CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In previous chapter, the researcher has presented the analysis of the data. The present chapter deals with the summary, conclusions and recommendations.

5.1 Summary

“It is science alone that can solve the problems of hunger and poverty, of insanitation and malnutrition, of illiteracy and obscurantism of superstition and deadening customs, of rigid traditions and blind beliefs, of vast resources going to waste of a rich country inhabited by starving millions.” These words of India’s first Prime Minister Jawaharlal Nehru, while delivering the convocation address of Allahabad University in 1946, indicate the importance of science in human life.

The word science originates from the Latin word ‘scientia’ meaning to know. Academic Press Dictionary of Science & Technology (1992) defines science as ‘the systematic observation of natural events and conditions in order to discover facts about them and to formulate laws and principles based on these facts.

Dr. D. S. Kothari (Chairman of Education Commission-1964-66) in his Shri Raj Krishen Memorial Lecture delivered at Delhi on October 11, 1977 said, “The great reality of our age is science. The understanding of nature which science provides, and the deep harmony it unfolds, are deeply satisfying to the human mind. The power of science to transform society is immense, perhaps more than of any other activity......”.

As per the guidelines of NCERT, ‘Schools should give much greater emphasis on co-curricular and extra-curricular elements aimed at stimulating investigative ability, inventiveness and creativity, even if these elements are not
part of the external examination system. An ongoing movement along the lines of the Children’s Science Congress held with great success at present. Gradually, such a movement should spread to the every corner of India and enter across South Asia, creating a wave of creativity and scientific temper among the young and their teachers.’ (NCF-2005, NCERT, P.44)

Thus Science Education is expected to be viewed with a much broader perspective than before. The first thing is that we have to think beyond the examinations. Second we have to cross the walls of our classrooms and the third, development of scientific attitude should be the major goal of Science Education.

Developing scientific attitude of mind is one of the important objectives of teaching science in present day schools in India. It is a very significant outcome of the process of science education.

STATEMENT OF THE PROBLEM
Programme for Development of Scientific Attitude among School Students – A Study

DEFINITIONS OF THE TERMS
1. Scientific Attitude

Conceptual definition
A set of emotionally toned ideas about science and scientific method and related directly or indirectly to a course of action, in the literature of science 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 commutation of science.

C. V. Good, Dictionary of education (1973)

Operational definition
Scientific attitude is a score obtained by a student on Scientific Attitude Scale and a Situational Test on Scientific Attitude which comprises of critical
thinking, open mindedness, to be ready to change the decision, to be curious, not to believe in superstitions, to suspend the judgment until suitable support is obtained, to be intellectually honest, seeking to adopt different planned procedures in solving the problems and to have respect for scientific experiments.

2. Scientific Attitude Development Programme

Operational definition

The programme prepared by the researcher for the Development of Scientific Attitude in school students, is Scientific Attitude Development Programme. It includes 13 activities as follows-


3. School Students

Conceptual definition

An organized group of pupils pursuing defined studies at defined levels and receiving instruction from one or more teachers frequently with the addition of other employees and officers and a staff of maintenance workers, usually housed in a single building or group of buildings.

C. V. Good, Dictionary of education (1973)

Operational definition

The group of students those are studying in 8th and 9th standard in Marathi medium schools.

4. A Study

Conceptual definition

The activity of learning or gaining knowledge either from books or by examining things in the world.

Illustrated Oxford Dictionary
Operational definition

A study means knowing and understanding about the level of Scientific Attitude in school students, preparation of a Scientific Attitude Development Programme for 8th and 9th standard students, and testing its effectiveness.

Need and Significance of the Study

The Directorate of Extension Programmes For Secondary Education, Government of India, in its brochures on Evaluation in General Science states one of the objectives of general science as ‘Pupil should adopt the scientific attitude in making statements, accepting information and forming beliefs’.

Almost all the commissions and committees on school education, which were formed after independence, have stated the importance of development of scientific attitude in the students. National policy on Education (1986) has identified scientific temper as one of the 10 core areas. Accordingly development of scientific attitude of mind has been given an important place in the school education. However constituents of scientific attitude may not automatically develop in the outlook of the learners. The teacher will have to make an effort to point out these aspects in the process of teaching science and try to inculcate this outlook in the behavioral pattern of the learners. Scientific attitude is warranted not only in pursuit of scientific problems but also in solving problems at home and in the society.

In a survey conducted by the researcher on 150 students studying in 8th, 9th and 10th standard in the schools of Solapur District, it was found that –

1. No student is having high level of Scientific Attitude.
2. Only 22 i.e. 14.67% students are having Scientific Attitude above average level.
3. 128 students i.e. 85.33% students are having Scientific Attitude at the average level.

