientific temper. All the policies after independence, viz., University Education Commission (1948-49), Secondary Education Commission (1952-53), Education Commission (1964-66), Science and Technology Policy (2003 and 2013), and National Education Policy (2020), have identified the importance of scientific temper. NEP 2020 has identified it as one of the most important 21st century skills.

It is said that we are living in the age of scientific advancement and the technological era. However, calling this age a scientific age just on the basis of the bulk of scientific information gained will be a mistake. When folks with a scientific temperament can address and solve society's problems, age can be considered scientific (Jahagirdar, N.A.). It is witnessed time and again that India fails to show the characteristics of scientific temperament and easily falls into the trap of believing in gods, magical beliefs, and superstition-related activities. This makes us think that besides all these advancements and development, India has yet to reach Nehru's desired scientific temper (Mahanti, 2016). This problem of rising misinformation and fake

news is also one of the key reasons why there is a need for the resurgence of scientific temper. Akbar and Pal (2020) found that there was a sudden expansion of misinformation during this pandemic in India and false claims that affected people emotionally also increased greatly. All of these things hurt the country's scientific and technical base and make it harder for people to think scientifically in the long run.

There are many obstacles to developing scientific temper, such as multiple religious beliefs, conflicts with religion and spirituality, a rising intellectual design movement, and so on, but it is the responsibility of citizens and policymakers to save this temper and ensure its development in the younger generation for the proper growth of the nation. The secondary education stage is the most critical stage as the students start to think in abstract terms at this stage of life. Secondary education strives to develop the intellectual, social, and moral traits necessary for democratic citizenship as well as to prepare young people for jobs or further study (Secondary Education Commission Report, 1952; Report of Education Commission, 1964–66). The attribute of scientific temper shows children's inherent proclivities, but as they grow older, the usefulness of this feature tends to wane due to ongoing shaping through school science, which has been the major vehicle for spreading NOS (Nature of Science) beliefs (Kaur & Vadhera, 2018). Hence, it is the teacher's responsibility to ensure that the innate inquisitiveness and critical mindset are not hampered due to any cause.

Usually, scientific temper is considered to be developed through science and mathematics subjects, but even another subject has the potential to inculcate this very domain in an individual. The same is suggested by the Kothari commission (1966–86) and the Statement of Scientific Temperament (1981), which said that scientific temper can be developed not only through science but through social science as well. Even the University Education Commission (1949) has considered language as the most powerful tool for imparting scientific thinking. NCF 2005 also emphasised the nature of social sciences and said that the social sciences, like the natural and physical sciences, offer themselves to scientific inquiry. Hence, in the present study, the researcher has taken all three subjects to develop a scientific temper.

6.1.0. REVIEW OF RELATED LITERATURE

Total **78** Studies have 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 have been done in qualitative type while most of the studies are of survey type and a considerable amount of studies have been done in experimental type.

After the substantive and methodological analysis of review, it can be concluded that the majority of the studies were done of survey type which revealed that students have an 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 through 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 a 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 have been done in qualitative type while most of the studies are of survey type and a considerable amount of studies have been done in experimental type. Most of the researchers have developed their own tool which was of a five-point rating scale. In the sampling method, random and in analysis mean, SD and t-test were mostly used.

Further, the analysis showed that the intervention program did help in the development of scientific temper but most of the research was 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 an integrated way that too by taking up social science as well. Hence the researcher has taken up this study wherein the researcher will try 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 has taken up three subjects of class 9th viz. Science, Mathematics and Social Science as various studies suggested that social science has the potential to develop scientific temper as well.

6.2.0. RATIONALE OF THE STUDY

The goal of instilling scientific temper is critical to the advancement of science and its application in the development process. There is a need to develop a scientific atmosphere in which people may participate in discussions about diverse science and technology concerns that touch their lives. Knowledge about natural occurrences and technological advancements must be disseminated through popular science publications and other media. There is also a need to encourage public debate on important issues that are detrimental to the nation's progress. The whole extent of scientific knowledge must be applied to the elimination of illogical attitudes that tend to keep the country from progressing.

