CHAPTER – VIII

SUMMARY, CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

INTRODUCTION

The present age is a scientific one. In order to keep pace with the rapid advance of knowledge in the present day world, there is need of developing scientific temper in children, and special emphasis should be given to science education in schools. National Policy on Education (1986) had also recommended that science education will be strengthened to develop in child well defined abilities and values such as spirit of inquiry, creativity, objectivity and courage to question.

According to Vaidya (1971), “scientific attitude is a particular bend of mind, in the person towards ideas, events and living world that is based on scientific explanations. Scientific attitude includes freedom from bias, prejudice and superstitions. It is open – mindedness, critical mindedness, intellectual honesty and ability to accept the new evidences. Scientific attitudes are certain mind – sets in a
particular direction. So, by adopting varied techniques, such mind sets in a particular direction can be developed.

Good (1973) has defined scientific attitude “as a set of emotionally toned ideas about science and scientific methods and related directly and indirectly to a course of action”. In the literature of scientific education the term implies such qualities of mind as intellectual curiosity, passion for truth, respect for evidence and an appreciation of the necessity for free communication in science”.

Wolfe (1923) stresses the fact that “it must be firmly borne in upon us that scientific attitude rests upon one and only one fundamental article of faith, faith in the university of cause and effect. Without this faith, a steady, undaunted pursuit of scientific knowledge as a guide to action may be incontinently flouted whenever it interferes with special interest or prejudices”.

To Francis (1924) “scientific attitude meant an inherent stimulus to climb the path that leads to knowledge with the strength to reach the summit – one which, if hindered or thwarted, will fret and strive until all hindrance is overcome, and it is free to follow its labour – loving instinct”.

For John Dewey (1933) a scientific attitude was linked with “an ordent curiosity, fertile imagination and tone of experimental inquiry”.

According to Victor “Scientific attitude includes the habits like accuracy in all operations, intellectual honesty, open-mindedness, suspended judgement, looking for true cause and effect relationship, criticalness including self criticism”.

According to Diedrich (1967) scientific attitude includes, “a desire for experimental verification” as a component labeled “Scepticism” as “an unwillingness to accept the statements which are not supported by evidence defined as verification of predictions”.

Kurz (1976) “a belief is true if and only if, it has been confirmed, directly or indirectly, by reference to observable evidence”.

Nair (1971) said that “scientific attitude is characterized by intellectual honesty, objectivity in drawing conclusions, adoption of scientific and systematic procedure,
open-mindedness in receiving new ideas and facts, curiosity, readiness to reconsider one’s own judgements, spirit of teamwork, self-help and self-reliance, intellectual satisfaction from scientific pursuits, economy in use of materials, honest recording and reporting of observation, faith in cause and effect relationship, pursuing activities with consistency, preparedness to face hardships and difficulties, a sense of dedication and faith in specialists in their respective fields”.

According to Kohli (1986), “the person possessing scientific attitude looks for natural causes for the thing that happens, curious concerning the things he observes, open-minded towards work and other’s opinion, evaluates techniques and procedures and makes the opinions and conclusions based on adequate evidences”.

Vaidya (1999) explained that “scientific attitudes are open-mindedness, curiosity, judgement based upon scientific facts alone, willingness to test and verify conclusions, faith in cause and effect relationship, honest reporting, rejection of the principle of authority and more faith in the books written by specialists in their respective fields etc”.
According to Auseker (1995), “scientific attitude can be defined as open – mindedness, a desire for accurate knowledge, confidence in procedures for seeking knowledge, and expectation that the solution of the problem will come through the use of verified knowledge”.

The National Council of Educational Research and Training (NCERT) conducted a workshop at Chandigarh in 1971 and evolved the following specific behaviour of a pupil who has developed scientific attitude.

