CHAPTER VI

SUMMARY AND CONCLUSION

6.1 Introduction

Human beings are bestowed with cognitive competency. Thinking is major part of cognitive domain. It enables an individual to process information gathered through various sources. In a current formal education set up, students spend approximately 13,000 hours at school by the time they finish secondary high school. This is big span of time where students can be trained to process the information acquired. This training is possible via daily classroom interactions. For this, teacher needs to create appropriate learning environment. Diversified learning experiences supported by constructive feedback and opportunities to share viewpoints, laboratory activities, use of variety techniques for instruction motivates students to develop interest in science which later develops scientific attitude. As pupil develops the ability to process the information, more understanding of phenomena occurring around gets developed in the pupil. This in turn increases the literacy level of pupil. This is only possible with appropriate learning environment which has ample opportunities to develop science process skills. It is a fact that people like to positively respond with which s/he has cognitive association. The right cognition can be created by presenting the issues/facts/events in a rational way. The rationality and the practice to apply rationality inculcate appreciation to science and scientific method. This appreciation catalyses tendency which contribute development of Scientific Attitude. The researcher was curious to know level of Scientific Attitude of secondary students developed and its contributing components. Hence, present study was undertaken.

6.2 Statement of the Problem

Relationship between Science related Process and Perception of Learning Environment of Secondary school students

6.3 Objectives of the study
1. To study the perception of Learning Environment of secondary School Students.
2. To study the Basic Science Process skills, of secondary School Students.
3. To study the Scientific Literacy of secondary School Students.
4. To study the Scientific Attitude of secondary School Students.
5. To ascertain the relationship between perception of Learning environment and Basic Science Process Skills of i) TSS ii) boys iii) girls of secondary schools.
6. To ascertain the relationship between perception of Learning environment and Scientific Literacy of the secondary i) TSS ii) boys iii) girls.
7. To ascertain the relationship between perception of Learning environment and Scientific Attitude of the secondary i) TSS ii) boys iii) girls.
8. To ascertain the relationship between Basic Science Process Skills and Scientific Literacy of the secondary i) TSS ii) boys iii) girls.
9. To ascertain the relationship between Basic Science Process Skills and Scientific Attitude of the secondary i) TSS ii) boys iii) girls.
10. To ascertain the relationship between Scientific Literacy and Scientific Attitude of the secondary i) TSS ii) boys iii) girls.
11. To ascertain the gender difference in the relationship between perception of Learning environment and Basic Science Process Skills.
12. To ascertain the gender difference in the relationship between perception of Learning environment and Scientific Literacy.
13. To ascertain the gender difference in the relationship between perception of Learning environment and Scientific Attitude.
14. To ascertain the gender difference in the relationship between Basic Science Process Skills and Scientific Literacy.
15. To ascertain the gender difference in the relationship between Basic Science Process Skills and Scientific Attitude.
16. To ascertain the gender difference in the relationship between Scientific Literacy and Scientific Attitude.
17. To ascertain the relationship between perception of Learning environment and Basic Science Process Skills of secondary school students after removing the effect of Scientific Literacy and Scientific Attitude.
18. To ascertain the relationship between perception of Learning environment and Scientific Literacy of secondary school students after removing the effect of Scientific Attitude and Basic Science Process Skills.

19. To ascertain the relationship between perception of Learning environment and Scientific Attitude of secondary school students after removing the effect of Basic Science Process Skills and Scientific Literacy.

20. To ascertain the relationship between Basic Science Process Skills and Scientific Literacy of the secondary school students after removing the effect of perception of Learning Environment and Scientific Attitude.

21. To ascertain the relationship between Basic Science Process Skills and Scientific Attitude of the secondary school students after removing the effect of perception of Learning Environment and Scientific Literacy.

22. To ascertain the relationship between Scientific Literacy and Scientific Attitude of the secondary school students after removing the effect of perception of Learning Environment and Basic Science Process Skills.