From this study it was clear that the Scientific Attitude Development Programme for 8th, 9th and 10th standard students is badly needed.
Students in the 8th, 9th and 10th standard are in the age between 13th to 15th years. This age is important as far as curiosity, critical thinking, decision making etc. are concerned.

The Scientific Attitude Development Programme prepared in this study is useful for the schools to develop different components of scientific attitude among the students and thereby to contribute to human resource development and to the development of genuine democracy.

**Objectives of the Study**

1. To measure the scientific attitude of 8th and 9th standard students.
2. To compare the levels of scientific attitude of boys and girls.
3. To compare the levels of scientific attitude of 8th and 9th standard students.
4. To find out the levels of different components of scientific attitude among the students.
5. To prepare a Scientific Attitude Development Programme for 8th and 9th standard students.
6. To study the effectiveness of the developed programme.
7. To make recommendations to the concerned institutions and personnel with reference to the development of scientific attitude.

**Assumptions of the Study**

Scientific attitude can be measured by a Scientific Attitude Scale as well as Situational Test on Scientific Attitude.

**Hypotheses**

**Research Hypotheses**

1. There is a significant difference in the level of scientific attitude of boys and girls.
2. There is a significant difference in the level of scientific attitude of 8th and 9th standard students.
3. There is a significant difference in the level of scientific attitude of control group and experimental group after the implementation of the programme.
4. There is a significant difference in the control and experimental group with reference to the mean level of critical thinking.
5. There is a significant difference in the control and experimental group with reference to the mean level of open mindedness.
6. There is a significant difference in the control and experimental group with reference to the mean level of readiness to change the decision.
7. There is a significant difference in the control and experimental group with reference to the mean level of curiosity.
8. There is a significant difference in the control and experimental group with reference to the mean level of superstitions.
9. There is a significant difference in the control and experimental group with reference to the mean level of ability to suspend the judgment.
10. There is a significant difference in the control and experimental group with reference to the mean level of intellectual honesty.
11. There is a significant difference in the control and experimental group with reference to the mean level of ability to seek to adopt different planned procedures in solving the problem.
12. There is a significant difference in the control and experimental group with reference to the mean level of respect to scientific experiments.

Scope and Delimitations of the Study

Scope
1. The findings of this study will be applicable to all the schools affiliated to State Board of Education, in Maharashtra.

Delimitations
1. The survey in this study was delimited to 644 students studying in 8th and 9th standards of 10% i.e. seven Marathi Medium Secondary Schools in Malshiras Taluka (Dist. Solapur, Maharashtra).
2. Experimental work was delimited to 40 (20 boys and 20 girls) 8\textsuperscript{th} standard and 40 (20 boys and 20 girls) 9\textsuperscript{th} standard students studying in one Secondary School from Malshiras Taluka.

3. The study was delimited to the following nine components of Scientific Attitude.
   i. Critical Thinking ability
   ii. Open Mindedness
   iii. To be ready to change the decision
   iv. To be curious
   v. Not to believe in superstitions
   vi. To suspend the judgment until the suitable support is obtained
   vii. To be intellectually honest
   viii. Seeking to adopt different planned procedures in solving the problem
   ix. To have respect for scientific experiments

Limitations of the Study

10\textsuperscript{th} standard students were not included in this study because schools generally do not permit researchers to experiment on these students, as they are going to appear for S.S.C. Board Examination.

PLAN AND PROCEDURE OF THE STUDY

Stage I – Survey

Survey method was used to know the present level of the scientific attitude in 8\textsuperscript{th} and 9\textsuperscript{th} standard students.

Stage II – Development of the programme

In this stage, scientific attitude development programme was developed which included 13 activities i.e. Reading of scientific stories, scientific method of problem solving, magic square, project method, concept mapping, heuristic method, reading of scientific books, prepare scientific toys, jigsaw, scientific puzzle, lecture cum demonstration on superstitions movie on superstitions.
Stage III – Experimentation

Research Design for the Experiment

The post-test only Equivalent Group Design

Shri Jaysing Mohite Patil Vidyalaya, Akluj (Dist-Solapur)

Total students in 8th and 9th standard

Random Sampling

80 students (40 from 8th standard & 40 from 9th standard)

Pretesting (Scientific Attitude Scale by Dr. G.S.Patil)

Equivalent Groups

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Experimental Treatment

Post testing

i. Scientific Attitude Scale (Prepared by Dr.G.S.Patil)

ii. Situation Test on Scientific Attitude (Prepared by the Researcher)
As given above Shri. Jaysingh Mohite Patil Vidyalaya was selected for conducting the experiment. From this high school 80 students, 40 from 8th standard and 40 from 9th standard, were randomly selected and a pretest was given to them. Based on the pretest scores two equivalent groups were prepared.

