CHAPTER II

REVIEW OF THE RELATED STUDIES

2.1 Introduction

A researcher tries to understand the field of study by screening related studies attempted by the predecessors. Such an attempt gives required cues to understand different dimensions of the study. Specifically, there are two important advantages of review. First, it helps in avoiding duplication of work. Many a times duplication is desirable provided it gives new insight or provides new direction or shows new paths of undertaking research. Second, a thorough review of the related studies gives general awareness about the field of study, insight into the intricacies of the field and new vision to get ideas to undertake such studies.

In this study, the researcher has selected two areas of science education. First area is understanding of science and the second area is scientific temper. The investigator has a feeling that the understanding of science spontaneously develops attitudes, values of science, and scientific temper.

The scope of this review and synthesis is limited only to those studies which have direct bearing on the present investigation. It appears
that limited attempts have been made in this area of research. This field has been enriched by recent research, though, much has been said and done about this field of work earlier.

This area of research is of great value to India. The country has realized that science education is an integral part of school education and science and technology education should be broad based and accessible to all students at all stages of primary and secondary education. It is also valuable to adult population. In other words, the country needs, scientifically literate citizenry to understand science, to participate in socio-scientific issues and to acquire values of science to make objective decisions. The study of science should foster inquiring, questioning and critical attitudes which are a part of scientific temper.

Considerable international interest has been shown by educationists, scientists and politicians to develop scientifically literate citizenry so that people can understand science and its related technology. There is an urgent need to understand problems such as, environmental degradation, pollution, population growth, energy crisis, radioactive fall out, harmful effects of insecticides and industrial disasters. Therefore, it is imperative that science and technology has a social perspective. *Silent Spring* was published in 1962. This book directed the world's attention to the detrimental effect of chemicals. Rachel Carson warned that the indiscriminate use of chemicals could 'linger in the soil', 'slow the leaping fish' and 'still the song of birds'. If society continued contaminating environment, then one day society would experience a
silent spring. Similarly, James lovelok, in his book Gaia (1978) has argued to maintain an ideal relationship between man and his environment. He has cautioned to protect tropical forests, particularly in Brazil. Prof. Carl Sagon has cautioned about the production of CFC, Chloro-Fluoro Carbon gas which is used as working fluid in refrigeration and air conditioning and its release destroys ozone in atmosphere. In his Nehru Memorial Lecture, in 1991 Prof. Sagon has argued that the destruction of ozone layer is a cause of skin cancer, eye cataract and many diseases. There has been many incidents of oil spill in sea which damaged not only ecology but the life in sea. Therefore, there is need of understanding science to become an active participant in solving socio-scientific issues.

The problem has an educational perspective. There is a need to relate science to its social and technological context. It will help in presenting that science manifests in all aspects of the world, and that it has a human face. Science and technology interact with, influence, and change society and this interaction can have important consequences. Therefore, science for all has been accepted by most of the countries as a part of core curriculum.

2.2 Studies Related to Understanding of Science

The Royal Society's report has mentioned that limited work has been done in this area and detailed investigations into the scientific knowledge which adults possess are sparse.
One of the most extensive publications in this area has been carried out by the National Assessment of Educational Progress (NAEP) in the United States where national samples of approximately 2000 adults in 1972-73 and 1300 in 1976-77 were stratified according to geographical region, community size, community type (urban/rural) and socio-economic status (NAEP, 1979). Adults survey were within the age range of 26-36 representing those years when formal education had ceased and careers were being developed.

Holmes and Wright (1980) in their report on the NAEP Survey results point out that persons in this age were often socially active and concerned about science and society issues. The national survey has indicated that percentage of answers/answer correctly was 44.6 percent in 1972-73 and 40.7 percent in 1976-77. This was taken an evidence of a decline in the science performance of young adults.

In a conceptual and empirical review of scientific literacy, Miller (1983) described the NAEP survey and argued a case for the secondary analysis of the data archive to produce a better portrait of the scientific understanding of young adults.

A new trend to explore the understanding of selected technical terms was like radiation, computer software, and how telephone works etc. were attempted. National Science Board's report, Science Indicators, 1985 has summarised such findings as follows:
TABLE 2.1
PUBLIC UNDERSTANDING OF SELECTED TECHNICAL TERMS
(N=1972)

<table>
<thead>
<tr>
<th></th>
<th>Clear</th>
<th>General</th>
<th>Little</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiation</td>
<td>31%</td>
<td>57%</td>
<td>19%</td>
</tr>
<tr>
<td>Computer Software</td>
<td>24%</td>
<td>33%</td>
<td>43%</td>
</tr>
<tr>
<td>How a telephone works?</td>
<td>19%</td>
<td>48%</td>
<td>33%</td>
</tr>
</tbody>
</table>

A study on Public knowledge of Elementary Physics was carried on by A. M. Lucas (1988). The study shows how to ensure that the knowledge of science acquired by children at the school level is retained in adulthood and whether it is useful to them.