Since the dawn of time, science and technology have been an intrinsic element of Indian culture. In terms of modern scientific knowledge and comprehension, India has always been at the forefront. Scientific temper is critical for a nation's progress in all sectors, including political, economic, and social (Saxena, 2014). It is a way of life that involves inquiring, observing physical reality, testing, hypothesising, analysing, and communicating using a

scientific approach. The term "scientific temper" refers to an attitude that is based on rationality. The scientific temperament requires debate, argument, and analysis.

Keeping in mind the importance of scientific temper, it has been included in the fundamental duties, and many efforts through science education and other activities have been taken. Despite these attempts, a scientific temper did not pervade society enough to have an influence on the national psyche. Regardless of the fact that today's Indian populace is more scientifically temperate than it was under the British Raj, creating a scientifically temperate society remains a faraway dream. (Nanda, 2013) but still, the aim of a scientific temper society is far away from achieving. As Mahanti quoted Narlikar (2003), "Today we live in a free India that is feeling its way towards economic prosperity. Yet we are still a long way from achieving that scientific outlook which Nehru considered so essential for our future wellbeing". Similar concerns were expressed by Bhargava and Mahanti (2013) quoted by Mahanti: "If one were to pick out three or four most important reasons for the country's backwardness or failure in many areas, the lack of scientific temper would be one of them", so it can be concluded that despite India's enormous progress in science and technology, the climate of scientific temper that Nehru envisioned for the country has remained largely unrealised.

Scientific temper also helps in carrying out good citizenship qualities with a rational and logical outlook. Blind obedience to religious and judicial authorities is not only against the spirit of science and value education but also a great obstacle to achieving the constitutional goals of India as well as international peace and cooperation. Realising the importance of scientific temper, Former President Kalam has also said, "Children must inculcate a Scientific Temper for pursuing knowledge to contribute towards making India one of the most developed countries in the world. An ignited mind is the most powerful resource on the earth, above the earth and under the earth. The current teaching methods need to be revamped with more practicals and experiments to inculcate Scientific Temper among students" even the present prime minister Narendra Modi has also, in the departmental meeting of Science and Technology, asked the Council for Scientific and Industrial Research (CSIR) to develop toys which "inspire and develop scientific temper in children" (Livemint, 2017).

The purpose of education is not to produce the next generation of scientists only but the person who can have a scientific bent of mind. In today's world, we all are facing issues on a global scale that are fundamentally technical, like changes in climate conditions, energy resources, food production, genetic transformations and many more. Such conditions demand basic

scientific temper throughout our population, not only by the scientists or elitists, so; those wise decisions can be reached about how to address them. Scientific temper should be instilled in all students, not only science students because scientific temper is not limited to science disciplines or rules, hypotheses, and formulae. Instead, it is what we refer to as a state of mind in which one constantly examines everything, seeks information, and is satisfied only when supported by sufficient evidence. Scientific temper is generic in nature, and it may be instilled through any subject, such as social science, mathematics, languages, physical education, painting, art and craft, and so on. However, subjects that are more factual in nature will be more convenient and easier for the development of a scientific temper. Hence in this study, subjects based on factual information and logic, like Science, Social Science and Mathematics, were selected. In a nutshell, scientific temper is the ability to comprehend the fundamental processes of scientific knowledge that follow the logical and reasonable investigation. Scientific knowledge can be verifiable, repeatable and falsifiable. It is always changing, and there is no absolute truth.

Secondary schooling is, as we all know, a critical period. It serves as a connection between primary and secondary education. Primary education is designed to meet the bare minimum for survival, but secondary education prepares a person to participate fully in a complex society. This stage provides students with a clear insight into their ability, and its completion ensures that the child has attained all the basic aims to live a life and to go toward the specialisation in the interested area. Good wholesome development of the students at this stage has a very crucial role in the future of any student. Hence, the researcher has considered secondary students for the present study. As class 10th students are going to face the board examination so this time is very important for them, which may be one of the factors for the authorities for not allowing the experiment at that stage, especially since the researcher has taken only 9th standard for the experimentation.

From the review of related literature, it was found that very rare studies have been done on scientific temper, and in that also most of the study was related to measuring scientific temper that too by considering very few components of scientific temper. The researcher could come across only one study that was done to develop a package that too in science subjects only. But as scientific temper is considered a temper of a free man so it can be inculcated by using any subject; with this assumption, the researcher has decided to develop strategies to enhance the scientific temper among secondary school students by taking Science, Mathematics and Social Science subjects of GSHSEB schools.