The pupil –

1. Is clear and precise in his statement and activities.
2. Bases his judgement on verified facts (not on opinion).
3. Is willing to consider new ideas and discoveries (free from prejudices).
4. Reacts favourably to efforts made to use science towards human welfare.
5. Is prepared to reconsider his own judgements.
6. Arranges the apparatus, materials etc. in their proper places at the end of the work.
7. Suspends judgement in the absence of sufficient data.
8. Is free from superstitions.
9. Is objective in his approach
10. Is honest and truthful in recording and collecting scientific data.

SCIENTIFIC ATTITUDE AND OBJECTIVES OF SCIENCE TEACHING

Rai in his Report on School Science Teaching states that the main objectives for teaching of science should be –

1. To arouse the curiosity of the students about the world we live in and to encourage him to understand the various natural phenomena.
2. To train to acquire the habit of making observation in a planned way.
3. To develop in him scientific attitude.
4. To give him an idea how a scientist works.

The aims and objectives of teaching general science, according to All India Seminar on Teaching of Science, should be:

1. To familiarize the pupil with the world in which he lives and make him understand the impact of science so as to enable him to adjust himself to his environment.
2. To acquaint him with the scientific method and enable him to develop scientific attitude.

3. To give the pupils a historical perspective, so that he may understand the evolution of scientific development.

The following similar set of objectives was formulated by the principals of Delhi Higher Secondary Schools in the third summer camp organized by the Extension Department of the Central Institute of Education, Delhi.

1. To develop in the student a scientific attitude.

2. To develop in the student critical thinking.

3. To enable the student to acquire the fundamentals of scientific method.

4. To develop the student to be creative.

5. To develop in the student skill in laboratory techniques.

6. To develop in the student the ability to apply scientific knowledge and principles to problems of everyday life and new situations.

7. To enable the student to comprehend scientific terms, concepts, symbols, various tables and their uses.

8. To enable the student to construct and interpret graphs, diagrams and models.
9. To enable the student to collect and interpret data for the solution of problems.
10. To enable the student to be familiar with the natural resources of his environment and their uses.
11. To enable the student to be familiar with the trends in modern science.
12. To enable the student to appreciate the beauty and order in nature.

Bhaskara Rao states that a teacher must formulate some definite objectives and specification..... in order to achieve desirable behavioural changes among pupils. He emphasizes on objectives such as knowledge, understanding, application, skill, interest, scientific attitude and appreciation.

And the latest National Policy on Education – 1986 states that ‘Science Education will be strengthened so as to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question, and an aesthetic sensibility’.

All the above aims and objectives of science stress, directly or indirectly, the importance of
scientific attitude along with scientific aptitude, skills, abilities and interests.

FACTORS INFLUENCING THE DEVELOPMENT OF ATTITUDES

1. Maturation

While the formulation of attitudes is unquestionably conditioned by experience, the effect of environmental stimuli is conditioned by prior organic growth. This applies not only to the growth of nervous system but also to the growth of the entire body. The crippled and undersized boy of sixteen years is unlikely to form the same attitudes as those formed by another boy of sixteen who is large, well proportioned, and strong for his age. Age and sex are important factors in determining just what attitude responses will be made to a given environmental situation.

On the intellectual side, attitudes are conditioned by the growth of intelligence. Development of attitude will depend on memory, understanding and reasoning. The young child has only a very limited capacity for understanding the world about him and he is consequently
incapable of forming attitudes about remote, or complex or abstract things or problems.

At about a mental age of twelve years the child begins to understand abstract terms such as pity and justice, and his capacity for both inductive and deductive reasoning shows a marked and continuous increase during adolescence.

At the age of four or five years, three characteristics especially deserve mention. These are curiosity contra suggestibility and independence. The child at the age is likely to express his curiosity by asking an endless series of questions. He is trying to understand the concrete world around him, and he consequently bombards his elders with questions as to what things are, where they come from and how they operate.

At about the age of ten or twelve years, there is an increase in self-confidence which is associated with a tendency to criticize older people, both parents and teachers.
2. Physical factors

Clinical psychologists have generally recognized that physical health and vitality are important factors in determining adjustment; and frequently it has been found that malnutrition or disease or accidents have interfered so seriously with normal development that serious behaviour disturbances have followed.