This assumption has relationship with the public understanding of science which is being discussed in UK at present. This study has been conducted to assess the level of scientific knowledge among the British Public. In this study the sample was 1033 British people aged 15 years above, interviewed face to face from 21st June to 1st July, 1986.

This study was attempted to obtain data about the knowledge of simple scientific ideas held by the members of general public.

It included questions multiple choice, true false, free response etc. The level of these questions were of grade IV CSE candidates.

In addition to the knowledge questions, researcher also asked about the respondent's highest level of formal education in science and
non-science subjects. The investigator discussed the relationship between level of education received with the answer given to the questions. The finding were as follows:

Sex Effects

The data has shown that women as a group are less successful in answering the questions appropriately. Men scored 11.4 correct answer over all 24 questions and women 10.0. It was also revealed that in all cases there were more women who claim that they do not know.

Educational Background

There seems to be little reference between these questions and their use in everyday life and for this reason they did not bother. People use products of science unthinkingly and it is extremely difficult to find evidence that knowledge of elementary science has utilitarian value in our everyday life.

This study has revealed that how little of the science that we spend so much time at school attempting to get children to remember is indeed remembrance to adulthood. This leads to the use of process approach to science teaching.

The classroom discussion of social issues by Joan Solomon and Kate Harrison in Education in Science 1990 has discussed some of the topics on kidney transplant, industrial waste, nuclear power.

The Discussion of Issues in school science is a project as a link research programme on the Public Understanding of Science. This project is concerned with school age participants.
Public view are important to judge their opinion about the risk of some scientific activities. It is also related to value or moral judgements.

What pupils feel about these issues is the crux of the whole matter. Personal and Social education cannot fail to be influenced by different styles of learning, such as small group discussions, to encourage schools to recognise that a democratic society thrives only where there is active debate about, and concern for values, and that education is crucial in ensuring that this can occur in a constructive spirit and manner.

Lucas (1987) in another study on 'The Public Understanding of Biology' has reported that the sample (N=1033) has had gaps in their knowledge concerning biology.

Beverley Bell (1984) conducted study on 'Aspects of secondary students understanding of Plant Nutrition. 'It was found that understanding of the function of food was restricted to a superficial level. They appeared to have little understanding of the role of energy in the maintenance of plant metabolism. This study was conducted on 15 years old students in Britain.

The classroom discussion of social issue by Joan Solomon and Kate Harrison (1990) University of Oxford have collected hundreds of recordings of small group discussions of issues like Kidney transplants, industrial waste and nuclear power. This project is part of a linked research programme on 'The Public Understanding of Science' and is concerned with school age participants.
The project show videos about issues that raised the personal
value positions.

A study on 'An analysis of four ways of assessing student beliefs
about STS topics' by Glen S. Aikenhead (1985) investigated four different
modes used to monitor student beliefs about science technology society
topics:

1. Likert type
2. Written paragraph
3. Semistructured interview and
4. Empirically developed multiple choice

XIIth grade students of Canadian urban responded to statements
in each of the four modes from views on Science Technology Society. It
was found that TV had far more influence on what students believed
about science and its social, technological context than other many
science courses.

The Likert type responses were the most inaccurate and only
a guess at student beliefs. Student paragraph responses contained
significant ambiguities in about 50 percent of the cases. The empirically
developed multiple choices reduced the ambiguity to the 20 percent level.
The semi structured interview was the least ambiguous of all four
response modes but it required the most time to administer.

A study on interactions between formal and informal sources
of learning science by A. M. Lucas (1987) discussed that people learn
science form many sources like schools and other formal institutions,
museums etc.
It was found that people with better science backgrounds generally visit science museums, read science news in the press and regularly watch television science programmes.

The possible interaction patterns are as follows:

- **Formal sources facilitate learning from the informal source.**
- **The informal source facilitates learning from formal sources.**
  - * Formal sources inhibit learning from the informal source.
  - * The informal source inhibits learning from formal sources.
  - * The efforts may be mutual also. Formal and informal sources are mutually facilitatory.
  - * Formal and informal sources are mutually inhibitory.
  - * Formal sources facilitate learning from the informal source, but the informal inhibits learning from the formal. Informal sources facilitate learning from the formal, but the formal inhibits learning from the informal.