Scientific Attitude Development Programme was conducted on experimental group. Control group was a no treatment group. Post tests were given to both the groups and results analyzed

**Sampling**

In the Present study the researcher selected sample in two stages. They are as follows

**A) Sampling For the Survey**

**B) Sampling For the Experimental work**

**A) Sampling for the Survey**

Marathi Medium Co-education Schools in Malshiras Taluka (Dist.- Solapur, Maharashtra)  

Aided schools - 62  

Unaided schools - 05  

Selection of 10% schools by lottery method  

Selection of 10% school by lottery method  

06 schools  

01 school  

07 schools  

From Each School  

8th standard-23 boys and 23 girls  

9th standard-23 boys and 23 girls  

7 schools x92 students  

= 644 students
1) **Selection of Schools**

In Malshiras Taluka of district Solapur (Maharashtra) there are 67 Marathi medium co-education schools. Out of those schools 62 schools are aided and five schools are unaided. Out of those schools 10% i.e. six aided schools and one unaided school was selected by using simple random sampling method (lottery method).

2) **Selection of the students**

From seven schools, 644 students were selected as follows.

7 schools X 92 students (per school)

8\textsuperscript{th} Std. = 46 students (23 boys and 23 girls per school)

9\textsuperscript{th} Std. = 46 students (23 boys and 23 girls per school)

= 644 students (322 boys and 322 girls)

**B) Sampling for experimental work**

Marathi medium co-education schools in Malshiras Taluka, Dist.-Solapur, Maharashtra

Purposive Sampling

Shri Jaysingh Mohite-Patil Vidyalaya, Sangramnagar (Akluj)

80 students (40 from 8\textsuperscript{th} standard and 40 from 9\textsuperscript{th} standard)

Pretesting-Two equivalent Groups

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As shown above from 62 aided Marathi medium schools Shri. Jaysinh Mohite- Patil Vidyalaya was purposively selected for the experiment, because the Headmaster was ready to provide all the facilities required for the experiment. From this school 80 students were randomly selected- 40 8th standard and 40 9th standard. After the pretesting two equivalent groups of 40 each were prepared. One group was experimental group and other was control group.

**Tools of Data Collection:**

In the present study the researcher collected the data through the following tools.

A. Situational Test on Scientific Attitude (prepared by the researcher)

B. Scientific Attitude Scale. (Prepared by Dr. G. S. Patil)

C. Rating Scale

**A. Situational Test on Scientific Attitude**

In the present study, researcher prepared a situational test on scientific attitude related to the nine components. viz, Critical Thinking, Open mindedness, to be ready to change the decision, To be curious, Not to believe in superstitions, To suspend the judgment until the suitable support is obtained, To be intellectual honesty, Seeking to adopt different planned procedures in solving the problem, To have respect for scientific experiments.

The face validity and constant validity was automatically established as a part of the procedure of developing the test.

The Reliability of the Situational Test on Scientific Attitude was established by using Test-Retest method. The gap between the Testing and retesting was of 10 days. The reliability of the test was found to be 0.84.

**B. Scientific Attitude Scale (prepared by Dr. G. S. Patil)**

The Scientific Attitude Scale prepared by Dr. G. S. Patil (Assistant Professor Department of Shivaji University, Kolhapur, 2007) was used in this study with her permission. This scientific attitude scale contains 45 statements related to the nine components, (five statements for each component) which are
selected in this study viz, Critical Thinking, Open mindedness, To be ready to change the decision, To be curious, Not to believe in superstitions, To suspend the judgment until the suitable support is obtained, To be intellectual honesty, Seeking to adopt different planned procedures in solving the problem, To have respect for scientific experiment.

The Reliability of this Scientific Attitude Scale was established by the researcher by using Test-Retest method. The gap between the Testing and retesting was of 15 days. The reliability of the test was found to be 0.93 which indicates that this Scientific Attitude Scale is much reliable.

C. Rating Scale

For the evaluation of the Scientific Attitude Development Programme and Situational Test on Scientific Attitude by the experts three point rating scale was used.

Analysis of the Data

The data was analysed quantitatively by using mean, standard deviation and ‘t’ value.

5.2 Findings
Finding Related to objective No. 1
Objective No. 1
To measure the scientific attitude of 8th and 9th standard students.
Finding

1. The 8th and 9th standard students are having average level of scientific attitude.

Finding Related to Objective No. 2

Objective No. 2
To compare the levels of scientific attitude of boys and girls.
Finding
1. There is a significant difference between the level of scientific attitude of boys and that of girls. The level of scientific attitude of boys is significantly higher than that of girls.

Finding Related to Objective No. 3

Objective No. 3

To compare the levels of scientific attitude of 8th standard and 9th standard students

Finding

1. There is a significant difference between the scientific attitude of 8th standard students and that of 9th standard students. The level of scientific attitude of 9th standard students is significantly higher than that of 8th standard students.