Low vitality is an important factor in producing poor social adjustment and will inevitably have an important effect on the formation of attitudes in many different directions. Such children are much more likely to have anti-social attitudes and are less subject to group influences in the formation of other attitudes.

Malnutrition and disease are to a considerable extent responsible for these cases of low vitality.

3. Home Influences

It is generally accepted that attitudes are determined largely by the social environment and that home influences are especially important. In a study of intra-family similarities in attitudes, Newcomb and Svehla compared parents and children on Thurstone’s scales for measuring
attitudes towards the church, toward war and toward Communism. Correlations between the parents were highest, those between parents and children were next and those between siblings were lowest. The fact that the correlations between siblings are lowest suggests, to some extent at least, the importance of outside social influences.

4. The Social Environment

Through social contacts, as well as through the home, the individual acquires a large proportion of his attitudes, stereotypes and prejudices.

A church group, or a social club, or a college community may come to have a particular kind of emotional and intellectual atmosphere, with the result that individual who accepts membership in the group also tends to appreciate the characteristic attitude of the group. The group influences are very strong in case of some attitudes, and, in case the schools attempt to develop attitudes that are opposed to such group – supported attitudes, the results are not likely to be encouraged.
5. School Government

The form of the school government seems to be an important factor in determining attitudes. In an experimental study, Lewin and Lippitt concluded that there were more tensions and more evidence of egocentric feelings in a group under autocratic control, whereas there were more cooperative endeavour, more expression of objective attitudes and of praise and friendliness, and more constructiveness in a group with democratic control.

There are large numbers of factors affecting scientific attitude of the students such as personality, intelligence, adjustment, interest, study habits, socio-economic background, achievement, school environment and home environment, etc. but out of all these factors the investigator has selected certain important variable and has tried to see their relationship with the scientific attitude of 9th class students.

The present study entitled, “A study of select Intellectual and Non – Intellectual correlates of Scientific Attitude” is undertaken with the following objectives:
OBJECTIVES OF THE STUDY

1. To construct and standardize Scientific Attitude Scale for Ninth Class students.

2. To find the relationship of Intelligence and Science Achievement (Intellectual variables) and Socio - Economic Status, Scientific interest and Home environment (Non – intellectual Variables) with their Scientific Attitude.

3. To examine the difference in scientific attitude if any, on account of sex, rural – urban and caste differences, type of school and also the viewing of Scientific Programme.

HYPOTHESES

1. Intelligence of the students correlates significantly with their scientific attitude.

2. Science achievement of the students correlates significantly with their scientific attitude.
3. Socio-economic status of the students correlates significantly with their scientific attitude.

4. Interest of the students in scientific activities correlates significantly with their scientific attitude.

5. Home environment of the students correlates significantly with their Scientific Attitude.

6. There will be no significant difference in the scientific attitude of girls and boys.

7. There will be no significant difference in scientific attitude of rural and urban students.

8. There will be no significant difference in the scientific attitude of the students studying in government and private recognized schools.

9. There will be no significant difference in the scientific attitude of scheduled caste and non-scheduled caste students.
10. There will be no significant difference in the scientific attitude of students who view Discovery Channel, Quiz Competition and similar type of programmes on Television and those who don’t view such type of programmes.

DELIMITATION OF STUDY

1. The present study is delimited to 9th class students studying in government and recognized private model secondary/senior secondary schools of Punjab State.

2. The study is restricted to Punjab State only.

3. The study is restricted to 740 students (from government schools and from recognized private model secondary/senior secondary schools) selected on the basis of multi – staged randomization techniques.

DESIGN OF THE STUDY

Descriptive survey method of Investigation is employed in the present study. Present study is
completed in two phases. In the first phase the construction and standardization of Scientific Attitude Scale is completed. In the second phase, data is analysed with the help of product moment correlation technique and t-ratio technique.