In India there is not a single published study on understanding of science. However, three studies. Mathur (1990), Sood (1992) and Kansakar (1996) have been attempted.

Mathur (1990) has conducted a study on the Public Understanding of Science and its relationship with scientific attitude.

In this study the investigator has laid down the following purposes.

1. To study the understanding of science among different groups
of students and public.

2. To study scientific attitude among different groups of students and public.

3. To study relationship between students and other groups regarding their understanding of science and scientific attitude.

4. To find out the effect of parental occupation on public understanding of science.

5. To study the effect of type of school on public understanding of science.

The following hypotheses have been tested in the study:

1. The theoretical mean on public understanding of science scale is higher than the obtained mean of the total sample.

2. There is no difference between different groups of public and students regarding their understanding of science.

3. There is no difference among different groups of students taken from different types of schools regarding their public understanding of science.

4. There is no difference among different categories of students taken on the basis of parental occupation, regarding their understanding of science.

5. There is no difference between two groups of students due to sex regarding their understanding of science.

6. The theoretical mean on scientific attitude scale is higher than the obtained mean of total sample.
7. There is no difference among different groups of public and students regarding their scientific attitude.

8. There is no difference among different groups of students taken from different types of schools regarding their scientific attitude.

9. There is no effect of the type of sample on relationship among public understanding of science and scientific attitude.

In this investigation 550 students and public of both the sexes, were selected. Random sampling method was used to select general public as well as schools for data collection.

In this study two instruments have been used namely:

1. Public understanding of Science Scale - developed by the investigator. The test comprises of 18 items. It is a 5 point likert type scale.

2. Scientific Attitude Scale-
   This scale comprises of 36 items. It is a 5 point likert type scale.

The finding have been as follows:

1. The study has indicated that the total sample of 550 students and public has favourable and positive understanding of science.

2. This study has revealed that there was no significant difference between two groups namely students and public concerning their understanding of science.

3. In this study it has been found that there was some effect on
public understanding of science when students from different types of schools were compared, namely:

i) There was significant difference between students from Government schools and students from Private schools concerning their understanding of science. It has also revealed that the students from Private schools possess significantly higher understanding of science than the students from Government schools.

ii) The students from Military schools were significantly better than the students from Government schools regarding their understanding of science.

iii) The students from Public schools possess significantly higher understanding of science than the students from Government schools.

iv) The students from Military schools showed better performance on the public understanding of science scale than students from any of the other schools.

4. In this study the total sample of students was divided into six categories based on parental occupations.

i) This study has shown that the parental occupation does influence the students' understanding of science.

ii) It has been found that the students coming from science related parental occupations are significantly different from the students coming from military services and other types of parental occupations.
5. This study has revealed that there was no significant difference between different groups of students based on sex differences concerning their understanding of science.

The product moment coefficient correlation was used to find out the correlation between public understanding of science and scientific attitude.

The findings are as follows:

1. This study inferred that the public understanding of science and scientific attitude are positively and significantly correlated.

2. There is highly significant correlation found between public understanding of science and scientific attitude in total sample of students and public (N = 550)

3. There is highly significant correlation between public understanding of science and scientific attitude in public group.

4. There is highly significant correlation between public understanding of science and scientific attitude in students groups.

5. It has been found that the relationship between public understanding of science and scientific attitude is not effected by the type of sample.

Another study was conducted by Sood (1992) entitled 'An investigation into the Public Understanding of Science.' The objectives of the study, sample, tools and analysis are as follows:
The objectives of this study were:

1. To determine the levels of the public understanding of Science among different groups.
2. To find out the differences in the public understanding of science, due to different social and educational background.
3. To determine the attitudes towards science among different groups.
4. To find out the differences in attitudes towards science in different groups.

The following null hypotheses have been developed for this study:

1. The Public Understanding of Science of the total sample (N = 308) is less than the theoretical mean.
2. There is no difference in the understanding of science between different groups of people (students and public).
3. There is no difference in the understanding of science due to community type, that is, urban and rural students.
4. There is no difference in the understanding of science due to sex differences.

Some schools were randomly selected from two categories of schools, namely, the public schools and the rural schools. Rural schools are generally Government schools. Secondly, general public was selected from different states of Northern India. The sample was as follows:
Students from Public schools  \( N = 88 \)
Students from Rural schools  \( N = 112 \)
General Public  \( N = 108 \)
Total  \( N = 308 \)

Male  \( N = 234 \)  
Female  \( N = 74 \)

The investigator developed two instruments, namely, The Public Understanding of Science Scale and Attitudes towards Science Scale. The first scale comprises 40 Likert type items and the second scale consisted of 20 items. Each item was a three point response format. In each test half of the items were of negative and remaining of half positive response.