6.3.0. STATEMENT OF PROBLEM

Development of Strategies to Enhance Scientific Temper among Secondary School Students.

6.4.0. OBJECTIVES

1. To develop strategies to enhance scientific temper among the secondary school students.
2. To implement the developed strategies on the secondary school students to enhance their scientific temper.
3. To evaluate the effectiveness of the developed strategies in terms of enhancement of scientific temper among secondary school students.
4. To evaluate the effectiveness of the developed strategies in terms of the reaction of secondary school students towards the strategies.

6.5.0. HYPOTHESES

The following null hypotheses were tested at the 0.01 level of significance.

H₀₁: There is no significant difference between the mean pre-test and post-test scores of scientific temper between secondary school students those did not expose to the developed strategies.

H₀₂: There is no significant difference between the mean pre-test and post-test scores of scientific temper between secondary school students those exposed to the developed strategies.

H₀₃: There is no significant difference between the mean post-test score of scientific temper between secondary school students those exposed and whose did not expose to the developed strategies.

6.6.0. EXPLANATION OF THE TERMS

Secondary school students – It includes students who are studying in classes IX and X.

Strategies – In this study strategies were referred to the prepared plan involving a sequence of steps designed to enhance the scientific temper considering the components of scientific temper through the instructional process.

6.7.0. OPERATIONAL DEFINITION OF THE TERMS

Scientific temper: Scientific temper is the score secured by a student in the scientific temper scale developed by the researcher.

Enhancement of Scientific Temper: It is a significant difference between the pre-test and post-test scientific temper scores of the experiment and control groups.

Effectiveness: Effectiveness is the significant difference in the post-test scores of the experiment and control groups in scientific temper.

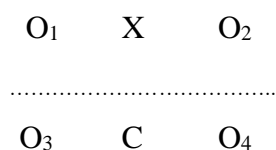
Effectiveness in terms of reaction: Effectiveness in terms of reaction is the overall positive reaction (3.5 and above) of students towards strategies to develop scientific temper in a Likert type 5 point reaction scale developed by the research.

6.8.0. DELIMITATION

The study is delimited to English medium school following GSHSEB syllabus in Vadodara city. In this study, Secondary School is delimited to standard IX only. The study is also delimited to Science, Mathematics and Social Science subjects. The scientific temper is delimited to eight components viz. healthy scepticism, objective intellectual honesty, rationality, perseverance, freedom from superstition, curiosity, open mindedness, observation.

6.9.0. DESIGN OF THE STUDY

The present study was experimental in nature, and the researcher used a quasi-experimental research design. Considering the typical nature of the study, a pre-test post-test non-equivalent group design of the quasi-experiment research design has been selected for the study. Further, the experimental and control groups were made equivalent on the basis of pre-test scores in scientific temper. The design of the study is presented as follows (Campbell & Stanley, 1966).



Where O₁ and O₃, - pretests

O₂ and O₄ - post-test

X stands for experimental group and

C stands for control group

Following the design, two groups were selected as conveniently as the experimental and control groups. The initial level of scientific temper had been checked prior to the experimentation by using a self-made scientific temper scale. On the basis of the obtained score on the scale, the experimental and control groups were made equivalent. The treatment, i.e., teaching through

developed strategies to enhance scientific temper, was done in the experimental group while the control group was taught through the traditional method without applying any kind of specific interventions.

6.10.0. POPULATION

The population for the present study is composed of all the students of the English-medium secondary schools in Gujarat state affiliated to GSHSEB (Gujarat Secondary and Higher Secondary Education Board) during the year 2019–20.

6.11.0. SAMPLE

Two English-medium GSHSEB affiliated secondary schools were selected with convenience from Vadodara district for the experimentation. Both the selected schools were considered equal in standards as both the schools were affiliated with the same board and located within the city area. The selected schools were University Experimental English Medium School and Vidyakunj High School in Vadodara. Out of these two schools, the former one was selected for the experimental group and the latter one was selected for the control group. Standard IX classes of both the schools had a combined strength of more than 45 students. These two groups were made equivalent on the basis of the pre-test score of the scientific temper scale. In this way, a total of 64 students, 32 from the experimental and 32 from the control group, formed the sample of the study. Students of the experimental group were taught through developed strategies in an integrated way, while the students of the control group were taught through the usual traditional method.