Finding Related to Objective No. 4

Objective No. 4

To find out the levels of different components of scientific attitude among the students.

Finding

1. The students are at average level in six components viz. to be ready to change the decision, curiosity, not to believe in superstitions, suspended judgment, intellectual honesty, seeking to adopt different planned procedure in solving the problem. They are at high level in the three components viz. critical thinking ability, open mindedness, and respect for scientific experiments.

Findings related to Objective No.5

Objective No. 5

To prepare a scientific attitude development programme for 8th and 9th standard students

It was a procedural objective.
Findings related to Objective No.6

Objective No. 6
To study the effectiveness of the developed programme.

Findings

1) The programme for developing scientific attitude is helpful for enhancing the level of overall scientific attitude of the school students.

2) The programme for developing scientific attitude is helpful for enhancing the level of critical thinking ability of the school students.

3) The programme for developing the scientific attitude is helpful for enhancing the level of open-mindedness of the school students.

4) The programme for developing the scientific attitude is helpful for enhancing the level of students readiness to change the decision

5) The programme for developing the scientific attitude is helpful for enhancing the level of curiosity of the school students.

6) The programme for developing the scientific attitude is helpful for enhancing the level of ‘not to believe in superstitions’ component of scientific attitude among the school students.

7) The programme for developing the scientific attitude is helpful for enhancing the level of suspended judgment ability of the school students.

8) The programme for developing the scientific attitude is helpful for enhancing the level of intellectual honesty of the school students.

9) The programme for developing the scientific attitude is helpful for enhancing the level of students ability to seek to adopt different planned procedure in solving the problems.

10) The programme for developing the scientific attitude is helpful for enhancing the level of students respect for scientific experiments.
5.3 Conclusions

1. The 8th and 9th standard students are at the average level of scientific attitude.

2. There is a significant difference between the level of scientific attitude of boys and that of girls. The level of scientific attitude of boys is significantly higher than that of girls.

3. There is a significant difference between the scientific attitude of 8th standard students and that of 9th standard students. The level of scientific attitude of 9th standard students is significantly higher than that of 8th standard students.

4. The programme for development of scientific attitude is helpful to enhance the overall scientific attitude of the school students and is also helpful for enhancing each component of scientific attitude included in this research.

5.4 Recommendations

1. Government
   
i. The scientific attitude development programme which is a product of this research should be integrated in the curriculum and the school time table.
   
ii. Training for implementation of Scientific Attitude Development Programme should be given to the teachers.

   
All activities included in the Scientific Attitude Development Programme in this study should be included in the school text books.

3. Schools and Head masters
   
The schools and headmasters should encourage the implementation of the Scientific Attitude Development Programme and provide facilities for the same.
4. **Teachers**

The teachers should organize the Scientific Attitude Development Programme for 8th and 9th standard students in their schools.

5.5 **Discussion**

In the present research the main objective of the research was to develop scientific attitude development programme for school students. She found that the programme developed by her was effective with the reference to the development of total scientific attitude as well as components of scientific attitude.

Francis D. Curtis (1924) in his research provided training to 8th and 9th standard students for developing the scientific attitude. He used the techniques like discussion method, incomplete demonstration, cutouts from newspapers and from this study he found that the level of scientific attitude of 8th and 9th students is very low. It was helpful to increase the scientific attitude of the students.

Vidhate Sulbha (1990) in her research, developed a text book based scientific attitude programme for 8th standard students. She used exhibition, field visits, discussion method, demonstration techniques etc in her programme and found that the scientific attitude programme was useful to develop the scientific attitude in the students.

Aloni Archana (1993) conducted a research for comparing the effectiveness of regular teaching method and inquiry training model for developing scientific attitude of students. She found that scientific attitude cannot be developed by regular teaching method. By using inquiry training model, freedom from bias, search for proofs and evidences, not to believe in superstitions, critical thinking, cause effect relations, can be increased in the students.

Shirode Sangita (2004) developed a scientific attitude programme for B.Ed. students. She used lectures, heuristic method, question answer, filed visits, discussions, group study, and inductive-deductive method for developing
the scientific attitude in the students. She found that the scientific attitude programme is helpful for developing scientific attitude in students.

In all these researches total scientific attitude was considered. However in this study nine separate components were considered for the development as well as measurement. Therefore this work contributes to the development in the previous researches on scientific attitude.

5.6 The topics for the further study

i. A training programme for teachers with reference to the development of scientific attitude among the school students – A study

ii. Scientific attitude development programme for college students – A study

iii. Self learning package for the development of scientific attitude among the college students – A Study.

iv. A study of relationship between scientific attitude and personality development of the college students.

v. An awareness programme for parents with reference to the development of scientific attitude among the school students – A study