The findings were as follows:

The total sample of 308 has indicated that the group has high level of the public understanding of science. It means, the sample as a group possess a high level of understanding on issues such as pollution, environment, energy, healthy living and science with ecological perspective.

Difference between general public and students was also determined. Thus, the data confirm that General public, that is people with higher education, different and diverse background and different geographical locales are much more aware about the socio-scientific issues which influence their living and environment. Issues related energy and radiation are of significance in a country like India. Consequently an understanding of such issues is of much relevance for the nation.
At first sight it is surprising that there is no effect of the quality of education and the social background of the students. However, students of public schools are much more awakened towards socio-scientific issues. Such issues are also discussed and analysed in school environment and with parents. They are also exposed to concerned literature and multimedia.

The test on the Public Understanding of Science has measured (a) Concepts of Science, (b) Science related social issues, and (c) Science with ecological perspective.

This research study has examined the extent of general public and students' attitudes towards science. A thorough and careful examination has revealed that the total sample has favourable feelings towards science. These sub-areas consists of attitudes towards methodology of science, interaction of science with society and opinion about scientists. It is an encouraging finding because as a nation we need positive attitude towards science related activities and scientists.

This study has also revealed that all different groups, independently, possess favourable attitudes towards science. It has also revealed that type of school or classroom climate develops favourable attitudes to science. The sample from Public schools had similar findings.

Another study was conducted by Leela Pradhan (Kansakar), 1996, entitled: 'An Investigation into the Undederstanding of Science and Scientific Temper: A cross cultural study.'
The purposes of this study regarding understanding of science were as follows:

1. To develop and validate instrument of understanding of science.
2. To determine the levels of understanding of science among different groups of pupils from India and Nepal.
3. To study the effect of type of school, class level, geographical locale and sex on levels of understanding of science among students.
4. To determine the relationship between levels of understanding of science and scientific temper.

The hypotheses taken by investigator regarding understanding of science were as follows:

1. Theoretical mean of the total sample is not different than the obtained mean on the understanding of science scale.
2. Students from India and Nepal are not different on the understanding of science scale and on its dimensions.
3. Students of different classes are not different on the scores of the understanding of science scale and its dimensions.
4. Students of different groups are not different on scores of understanding of science scale and its dimensions due to class level differences.
5. Students from urban and rural schools are not different on the scores of the understanding of science scale and its dimensions.
6. There is no significant effect of class level, geographical location, type of school and sex of students on coefficient of corelation between scores of understanding of science and scientific temper.

The findings of the study were as follows:

1. The total sample of students from India and Nepal (N=1315) has favourable understanding of science. It was also inferred that the total sample has favourable understanding of scince concepts, science policy perspective. Incidentally, understanding of science among students was not highly favourable on dimension value judgement.

2. It was found that students from Nepal (N=705) possess significantly higher understanding of science than the students of India (N-610). Students from Nepal had significantly higher understanding of science concepts, science policy perspective and value judgement dimensions.

3. It was indicated that students from Xth class do not significicantly differ from students of XIth class on their understanding of science.

4. Similarly, male and female students do not differ significantly on their understanding of science. It is also true in case of three dimensions of the scale.

5. It was revealed that students from schools situated in urban
localities possess higher understanding of science than the students from schools situated in rural areas. It is true on the three dimensions of this scale also.

6. It was indicated that the students studying in private schools has higher understanding of science than students from Government schools. It was also revealed that the students from private schools in Nepal possess higher understanding of science, the students from private schools in India were not different from the students of Government schools concerning their understanding of science.

7. There is significant difference between secondary and senior secondary students from Nepal in their understanding of science. Senior secondary students possess higher understanding of science. But their counterparts in India were not significantly different in their understanding of science.

8. It was indicated that the secondary and senior secondary students from Nepal and India differ on their understanding of science and students from Nepal possess much more favourable understanding of science.

9. It was indicated that male and female students from India and Nepal independently do not differ significantly concerning their understanding of science.

10. It was indicated that the students from urban and rural schools differ in their understanding of science. This is true for the
students from both India and Nepal. The students from urban schools possess much higher understanding of science. But students from rural schools of India and Nepal do not differ in their understanding of science. Students from urban schools of India and Nepal differ in their understanding of science.

11. Students from Government schools of Nepal and India differ on their understanding of science. This is also true to students of private schools.