23. To ascertain the relationship of Scientific Attitude with Basic Science Process Skills b) Scientific Literacy c) perception of Learning Environment in case of i) TSS ii) Boys iii) Girls.

6.4 Hypotheses of the Study

1. There is no significant relationship between perception of Learning environment and Basic Science Process Skills i) TSS ii) boys iii) girls of secondary schools.

2. There is no significant relationship between perception of Learning environment and Scientific Literacy of the secondary i) TSS ii) boys iii) girls.

3. There is no significant relationship between perception of Learning environment and Scientific Attitude of the secondary i) TSS ii) boys iii) girls.

4. There is no significant relationship between Basic Science Process Skills and Scientific Literacy of the secondary i) TSS ii) boys iii) girls.

5. There is no significant relationship between Basic Science Process Skills and Scientific Attitude of the secondary i) TSS ii) boys iii) girls.

6. There is no significant relationship between Scientific Literacy and Scientific Attitude of the secondary i) TSS ii) boys iii) girls.
7. There is no significant gender difference in the relationship between perception of Learning environment and Basic Science Process Skills.
8. There is no significant gender difference in the relationship between perception of Learning environment and Scientific Literacy.
9. There is no significant gender difference in the relationship between perception of Learning environment and Scientific Attitude.
10. There is no significant gender difference in the relationship between Basic Science Process Skills and Scientific Literacy.
11. There is no significant gender difference in the relationship between Basic Science Process Skills and Scientific Attitude.
12. There is no significant gender difference in the relationship between Scientific Literacy and Scientific Attitude.
13. There is no significant relationship between perception of Learning environment and Basic Science Process Skills of secondary school students after removing the effect of Scientific Literacy and Scientific Attitude.
14. There is no significant relationship between perception of Learning environment and Scientific Literacy of secondary school students after removing the effect of Scientific Attitude and Basic Science Process Skills.
15. There is no significant relationship between perception of Learning environment and Scientific Attitude of secondary school students after removing the effect of Basic Science Process Skills and Scientific Literacy.
16. There is no significant relationship between Basic Science Process Skills and Scientific Literacy of the secondary school students after removing the effect of perception of Learning Environment and Scientific Attitude.
17. There is no significant relationship between Basic Science Process Skills and Scientific Attitude of the secondary school students after removing the effect of perception of Learning Environment and Scientific Literacy.
18. There is no significant relationship between Scientific Literacy and Scientific Attitude of the secondary school students after removing the effect of perception of Learning Environment and Basic Science Process Skills.
There is no significant relationship of Scientific Attitude with perception of Learning Environment with Basic Science Process Skills and Scientific Literacy in case of i) TSS ii) Boys iii) Girls.

6.5 Design of the study

The present study is of descriptive type as it intends to describe the present status of secondary school students’ Perception of Learning Environment (PLE), Basic Science Process skills (BAPS), Scientific Literacy (SL) and Scientific Attitude (SA) of students. An attempt is made to find out relationship between these variables. Therefore co relational type of method has been used. The measurement of relationship between the variables gives idea about effect of one variable on other. This effect of one variable on other is calculated and predicted by using Partial correlation and Multiple Regression analysis.

6.6 Sample for the study

In the present study, a two stage sampling technique has been used. At the first stage the English Medium schools from Madhyamic Shikshkan Board (SSC), Maharashtra located in Navi Mumbai were selected. At second stage, ninth standard students from one division were selected. The total sample chosen is 1065 students. Thus, stratified random sampling technique has been used. Composition of sample is; i) 107 boys and 68 girls out of 175 students from Uran Taluka i) 186 are boys and 162 girls out of 348 students from Panvel Taluka and iii) 300 boys and 242 girls out of 542 students from Thane. Thus, 592 boys and 472 girls out of 1065 students of Navi Mumbai are chosen. The method used for sampling is random and cluster sampling.