SAMPLE

In order to obtain the proportionate and representative sample of Urban, Rural, Government, Model School Students, Scheduled Caste and Non-Scheduled Caste students and also girls and boys students, multistage randomization technique of sampling is employed in the present study. Present study is conducted on a sample of 740 students of 9th Class, studying in Government and recognized private Model secondary/senior secondary schools of Punjab State.

TOOLS USED

1. Scientific Attitude Scale. This scale is constructed and standardized by the investigator herself.

2. Group Test of General Mental Ability (Tandon, 1971).
3. Science Achievement is measured from the result of Eighth Class Annual examination of the students, conducted by the Board of School Education.


**DATA COLLECTION**

Collection of data is completed in two stages. In the first stage, data is collected for the standardization of Scientific Attitude Scale.

In the second stage, collection of data for the final phase of the study is undertaken over a sample of 740 students (from government school students and from recognized private secondary/senior secondary school students). All the tools namely Tandon’s Group Test of General Mental Ability, Kohli’s Socio-Economic Status, Dubey and Dubey’s Science Interest Test, Misra’s Home Environment Inventory and Scientific Attitude Scale were administered personally by the investigator to students of recognized private model secondary/senior school students and government secondary/senior secondary school students. As
tests are lengthy, therefore, these were administered one after the other with some recurrent break in two sessions spread over a period of 1-2 days for each school. The permission of concerned principal was also sought before collecting the data.

STATISTICAL TECHNIQUES USED

1. To find the relationship between intellectual and non-intellectual variables with the scientific attitude of students, a technique of Product – Moment Correlation is employed.

2. To find the effect of different independent variables such as sex differences, rural – urban differences, type of schools, scheduled caste and non-scheduled caste differences and also the effect of viewing of scientific programmes by the students on T.V, on their scientific attitude, a technique of t – ratio is used.
OPERATIONAL DEFINITIONS OF THE TERMS USED

i. Scientific Attitude:

It consists of attitude or readiness to be confident that universe is a self sustaining unit and human intelligence is capable of understanding natural phenomenon. It is readiness to accept tested human knowledge, attack problems with reason to look for true and cause and effect relationship and readiness to love knowledge for its own sake. It is readiness to have broad and versatile interests and sensitivity curious. It is readiness to seek correctness in work and thinking so that truth may be discovered, to seek a factual basis for all conclusions and to avoid assertion. It is also readiness to be carefully and pains-takingly accurate in all work and thinking and readiness to be orderly in all work and thinking. In other words it is curiosity, open-mindedness faith in the scientific method, to seek evidence, to be objective, suspended judgement and aversion to superstition.

ii. Intelligence:

In the present study intelligence has been operationally defined as, "The ability to
deal with numbers, analogies, opposites and synonyms, to make categories, to draw inferences”. Its measurement (verbal) is the total score on Tandon’s (1971) Group Test of General Mental Ability.

iii. **Science Achievement:**

According to Crow and Crow (1956), “Achievement means the extent to which a learner is profiting from instruction in a given area of learning”. Therefore, science achievement means marks of the students in the subject of science of the preceding year.

iv. **Socio-Economic Status:**

As defined by the author of the test, ‘Socio-economic status may be defined as “economic rank or position of the individual in a group to which he belongs. An individual’s socio-economic status is his group standing or ranking in terms of his social and financial position in relation to others”.’ In the present study, socio-economic status of the students is the measure of scores

v. Science Interest:

According to Dubey and Dubey (1986) ‘Interest may be defined as a tendency to choose one activity in preference to another or to seek out an activity or object. Science interests cover such things as our preferences and diversions or likes and dislikes in the field of science”.

vi. Home Environment:

Misra (1989) has identified the following characteristics of home environment: permissiveness, willingness to devote time to the child, parental guidance, parental aspirations for achievement, provision for the child’s intellectual needs, affective reward, instrumental companionship, prescription, physical punishment, principled discipline, neglect, deprivation of privileges, protectiveness, power, achievement, demands and conformity.
NEED AND IMPORTANCE OF THE STUDY

One of the general aims of education is to develop scientific attitude in children which can be done effectively through science education.