2.3 Studies Related to Scientific Temper

Science is an on-going, dynamic and humanistic process. The impotance of helping people understand the dynamic nature of science, is essential. As our world continues to become increasingly rooted in science and technology, citizens will use such knowledge in their daily lives with increasing frequency. When science has become and integral part of contemporary socio-cultural milieu and many science technology related issues can be solved only by applying scientific thinking, scientific ethos and methods of science, becomes essential to develop scientific thinking among the people. It also includes the development of scientific attitude and scientific way of thinking and action. Scientific attitude includes both opinion about science and those traits of the mind which gives impetus to curiosity, rationality and objectivity. Scientific attitude is a mental disposition with regard to looking at things objectively and rationally. It includes traits such as open mindedness, curiosity, suspended judgement, objectivity, honesty and humility.
Much research work has been attempted in conceptualizing and getting empirical evidences on scientific attitude. Starting with Curtis (1924), Noll (1935), Davis (1935), Ebel (1938), Lampkin (1938), Honey (1964), Harris W. Chaster (1966), Diederich (1967), Jāin (1976), Kozlow and Nay (1976), Fleming Joseph (1979), Srivastava (1980), Vyas (1981), Golwalker (1978), Ramachary (1982), Sanadhya (1986) have studied conceptual aspect as well as development and measurement of scientific attitude.

It appears, contemporary scenario as related to science technology and society, is different specifically in the developing countries. Developing countries suffer from illiteracy, traditionalism, and conventional way of thinking. These countries are increasingly encouraging the growth and development of science and technology. Thus on one hand science is a mysterious thing and scientific thinking is far away from them and on the other science has become the source of development. Goswami (1984) has very mentioned:

India, really is a land of contrast. Here, the high science and technology of space and electronics go hand in hand with the bullock cart, atomic energy goes side by side with cowdung burning, highly sanitary conditions and nutritious food in big hotels go along with the stinky slums where penniless, jobless dwellers live in a primitive state. But the fruits of science and technology have percolated not only to the sophisticated urban life but to the simple life of the remote village which outwardly looks undisturbed by the change. The man in the remote
village also occasionally listens to the radio, uses a contraceptive device, swallows a tablet, sprays insecticides, takes a bath with a cake of soap, rides a bicycle and a bus and receives a telegram. He may even be luckier and be able to see an instructional telecast, or a movie shown by a social welfare body that encourages him to get his children inoculated and vaccinated, to sow a high yielding disease resistant variety of seed in fields or to get his wife tubectomised.

The course of science and technology has also touched the life of almost every Indian (like his counterpart in any other part of the world). The shock of rapid change and the unmanageable emotional adjustments, the ill effects of land, water and air pollution, the tilted balance of the ecosystem - all have echoed and re-echoed in his life either in an urban or rural environment.

Thinkers have agreed that the masses should adequately interpret science and scientific thinking. Many a times, it has been observed that the students and public may know what these styles of thinking are, but may be quite unwilling to adopt them as their own: that is they may have negative attitudes to these 'scientific attitudes' (Schibeci, 1984). Thus the attributes such as open mindedness, tolerance of the views of others, objectivity, and rationality (which are also known as attributes of scientific attitude) have not been taken as a way of thinking and action. Therefore, a more generalised view of scientific attitude has to be inculcated among the people. This has been taken as scientific temper.
It is now well accepted that the continuation of a medieval outlook and value system and social norms have been a hinderance to the development and integration of developing societies. The sixth five year socio-economic plan (1980-85) in India has mentioned.

The task of creating scientific temper is a vital necessity for the growth of science and its utilisation in the development process. There is need to create scientific climate and involve the people in discussion on various issues of science and technology which affect their life. There has to be dissemination of knowledge about natural phenomena and technological innovations through popular science journals and other media. There is also need for promoting public debate on major issues on science and technology. The full potential of science has to be utilised for eradication of irrational attitudes, which tend to hold back the nation from the path of progress.

India has distinctly accepted the development of scientific temper as one of the objectives of education. But there are limited studies in this field of research.

The investigator could find only four studies on scientific temper. These studies have been attempted at Ph. D. and M. Ed. level. Singh (1990) has attempted Ph. D. research entitled 'Scientific Temper and Education'; Sharma has attempted M. Ed. (unpublished, 1991) entitled 'A study of the Scientific Temper of students of senior higher secondary schools; Dubey K. K. 1992 conducted a study entitled 'A study of the scientific temper and its measurement.' The investigator has pointed in his study that whereas the measurement of scientific temper is a real problem, its development is regarded as one of the most important goals of school science education. Me said that the present study attempts at the measurement of scientific temper.
The objectives of the study are as follows:

i) To develop a scale for measuring scientific temper along with its appropriate working definition and determination of its ingredients using factor analysis and

ii) to compare the incidence of scientific temper as judged by scores on the scientific temper test among different groups of teachers and students, such as male and female, urban and rural and science and non-science students as well as teachers.