6.7 Tools

For the data collection, the researcher has used following tools; i) Personal data sheet, ii) Perceived Learning Environment scale (PLES) iii) Test of Basic Science Process skill (BAPS) iv) Test of Scientific Literacy (SL) and v) Situational test of Scientific Attitude (SA).

1. The personal datasheet: It included the personal information regarding the respondent such as name, gender, and name of the school.
2. Perceived Learning Environment Scale (PLES): This is a four point rating scale prepared by researcher. It has 49 statements. It is based on the following dimensions: a) Teacher preparedness b) Communication of Learning Objectives c) Learning opportunities d) Learning Resources e) Laboratory Work f) Feedback g) Motivation h) Classroom Arrangement. The tool is validated by giving it to the five experts.

3. Test of Basic Science process skills (BAPS): It is prepared by Padilla M. (1989), Professor of Science Education, University of Georgia, Athens. It contains 36 questions. Permission was taken from the Prof. Padilla via email dated 1/10/2014. This test is based upon basic processes namely Observing, Inferring, Measuring, Communicating, Classifying and Predicting.

4. Test of Scientific literacy: It is prepared by Prof. Carrier R. (2001). This test contains 24 statements. It is based on aspects are; a) Science is a Tentative Enterprise b) Science is an Empirical “Faith” c) Science is not a single method d) Experiments are a goal-oriented form of Scientific observation e) Scientific theories are explanations of scientific facts f) Scientific laws are descriptions of nature’s behavior and g) Science is a creative enterprise.

5. Situational test of Scientific attitude: This test is prepared by Inamdar R. (2013). It contains 45 situations. It is based on nine components. viz, critical thinking, open mindedness, readiness to change the decision, curiosity, aversion to superstitions, suspended judgment, intellectual honesty, problem solving ability, respect for scientific experiments and it is developed in Marathi Language. After seeking permission from researcher the test was translated into English.

6.8 Scoring of tools

As the perceived Learning Environment scale is four point rating scale, its scoring pattern is attached in appendix C. Also, the scoring of Test Basic Science Process Skills, Test of scientific Literacy and Situational test of scientific Attitude is attached in Appendix E, G and I respectively.
6.9 Data Collection

The researcher administered four scales namely Perceived Learning Environment Scale, Test of scientific Literacy, Test of Basic Science Process Skills and Situational Test of Scientific Attitude to 1065 students personally. After the data collection, the responses of the students were quantified as per scoring given and tabulation is carried out.

6.10 Data Analysis

The data is analysed by using descriptive analysis and descriptive analysis.

Descriptive Analysis

The data were described using measures of central tendency such as mean, median, mode, standard deviation, skewness, kurtosis, bar graphs and scatter grams. The fiduciary limits of mean and standard deviation were calculated at 0.95 and 0.99 level. The standard error of mean and standard error of standard deviation were calculated.

Inferential Analysis:

The techniques used for inferential analysis are Pearson’s r, Z test, Partial r and Multiple R.

6.11 Findings of the study

Levels of the PLE, BAPS, SL and SA were calculated by taking into consideration its range of scores. The null hypotheses have been tested using appropriate parametric statistical techniques. The null hypotheses have been tested using Pearson”s Product Moment Coefficient of Correlation to establish the relationships between PLE & BAPS, PLE & SL, PLE & SA etc. Z test- this test is used to determine the significance of gender difference among the relationship between two variables. Partial r is used ascertain the correlation between the two variable after removing the effect of other remaining variables. Multiple R is used to measure the relationship among the more than two variables.

6.11.1 Findings related to levels of PLE, BAPS SL and SA

1. About 8% of the students fall in the low level of perception of learning environment, 20 % of the students are having high level of Perception of Learning Environment
and majority (71.17 %) of the students belongs to be moderate level of Perception of Learning Environment.

2. About 15 % of the students fall in the low level Basic science Process skills, 35 % of the students are having high level of Basic science Process skills and 50% of the students belongs to be moderate level of Basic science Process skills.