6.12.0. VARIABLES OF THE STUDY

In the present study independent variable is the developed strategies to enhance scientific temper and the dependent variable is scientific temper.

6.13.0. TOOLS OF DATA COLLECTION

Following tools were prepared by the researcher and used for the collection of data.

Scientific temper scale: The scientific temper scale was developed and standardised by the researcher herself which was meant for the secondary school students exclusively. Total of eight components of scientific temper were identified after a thorough study of the topic and analysing the review of related literature. The selected 8 components are Healthy Scepticism,

objective intellectual honesty, Rationality, Perseverance, freedom from superstition, Curiosity, Open Mindedness, and Observation. 32 items were finalised after the item analysis and validation by experts. Each item was based on a situation having five most likely responses ranging from highest to the lowest level of scientific temper. The responses were scored between 5 to 1 on the basis of the degree of scientific temper reflecting from the alternatives. In this way, the highest and lowest possible score could be 160 and 32 respectively. For validity content and factor validity were taken out. The reliability of the scientific temper scale was established by using two types of reliability methods which are Split Half reliability and Cronbach Alpha reliability. In both the reliability methods the tool was found to be highly reliable with a score of 0.75 and 0.79 respectively.

Reaction scale: The researcher had prepared a five-point Likert scale to know the reaction of students towards the developed strategies to enhance scientific temper. There were a total of 30 statements in the scale catering to different aspects of their experiences during the execution of strategies and teaching-learning. Each statement has a five-point rating ranging from strongly agree to strongly disagree. The students were asked to read each statement carefully and mark a tick on an option that is most suited to their reaction. There was no time limit to complete this scale. The weightage of score of each statement was 5,4,3,2,1 respectively for the SA, A, UD, D, SD. In this way the highest score one could get was 150 and lowest was 30.

6.14.0. DEVELOPMENT OF STRATEGIES

In the present study, strategies were developed by the researcher to enhance the scientific temper among secondary school students by teaching Science, Mathematics and Social Science subjects. For this purpose first of all the identification of chapters to be taught was done of these three selected subjects. After that content analysis was done and the researcher has divided the chapters into various topic and subtopics so that the each recognised scientific temper components can be assign exclusively to subtopics. Then the researched has developed integrated strategies for all these selected topics. The strategies included ICT enabled learning, story telling, Questioning, Timeline, Debate, Discussion, Role play, News/Movie analysis, Worksheet. Once all the things have decided the researcher has prepared the final lesson plan to be used for teaching learning by using Herbatian steps.

6.15.0. IMPLEMENTATION OF STRATEGIES

The developed strategies were implemented in the experimental group for the teaching of Science, Mathematics, and Social Science subjects, with the chapters common in both the experimental and control groups. The selected topics that could develop scientific temper in all the subjects were taught by the researcher in the allotted classes that vary from 3-5 classes in a week. This activity continued for the whole second semester.

6.16.0. DATA COLLECTION PROCEDURE

For the purpose of data collection, two tools, the scientific temper scale and the reaction scale, were developed by the researcher. The data were collected at the beginning and end of the experimentation because the study is a pre-test post-test non-equivalent group design. First and foremost, the scientific temper scale was used as a pretest on both groups to determine their initial level of scientific temper and to make them equivalent. After that, the developed integrated strategies were implemented in the experimental group, whereas the control group was taught through the regular teaching and learning process. At the end of the second semester, the scientific temper scale was administered again to both groups as a post-test. To know the reaction of developed strategies, a reaction scale was also administered to the experimental group.

6.17.0. DATA ANALYSIS

Considering the nature of the Sampling method, collected data were analysed using mean, SD, Mann whitey U test, frequency percentage and intensity index. All the analyses were done using SPSS 20.0 (Statistical Package for Social Science) and MS Excel.

6.18.0. MAJOR FINDINGS

Following major findings were drawn on the basis of data analysis and interpretations.

1. No significant difference was found among the mean pre-test and post-test scores of Scientific temper of control group those were taught in traditional method of teaching. This was also found in case of all the eight components of scientific temper viz. healthy scepticism, objective intellectual honesty, rationality, perseverance, freedom from superstition, curiosity, open mindedness and observation. In other words, traditional method of teaching did not help in enhancing scientific temper either as a whole or in any of it's components.