The methodology used in this study is a two-stage stratified sampling method to select class XI science and non-science students. It also included two groups of teachers, i.e. science and non-sciense teachers. The scientific temper scale devised on the Likert method of summated ratings was used to collect the data.

The major findings of this study are as follows:

1. All the groups of students and teachers manifested scientific temper.

2. Significant differences in scientific temper were noticed between male science teachers and male non-science teachers; female teachers and male teachers, rural girls and urban girls, urban boys and urban girls and finnaly male science students and female science students.

3. No significant differences appeared between female science and non-science teachers as well as science students and non-science students.
4. The mathematical structure of tools and tasks as used in this study showed the existence of two factors, namely, curiosity and aversion to superstitions.

Another study was conducted by Leela Pradhan (Kansakar), 1996, entitled 'An Investigation into the Understanding of Science and Scientific Temper: A cross cultural study.'

The objectives of this study regarding scientific temper were as follows:

1. To develop and validate an instrument on scientific temper.
2. To study the levels of scientific temper among different groups of pupils from India as well as from Nepal.
3. To study the effect of type of school, class level, geographical locale on levels of scientific temper and
4. To determine the relationship between levels of scientific temper and understanding of science.

The following hypotheses regarding scientific temper were tested in the investigation:

1. Theoretical mean of the total sample is not different than the obtained mean on the scientific temper scale.
2. Students from India and Nepal are not different on the scientific temper scale and on its dimensions.
3. Students of different groups are not different on scores of scientific temper and its dimensions due to class level difference.
4. Students of different sexes are not different on the scores of scientific temper and its dimensions.

5. Students from urban and rural schools are not different on the scores of the scientific temper scale and its dimensions.

6. Students from different types of schools are not different on the scores of the scientific temper scale and its dimensions.

7. There is no significant relationship between scores of understanding of science scale and scores of scientific temper scale.

8. There is no significant effect of following on coefficient of correlation between scores of understanding of science and scientific temper.

i) Class level of students.

ii) Geographical location of students.

iii) Type of school of students and

iv) Sex of students.

The sample of the study were selected by random sampling procedure. The sample comprises students studying in Xth and XIth classes from India and Nepal and the total sample includes 1315 students.

The findings were as follows:

1. The total sample (N=1315) has above average scientific temper. The sample has positive and favourable value perspective, it has aversion to superstition, favourable attitude towards science...
and has constructive world view about science and its role in developing a balanced world.

2. It was indicated that the students from Nepal reflect higher level of scientific temper than the students from India. These two groups significantly differ on different dimensions of scientific temper, that is, Value Perspective, Aversion to Superstition, Attitudes towards science and a World View Perspective.

3. This study has reflected that senior secondary students possess much more favourable scientific temper in comparison to secondary school students. It was also indicated that senior secondary students possess higher level of value perspective, aversion to superstition, attitude towards science and a world view perspective.

4. It was indicated that there is no difference in the level of scientific temper due to sex differences. But there was significant difference between male and female students on a world view perspective. Male students' thinking was on the higher side.

5. It was revealed that the students from the schools situated in urban areas has much higher level of scientific temper than the students from schools of rural areas. This is true on the all four dimensions of Scientific Temper Scale.

6. It was indicated that the students from private schools possess high level of scientific temper than the students from Government schools.
7. It was inferred that the secondary students from Nepal possess high level of scientific temper than the secondary students from India. But the secondary students from India possess high level of attitudes to science in comparison to secondary students from Nepal.

8. It was observed that the senior secondary students from Nepal has high level of scientific temper than the senior secondary students form India. But there was no difference in these tow groups on dimension a set of attitudes.

9. It was observed that the male students from Nepal has high level of scientific temper than the male students from India.

10. It was revealed that the female students from Nepal has high level of scientific temper than the female students from India.

Singh (1990) has defined scientific temper as follow:

"For operational purposes, scientific temper would mean a value frame, an outlook for the world and an approach to one is world of deeds and action."

The investigator has determined the role of education to cultivate scientific temper. According to him education plays a liberating role in changing economically determined and socially conditioned attitudes of teachers, and teacher education can cultivate, 'Scientific Temper' in the prospective teachers, despite level of development and such was the presumption. Since the only criteria of educational development of the
teachers could be their educational background, it came to light that their achievement level is more or less the same, except for a few variations.