3. About 8 % of the students fall in the low level of Scientific Literacy, 10 % of the students is having high level of Scientific Literacy and majority (82.16 %) of the students belongs to be moderate level of Scientific Literacy.

4. About 5 % of the students fall in low range Scientific Attitude, 34 % of the students are high range Scientific Attitude and majority (61.22%) of the students belongs to be moderate range Scientific Attitude.

6.11.2 Findings related to Pearson’s product moment coefficient of ‘r’

Pearson’s Product Moment Coefficient of Correlation is used to establish the relationships between PLE & BAPS, PLE & SL, PLE & SA etc.

1. Relationship between PLE and BAPS: for TSS and girls, the obtained ‘r’ is significant at 0.01 level. It is positive and negligible in magnitude. Hence null hypothesis is rejected. Whereas for boys obtained ‘r’ is less than the tabulated value. Hence null hypothesis is accepted.

2. Relationship between PLE and SL: For TSS and boys the obtained ‘r’ is significant at 0.05 level and 0.01 respectively. It is positive for TSS and negative for boys, negligible in magnitude. Hence null hypothesis is rejected. But, for girls obtained ‘r’ is significant at 0.05 level. It is positive, negligible in magnitude. Hence null hypothesis is rejected.

3. Relationship between PLE and SA: For TSS, and girls the obtained ‘r’ is significant at 0.01 level. Hence null hypothesis is rejected. It is positive, negligible in magnitude. But in case of boys, it is not significant.

4. Relationship between BAPS and SL: for TSS and boys the obtained ‘r’ is significant at 0.01 level. Hence null hypothesis is rejected. It is negative and negligible in magnitude. But, in case of girls, the obtained ‘r’ is tabulated value. Hence null hypothesis is accepted.
5. Relationship between BAPS and SA: For TSS, boys and girls of the obtained ‘r’ is significant at 0.01 level. It is positive, moderate for TSS and Boys & low for girls. Hence null hypothesis is rejected.

6. Relationship between SL and SA: For TSS the obtained ‘r’ is significant at 0.01 level. It is negative and negligible in magnitude. Hence null hypothesis is rejected. But in case of boys and girls it is significant at 0.05 level. It is negative and negligible in magnitude.

Conclusion

1. There is a significant relationship between PLE and BAPS for TSS, and girls. It means that if learning environment is perceived better, then better acquisition of BAPS takes place. But in case of boys no such relation exists.

2. There is a significant relationship between PLE and SL for TSS, boys. It means that if learning environment is perceived better, then the SL is better. But in case of girls no such relationship exists.

3. There is a significant relationship between PLE and SA in case of TSS and girls. It means that if Learning Environment is perceived better, then better development of SA takes Place. But in case of boys no such relation exists.

4. There is a significant relationship between BAPS and SL in case of TSS and boys. It means that if Students Basic Science process skills increases, then scientific Literacy is likely to increase. But no such relationship exists in case of girls.

5. There is a significant positive relationship between BAPS and SA. Students with better BAPS displays better SA.

6. There is negative relationship between SL and SA for TSS, boys and girls.

6.11.3 Findings of correlation of variables for the gender difference

Z test is used to compare two coefficients of correlation. While conducting this test, first ‘r’ is converted into Fisher ‘z’ coefficient. Then the significance of the difference between two groups is determined.
1. Obtained ‘z’ coefficient for gender difference in the relationship between PLE and BAPS is significant at 0.01 level. Hence null hypothesis is rejected.

2. Obtained ‘z’ coefficient for gender difference in the relationship between PLE and SL is not significant. Hence null hypothesis is accepted.

3. Obtained ‘z’ coefficient for gender difference in the relationship between PLE and SA is not significant. Hence null hypothesis is accepted.

4. Obtained ‘z’ coefficient for gender difference in the relationship between BAPS and SL is not significant. Hence null hypothesis is accepted.