2. Post-test score of Scientific temper of experiment group those were taught through developed strategies was found significantly higher than their pre-test score in scientific temper. This was also found in case of all the eight components of scientific temper viz. healthy scepticism, objective intellectual honesty, rationality, perseverance, freedom from superstition, curiosity, open mindedness and observation. In other words, teaching through developed strategy helped in enhancing scientific temper as a whole and in all the eight components.
3. Post-test score of Scientific temper of experiment group those were taught through developed strategies was found significantly higher than the post-test score of Scientific temper of control group those were taught in traditional method of teaching. This was also found in case of all the eight components of scientific temper viz. healthy scepticism, objective intellectual honesty, rationality, perseverance, freedom from superstition, curiosity, open mindedness and observation. In other words, teaching through developed strategy was found superior and effective in enhancing scientific temper among secondary students in comparison to the traditional method of teaching.
4. The developed strategy was found effective in enhancing scientific temper among secondary students in terms of favourable reaction of students towards different aspects of strategies.

6.19.0. EDUCATIONAL IMPLICATION OF THE PRESENT STUDY

The findings of the present study showed that the implementation of strategies does help in the enhancement of the scientific temper of students. In traditional teaching, the same has failed to happen. In the present study, no complex words have been employed and only the available resources have been used to teach the students during the implementation phase. The only thing that made this whole process successful was the deliberate attention to the objective of enhancing the scientific temperament. It was made simpler by identifying the specific domain that comprised the whole of scientific temper. In this way, the finding is very useful for all the stakeholders in the education system.

Generally, it is believed that for implementing any such strategy, a special environment, resources, funding, and extra time, etc. are needed, while in the present case, the researcher has used only the available resources. Nowhere in the whole process, the researcher has disturbed the traditional teaching going on in parallel. In fact, all the strategies were integrated with the normal teaching in such a way that no extra time was needed for the same. Extensive use of

questioning was used for the success of the experiment so that the inherent inquisitiveness of the students could be ignited. Besides that, the use of ICT tools for the presentation of content and various options like time line, drawing, debating, discussion, etc. were used for the evaluation and expressing the views of students. The environment was created in such a way that no student felt fear or shyness. They were all given ample opportunity to work in groups to overcome the fear in them and to make them open to various kinds of experience and differences in opinion. In this way, it can be said that even tiny efforts and little deliberation towards the goal of enhancing scientific temper can work miracles in achieving the goal of scientific temper development.

6.20.0. SUGGESTIONS

The present study was experimental in nature and during the course of implementation of this, the researcher has come to many such observations which can prove beneficial for all the stakeholders of the education system to bring in qualitative improvement. For each of the stakeholders, the suggestions are listed below separately.

6.20.1. Suggestions for Teachers and teacher educators

Teachers are the biggest change-makers in the education system. They are someone who remains in direct contact with the students. This study has demonstrated how a teacher can enhance the scientific temper of students by implying very basic methods of teaching. It further presented what all tools can do in the lack of resources and how questioning can work as a boon in this very endeavour. There is no need for a complicated method or many resources. It also brings in the perspective of creating a conducive environment where students can overcome their fear of asking questions and be encouraged to work in groups along with giving them an opportunity to work individually. As the definition of education given by Vivekananda suggests, education is the manifestation of perfection already in man; hence all the efforts to be made to unlock this inherent latent potential of students by all means. For this purpose, a teacher should consciously bring in discussions and topics that can help in the development of scientific temper. The purpose of learning anything and its connection with the real-life world needs to be reiterated again and again so that a child can start to think in that direction. Even a teacher education institute can help the pupil teacher understand the importance of scientific temper. It can be done by including it in the curriculum as an important part. As we have seen in this study, all the subjects have the potential to develop this very bent of mind. Hence, in all the methodologies of teaching, the strategies can be taught to do the same. Preparing the right

kind of teachers with a scientific temper can surely bring change in the overall education system. A person with a scientific temper is a person with a learning mindset who is open to all kinds of experiences.