**Hypotheses of the Study:**

1. Level of scientific and technological development determines the perception of a society.
2. Teacher pick up their attitudes from the society they belong to.
3. Education plays a liberating role in changing economically determined and socially conditioned attitudes of teachers.
4. Scientific Temper is an attitude and a world view which is positively correlated with the development of society.
5. Teachers' attitude is an indicator of level of development and level of liberation as correlates of 'Scientific Temper.'
6. Teacher education can cultivate 'Scientific Temper' in the teacher-learner despite level of development.

**Findings of the Study:**

This diagnostic study, reflects the mental and projective formations, in the teachers of higher secondary schools, of Kanpur District as the human component of educational system. The method adopted in sampling data collection and analysis have been portrayed, and the synthetic view sums up the study by bringing out the blocks, which handicap the teachers in a perception, conducive to critical thinking, rational approach, scientific method and above all scientific temper. Negations of scientific temper in their mental make up should be negated
and positives have to be re-inforced in the interest of the educational system. Hypotheses were six in numbers which were reorganised into 1 and 2 as one unit, 3 and 6 as the other and 4 and 5 as the third unit, for inspection and enunciation of the qualitative study.

**Technology, Society and Teachers**

The first set suggests estimation of the interplay of technology, society and teachers. The two types of samples, from rural and urban Kanpur represented two levels of technology in the District. Perception of the teachers while estimating their attitudes, did not reflect an equally different type of attitudes on this score. Rural and urban teachers in the sample were categorised on the basis of scores and the rural born and working also in rural areas did not have share in one category or some specific categories only. Another indicator of use of technology possibly, lies in the economic capacity of the family of origin. There has been a marked difference in the attitudes of those teachers whose parents were illiterate regarding their aspiration for the education of their children. So they feel that they should be able to do their maximum towards the better bringing up of their offsprings. A third level check up was made available from the data through the tools, about the perception of the teachers of the profession they belong to, their academic satisfaction and the difficult, if any, faced by them in securing the first job and promotion. Responses about these items are also clear in uniformity without the portrayal of level of science and technology gets minimal reflection in the attitudes of the teachers. The assumptions are not
supplanted by the data and results. If there is any difference, it is in the context of definitely positive perception about the future of their children in a growing dimension of changing society.

**Education and Cultivation:**

Education plays a liberating role in changing economically determined and socially conditioned attitudes of teachers, and Teacher Education can cultivate 'Scientific Temper' in the teacher-learner, despite level of development and such was the presumption. We saw the role of education per se, before getting into teacher education. Since the only criteria of educational development of the teacher could be their educational background, it came to light that their achievement level is more or less the same, except for a few variations, when a very marginal number is very high achiever and few at the bottom. Equally dispersed in the categories, they prove that education as such has played its role to make up their attitudinal profile. However, those teachers who got the advantage of orientation and training programmes are certainly different than those who did not get the advantage. This second level training is upheld by data, the first level is compulsorily obtainable in the teachers. Both the factors of education and teacher education get upheld and sustained. Obviously, there could be difference between the uneducated and the educated which we did not check up.

**Levels Available**

We tried to understand hypotheses four and five and developed items for tool two, to estimate attitudes (the value frame) the world view,
and for their being teachers as liberated individuals in the educational system, the teaching learning component of the questionnaire. The highly loaded category XIV, both individually and collectively, of the responses on these three variables in tool two suggests the preponderance of the medium image. When we took up the study, we were not sure of such a level of performance. There has been in the air an opinion that the Indian society has been traditional, loaded with dogma and obscurantism. Different religious groups, caste groups and urban/rural groups have their share in this category, as in the category I and XXVII. Certainly, scientific temper is at different levels with respect to the categorisation of teachers but none of the off quoted statements are upheld by our data, which could put us up against the set up in which teachers are being nurtured. This aspect of the theses may be repleted in other studies to substantiate the arguments in districts other than Kanpur, since each district differs in its artifacts. The value frame thus discovered in our sample is a case where rural - urban differentials have upheld the continuum principle, religious, caste and community differences are minimised by educational intervention, and scientific temper is an equitably shared culture amongst the teachers, depending on their level of allround development as human beings.