5. Obtained ‘z’ coefficient for gender difference in the relationship between BAPS and SL is not significant. Hence null hypothesis is accepted.

6. Obtained ‘z’ coefficient for gender difference in the relationship between SL and SA is not significant. Hence null hypothesis is accepted.

**Conclusion**

1. The ‘z’ coefficient of gender difference in the relationship between PLE and BAPS is 2.63. It is significant at 0.01 levels. It means that there is significant gender difference in the relationship between PLE & BAPS. The girls are higher than boys in the relationship between PLE and BAPS.

2. There is no significant gender difference in the relationship between (I) PLE & SL, (II) PLE & SA, (III) BAPS & SL, (IV) BAPS & SA, (V) SL & SA.

**6.11.4 Findings of Partial ‘r’**

Partial correlation is used to obtain a measure of correlation by eliminating or removing the effect of other variables. Because of difficulty in interpretation Partial correlation is calculated.

Following table shows the significance of partial ‘r’ for PLE & BAPS, PLE & SL, PLE & SA, BAPS & SL, BAPS & SA, SL & SA.

Using the SPSS software for calculation and interpretation, the partial r is interpreted as follows.
1. For the relationship between PLE and BAPS of TSS obtained $r$ is significant at 0.01 level after partial out the effect of SL and SA. It is positive and negligible in magnitude.

2. The relationship between PLE and SL of TSS is significant at 0.01 level after partial out the effect of BAPS and SA. It is negative, negligible in magnitude.

3. The relationship between PLE and SA of TSS is significant at 0.01 level after partial out the effect of BAPS and SL. It is positive, negligible in magnitude.

4. The relationship between BAPS and SL of TSS is not significant after partial out the effect of SL and SA.

5. The relationship between BAPS and SA of TSS is significant at 0.01 level by partial out the effect of PLE and SL. It is positive, low in magnitude.

6. The relationship between PLE and BAPS of TSS is significant at 0.01 level by partial out the effect of SL and SA. It is negative, negligible in magnitude.

**Conclusion related to partial coefficient of correlation:**

1. By partial out the effect of SL and SA, there exists a relationship between PLE and BAPS. It is positive and negligible in magnitude.

2. By partial out the effect of BAPS and SA, there exists a relationship between PLE and SL. It is negative and negligible in magnitude.

3. By partial out the effect of BAPS and SL, there exists a relationship between PLE and SA. It is positive and negligible in magnitude.

4. By partial out the effect of PLE and SA, there does not exists a relationship between BAPS and SL.

5. By partial out the effect of PLE and SL, there exists a relationship between BAPS and SA. It is positive, low in magnitude.

6. By partial out the effect of PLE and BAPS, there exists a relationship between SL and SA. It is negative, negligible in magnitude.

**6.11.5 findings of Multiple Correlation**

In present study, there is one dependent variable and three dependent variables. There is a possibility of existence of scientific attitude being a criterion and PLE, BAPS and SL
as predictors. The multiple correlation coefficient is calculated to find out measure of relation between dependent variable (scientific Attitude) and independent variables (PLE, BAPS, and SL).

1. The tabulated value of ‘F’ for d. f. (3, 1061) at 0.05 level is 3.00, at 0.01 levels is 4.63. Comparing these values it can be interpreted as the ‘F’ value for d. f. (3, 1061) is 75.390, it is greater than tabulated value at 0.01 level of significance for $R^2=0.176$. Hence null hypothesis is rejected.

2. The tabulated value of ‘F’ for d. f. (3, 589) at 0.05 level is 3.01, at 0.01 levels is 4.65. Comparing these values it can be interpreted as the ‘F’ value for d. f. (3, 1061) is 42.321, it is greater than tabulated value at 0.01 level of significance for $R^2=0.177$. Hence null hypothesis is rejected.