6.20.2. Suggestions for the school authorities

School authorities are the most powerful to bring in desirable changes in the education system by implementing the curriculum formed for a particular standard. They are someone who can empower teachers to do better and achieve the goal of education successfully. Scientific temper is the need of the hour, and it is very important in our diverse country to bring peace and harmony along with R&D. This is the reason that it is recognised as one of the most important 21st century skills one should have in NEP 2020. Hence, all the efforts from the school authorities should be made in this very direction. The teacher should be given enough encouragement to take part in such scientific discussions and programmes where the importance of this very notion is explained. Besides that, field trips and talks with scientific personnel can be organised to motivate students for R&D.

6.20.3. Suggestions for Students

Long students are the future of any nation, hence their development needs to be done with much caution. This very study suggests that students have ample potential to have a scientific bent of mind. If the right kind of environment and opportunity are provided, they can bloom to their best. In this study, initially students were shy about taking part in discussions, but as the cause proceeded, they started taking part in both. They have started focusing on the events happening around them more attentively and have started discovering things on their own. Self-learning was also somehow encouraged during the course of implementation.

6.20.4. Suggestions for Education Boards and policy makers

Education bears and policy makers are the ones who lay down the framework of what is going to be taught in school. The above study suggests that if conscious effort is made in the direction of inculcating scientific temper, then it does develop successfully. The study clearly suggested that the implementation of strategy doesn't need any extra hours of time and it can be integrated with the syllabus very easily and effortlessly. It is also proved that these mental sets can be generated by using not only science subjects but other subjects like mathematics and social science as well. Hence, while forming the curriculum and making policy, this very aspect needs to be considered in mind. A clear guideline on how this very temperament can be developed

needs to be framed for the convenience of the teachers and uniformity. It was observed that this concept is not known directly by many of the teachers as it is something which is implicitly included in the syllabus. Hence, the effort to make it more explicit is the need of the hour. It is high time that scientific temper should be defined with all its components and a nationwide workshop or any kind of training provided to teachers at all levels.

6.20.5. Suggestions for Further Research

The present study was done with some of the delimitations and limitations. On the basis of the experiences gaining while doing this very research, the researcher had identified few of the areas where the further researches can be performed by the researchers who will have willingness to do the research in this area. The suggestions for further studies are listed below.

- Similar kind of experimental study may be done where the strategy can be formed by taking language into consideration.
- Similar kind of experimental study may be conducted by taking different level of school children like primary, higher secondary.
- Longitudinal studies may be conducted for the period of 2-3 years where the effect of implemented strategies may be observed every year and at the end of all years to see the cumulative effect.
- In the similar experimental study the effect of demographic variables like gender, location, socio economic status etc. may also be assessed.
- Similar kind of study may be done by employing qualitative approach.
- Similar kind of study may be conducted by taking different kind of boards of education like state board, IB and CBSE.
- The similar kind of study may be done in the different geographical locations.
- Correlation study with the achievement of different subjects may be conducted.
- Similar kind of study may be performed with the disadvantage group like tribal.
- Similar kinds of study may be performed with the adult learner under continuing education.
- Similar kind of study may be conducted by implying different experimental designs.

6.21.0. CONCLUSION

A scientific temper is a scientific bent of mind that not only opposes rigid thinking but also motivates one to ask questions in order to find logical and rational answers. It is so critical that it is included in our fundamental duty; even the recently released NEP 2020 recognised it as one of the most important 21st-century skills. The present study was conducted by keeping this very perspective in mind. The study revealed that the implementation of developed strategies proved useful in the enhancement of scientific temper among secondary school students. The differences in the level of scientific temper were clearly visible in the scores of students who were taught by the traditional vs. integrated method. Usually, it is considered that this very temperament can only be developed through science subjects, although this study advocated that it is not the case. This task of the development of scientific temper can be done using any subject. In this case, the researcher used three subjects to accomplish the same goal: Science, Mathematics, and Social Science. Even the reaction of students towards the developed strategies was found to be favourable, which showed that they love to learn in new ways. According to the students' reactions, the strategies encouraged them to think scientifically and aided in the development of their natural inquisitiveness. It made them more confident and fearless in asking the question. At the end of the course, it was also observed that students started to find new information on their own and started discussing it in the class. Overall, the response was very positive and the result proved to be significant in enhancing the scientific temper of secondary students. The result of this study could be beneficial for all the stakeholders of the education system, be it a teacher or policymakers. It proves that even with very little conscious effort, improvement can be witnessed.