So far so good about the hypotheses that we had set and synthesized for qualitatively interpreting the data. We did undertake a study of women teachers as a separate exercise, so as to find out their
situation in the whole study. Women teachers, almost a representative sample of educated women in the society, have proved in the study that they are around better achievers, performers and more satisfied, accountable by generally belonging to educated parents and better off families. Also, with respect to belongings, they show higher level of possessions, including their own transport as scooters. They did not face difficulties in securing their jobs, casteism and communalism has been reckoned by them as a factor creating problems. But this has to be seen in far wider terms than this study provides. We check up these problems as survivals, revivalism has to be measured by subsequent studies, as an intervening variable. One significant aspect failing out of the study is the perception of female component, about the status of the teacher in the society. Women have generally ranked wealth and social - political influence as two criterion at top levels. This shows that women find themselves handicapped because of these factors in a society more conducive to other than professional competence as determinants. The theses in this aspect provides a latest indicators for women studies.

The Blocks

The tool to test the scientific temper brought the categories in descending orders. There were HHHH performers. MMM performers and LLL performers. They are without contradictions teachers in their straight perceptive profile. However, the combinations of HML give a very different category of double jumps as described in the synthetic portrayal of the data. These are the cases which gave us material to understand the
reason of such double jump and these we called blocks. These blocks are primarily socially conditioned nothing to do with level of technology. Casteism, communalism and the culture of differentials in wealth have provided one set of blocks. It is obvious that the differential logic regarding these factors as observable in society must get reflected in the desperate view.

However, our work takes note of three dimensions, cognitive, affective and conative aspects of the professionals, as teachers. The mental block regarding cognitive domain comes from lack of information and correct knowledge about two aspects one is the understanding of reality behind the myths that influence them from early socialisation. The second one is their lack of comprehension of the concept 'citizenship of the earth.' If one is an understanding of ancient and its survivals in science of India, the other is designed to take strides with all that which is not yet a common message in ecosystem approach. In the affective domain, this group of mental blocks redeems one level data to substantiate absence of critical appraisal and scientific method in pursuing the observance of what was conveyed to them in their receptive formative stages. The third area is the conative or work situation. Generally there is a poverty, more reflected in block formations when high achievers otherwise become low performers in teaching learning. In this tool, teaching learning is a part of the compendium of three sections. A teacher world only be as liberated a person as he/she is able to liberate the children. And certainly, the factor is the outcome of one's
perception of the past in retrospect and connected with the future and at the mid point sees the present. This requires an outlook, which is not their fault, either. If teaching learning is an outcome of a training programme, it should highlight the totality of the things in situational context to develop the appropriate outlook for the equally desirable efforts as teachers. There are born teachers and we cannot depend on this natural gift only.

**General Conclusion:**

While discussing the components and their inter play in the sample we did see the interaction and their reflect on the sample. Following is the presentation of conclusion arrived at.

a) The highest categories in values, teaching learning and world view start from the scores 75, 71 and 75 respectively. Therefore, it is concluded that in high categories, scores are almost at equal level. The medium categories, however, for values is for scores 56 to 74 in teaching learning, for 52 to 70 and 65 to 74 for world view. This is to conclude that drop in score in world view is much lesser than the corresponding drop in teaching learning and values. Similar is the trend in the low categories.

b) The above trend is reflected in the relationship of these three ingredients: between values and teaching learning and world view. Between values and teaching learning the relationship is linear, both in low and high regions of values. In its medium region, the teaching learning score is almost constant. However,
the world view drop in the lower region is at much lower rate than the drops in values and teaching-learning.

c) We conclude that there is a positive relationship between these three ingredients of scientific temper. However, since for the high achievers the scores are almost the same, remedial measures are required for the relatively medium and lower category people in their value and teaching-learning domains, although as interdependent ingredient world view is to be over all improved, for all the teachers so that the logic of the 'citizenship of the earth' gets scientifically and technically opened up.

2.4 Implications for This Study

A review of the related studies have been attempted in this chapter. It appears that the concepts of understanding of science and scientific temper have not be studied by many researchers. Undoubtedly, there are many studies on scientific attitude both abroad and in India but there were only three unpublished studies on the understanding of science and four studies on scientific temper. Some of implications for this study are as follows:

1. Contemporary socio-cultural scenario in India needs empirical evidences on the development of the understanding of science and scientific temper.

2. Socio-cultural scene in India reflect wide and varied contrast which necessitate the significance of inculcation of scientific
temper based upon adequate research based feedback.

3. There is not a single cross-religion study on the understanding of science and scientific temper.

4. There is paucity of conceptual ideas on scientific temper.

5. It is evident that an adequate understanding of science will generate scientific thinking and scientific temper among the people. It is implied that the cognitive aspect of the understanding of science will help in inculcating affective aspect of scientific thinking.

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