Science education occupies a very important place in the curriculum both of school and university stages of education. Science education, if properly conceived should primarily be concerned with the education of mind rather than acquisition of isolated pieces of scientific knowledge.

One of the major strength of this study is that it will help the teachers, parents and educational planners to measure the scientific attitude of students studying at the secondary stage, as in the present study the investigator herself constructed and standardized this scale.

Present study will enrich the field of scientific attitude as it identifies the factors which go with the scientific attitude of the students studying at the secondary stage.
Last but not the least after reviewing the research literature it had been found that not much work of this nature had been done in India and thus leaving the ample scope for the exploration of this field of research.

CONCLUSIONS

Researcher has drawn following conclusions on the basis of analysis of data, interpretation and discussion of results:

Bi-Variate Correlation

1) Variable of intelligence is positively and significantly correlated with the variable of scientific attitude of students at 0.01 level. In other words intellectual ability and scientific attitude of the students go together in the same direction.

Thus, hypotheses no. 1 that intelligence of students correlates significantly with their scientific attitude is retained in the present study.
2) Independent variable of science achievement is insignificantly correlated with the dependent variable of scientific attitude at 0.05 level. In other words, science achievement and scientific attitude are independent of each other.

Hence, hypotheses no. 2 that science achievement of the students correlates significantly with their scientific attitude is not retained here.

3) The variable of socio-economic status is found to be significantly correlated with the dependent variable of scientific attitude at 0.01 level of significance. Thus development of scientific attitude has close association with the socio-economic status of the students.

Hence, hypotheses no. 3 that socio-economic status of the students correlates significantly with their scientific attitude is accepted in the present study.

4) Variable of science interest is also found to be significantly and positively correlated with the criterion measure of scientific attitude at 0.01 level. In other
words, interest of the students in scientific activities is a powerful determinant of deciding their scientific attitude.

In the light of above findings, therefore, hypotheses no. 4 that interest of the students in scientific activities correlates significantly with their scientific attitude is also retained.

5) The variable of home environment is found to be significantly and positively correlated with the dependent variable of scientific attitude at 0.01 level. Thus, as per the findings of the study, the more congenial the home environment, the more positive is the scientific attitude of the students.

Therefore, hypotheses no. 5 that home environment of the students correlates significantly with their scientific attitude is retained here.

**t – ratios**

1. It is revealed that there is insignificant difference in the scientific attitude of boys and girls at 0.05 level of significance although mean scores of scientific attitude in
case of boys are little bit higher as compared to the girls. It means sex-differences do not affect the scientific attitude of the students.

Thus, hypotheses no. 6 that there will be no significant difference in the scientific attitude of girls and boys is retained in the present study.

2. It is noticed that when the scientific attitude of the groups i.e. urban and rural students are compared, insignificant mean difference is obtained on scientific attitude at 0.05 level. Although mean scores of scientific attitude of rural students are slightly higher as compared to urban students yet the urban – rural differences of students do not affect their scientific attitude.

Therefore, hypotheses no. 7 that there will be no significant difference in the scientific attitude of rural and urban students is also retained here.

3. From the results of present study, it is noticed that significant differences are obtained between the mean scores of government school students and students of privately managed model schools on the variable of
scientific attitude. Further mean scores of government school students on scientific attitude are higher as compared to model school students. In other words, students of government schools have certainly positive and favourable scientific attitude as compared to students of model schools.

Thus, hypotheses no. 8 that there will be no significant difference in the scientific attitude of the students studying in government and model schools is not retained in the present study.

4. In case of caste – differences, insignificant difference is obtained between the mean scores of two groups i.e. scheduled caste and non-scheduled caste students on the dependent variable of scientific attitude due to insignificant t-value at 0.05 level. It is also revealed that students belonging to scheduled caste got some what higher mean score on the variable of scientific attitude as compared to students of general category.

Hence, hypotheses no. 9 that there will be no significant difference in the scientific attitude of
scheduled caste and non-scheduled caste students is retained.