3. The tabulated value of ‘F’ for d. f. (3, 469) at 0.05 level is 3.01, at 0.01 levels is 4.65. Comparing these values it can be interpreted as the ‘F’ value for d. f. (3, 1061) is 30.401, it is greater than tabulated value at 0.01 level of significance for $R^2=0.163$. Hence null hypothesis is rejected.

Conclusion:

SA being a dependent variable; has strong association with PLE, BAPS, and SL. It means SA can be best predicted on the basis of PLE, BAPS and SL in case of TSS, boys and girls. There is significant relationship of Scientific Attitude with

a. Perceived Learning Environment
b. Basic Science Process Skills
c. Scientific Literacy

For i) TSS ii) Boys iii) Girls

6.12 Suggestions

1. Learning environment plays vital role in ‘learning’ of a student. Minimum requirement such as basic infrastructure and library resources, laboratory etc. must be made available by school authority. Open access should given to teachers and students to use all resources available in school. Teachers should be given authority to modify Learning Environment as per the requirement.
2. Textbook functions as major learning resource. It should be updated from time to
time. Some modern inventions, current science researches and its outputs should
be included. The curriculum should provide opportunity for logical thinking,
imagination and higher order thinking.
3. Schools should organize talks and interviews of junior scientists so that students
can get motivation.
4. Schools from neighbouring locality should share the learning resources. ‘Share
and care’ can be promoted keeping in mind economical constraints. Learning
atmosphere should risen by collaboration of different schools.
5. Interschool competitions on science quizzes, debates, elocution, essay and
projects should be organized.
6. School should organize regular visits to Science related institutions like Homi
bhabha centre for Science Education, Indian Institute of Geomagnetism, Marathi
Vidnyan Parishad etc.
7. School Principal can create forum where students and teachers can interact
discuss the science . Senior teachers’ talk, Workshop can be organized so as to
help new teachers.
8. Teacher’s in-service training program must stress on innovative practices and
development of science process skills.
9. Teachers should be motivated to develop learning resources and improvised
Apparatus.
10. Science teacher should always promote rational thinking. ‘Knowing -why and
How’ should be all time agenda of science classes.
11. Mobile science laboratory/ laboratory on wheels which is promoted by NCERT
must be implemented practically. It will provide opportunities to students to
perform experiments. Close relevance of science should be created by discussing
the topics related to daily life ex. hygine, common diseases, cleanliness etc.
12. Projects like ‘Vidyavahini- run by Government of Maharashtra’ should be
popularized and maximum schools should be motivated to part in it.
13. Pseudoscience should be discouraged at all levels of learning. For the same teachers should be active members of movements like ‘ANIS- Andhshraddha Nirmulan Samiti- one such movement is popular in Maharashtra.

14. Instructional planning of teachers must include discussion; debate, quizzes etc. constructive learning, learning by doing, experimenting should be promoted. It gives thrill of doing and develops positive self concept. Science Clubs, Excursions, Educational visits should not be mechanically worked out. Teacher should focus on the development of scientific attitude rather than only achievement in science.

15. Teacher should be adequately trained to make use of Science Process skills in their regular teaching. They should also work towards self regulated learning so that students will be motivated and accountable for own learning.

16. Cautious efforts to be done to improve Scientific Literacy. Open discussion should be held on various topics. Superficial learning should be discouraged. Revisiting the concepts and curriculum should have place in regular timetable. Habit of Science reading and discussing should be nurtured. It should be considered as a part of Academic Achievement.

17. Development of Scientific Attitude should be marked as mission of every school.

6.13 Suggestions for further researches

1. Co relational study of Integrated Science Process Skills and Scientific Attitude of secondary school students studying in different board schools can be studied.

2. The learning Programmes can be developed to enhance Basic Science Process Skills, scientific attitude of Secondary school students.

3. Development of Program to enhance Scientific Literacy of secondary school students

4. The learning environment provided by the teachers and the interaction patterns of students can be studied.

5. The same variables can be studied in the schools from rural set up.

6. It would be interesting to study the efforts made by schools to eradicate superstitions from students and society at large.