5. Results of the present study disclose that insignificant difference on the dependent variable of scientific attitude is obtained due to two groups of students i.e. viewing scientific programme on TV and non-viewing scientific programmes on TV as obtained t-value is insignificant at 0.05 level. In other words viewing or non-viewing of scientific programmes on TV has no impact on the development of scientific attitude of students.

Thus hypotheses no. 10 that there will be no significant difference in the scientific attitude of students who view Discovery Channel, Quiz Competition and similar types of programmes on TV and those who do not view such type of programmes is retained in the present investigation.

EDUCATIONAL IMPLICATIONS

Findings of the present study have following educational implications for the teachers, principals, parents, curriculum framers, government and society at large:
1. As per the findings of the study, rich institutional climate promotes the scientific attitude among the children. Therefore in a good educational environment Science Education should be strengthened so as to develop in the child well-defined abilities and values such as the spirit of inquiry, creativity, objectivity, the courage to question and an aesthetic sensibility.

Science Education Programme should be designed to enable the learner to acquire problem solving and decision making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life. Every effort should be made to extent science education to the vast numbers who have remained outside the pace of formal education.

Teachers with the cooperation of principals should develop micro-teaching skills and skills of organizing out of school or extended curricular activities such as science clubs, science fairs, science exhibitions and field studies.
The facilities like library, laboratory, audio-visual aids, and exposure to eminent personality's participation in fairs, exhibitions etc. will help in the inculcation and promotion of scientific attitude in the individuals.

2. As per the results of present study, the scientific attitude in both boys and girls is average and there is no difference in the level of scientific attitude possessed by them. The distribution of scientific attitude in these two groups is also normal. These results state that if the opportunities are equal to either sex, they can compete with each other equally in any area. The science teacher must try to promote scientific attitude in the children through the above suggested procedures.

3. The scientific attitude possessed by the pupils of urban and rural schools is average. As per the results of the present study, there is no significant difference in the scientific attitude of urban and rural pupils although contrary to the results rural pupils possess some what higher scientific attitude than urban pupils.
In other words findings of the present study revealed that locale did not influence the possession of scientific attitude. The results of this study is a surprising one, because, the urban schools are supposed to be equipped well with all facilities and the quality of teaching may also be good as most of the people say. This study says that if conducive facilities are provided to the rural pupils they will score as better as urban pupils.

4. As per the findings of the present study home environment plays significant role in developing scientific attitude among the children. Therefore, parents should provide scientific literature, physical facilities and psychological environment for the proper development of scientific attitude among their children.

5. The study reveals that scientific attitude in pupils of the model and governmental schools also differ. Normally teachers of private model schools teach the pupils throughout a pupil’s school career as the teacher works in the same school for a long time without any transfer, and he/she understands the flaws, limitations and potentialities of the pupils. But results of the present
study are contrary to the expectation. It may be the high qualification and sense of security among teachers of government schools which are responsible for the higher scientific attitude among pupils. These factors along others as good salary in government schools play a significant role in promoting scientific attitude, which may be adopted in private model schools.

SUGGESTIONS FOR FURTHER RESEARCH

1. A study may be conducted on the scientific attitude and its relation to intellectual and non-intellectual variables of graduate students or students of senior secondary stage.

2. Instead of taking the present non-intellectual variables some other variables e.g. personality traits may be taken up.

3. A comparative study of the science achievement of high school students having high, average and low scientific attitude may be taken up.
4. The relative efficacy of the scientific aptitude and scientific attitude in relation to intellectual variables in predicting the science achievement of students at secondary or senior secondary stage may be taken up.

5. Study may be conducted on the influence of study habits, hobbies etc. in the promotion of scientific attitude.

6. Study may be taken up to find out the effect of environmental and psychological factors on the development of scientific attitudes.

7. Studies may be taken up to find out the effect of different mass media and A.V. aids in promoting scientific attitude.

8. Studies on the role of science club, science exhibition, science museum etc. in developing scientific attitude may be carried out.

9. A comparative study of scientific attitude of different exceptional children in relation to science achievement may be taken up.