5.0 SUMMARY

5.0.1 Introduction

Man is highly intellectual creation of the nature. Man is the most powerful source of development of nation and the quality of people. Education plays an important role in the development of individual, society and nation. It is generally held that the person get higher status through education than economy. The educational status of an individual is highly depicted through the academic achievement. Academic achievement has become a potential index in determining present and future of the students.

Quality of education is mostly assessed on the basis of academic performance or academic achievement of students. It serves as a key criterion in order to judge students' true potentials and capabilities. Students who achieve well academically have some advantages. Academic achievement is a product of examination. A good examination system can helpful in producing higher and quality achievers. But this is very true fact that a large number of students fail each and every year at secondary and higher secondary levels. Students who fail in the education system cannot be expected to become productive members of their communities. Failures are a drain on the economies of each state and the nation. Failure of students in examination creates a considerable lose on intellectual potency which hamper national development. It is one major cause of teen-age student suicide.

Researchers are searching factors responsible for achievement since middle time of 20th century. Previously, general people notion was that only intelligence play
significant role in achievement. After recognition of non-intellectual factors role in achievement several researches conducted related to non-cognitive/non-intellectual factors and achievement. Some studies also conducted related to combination of cognitive and non-cognitive factors in relation to academic achievement. Some researches show positive impact of non-cognitive factors on achievement while other researchers found no significant impact of non-cognitive factors on achievement. But majority of researches reveals that non-cognitive factors are playing significant role in academic achievement of students.

When the investigator goes through several library and Internet, she found that some cognitive variables like logical thinking, science process skills are important factors responsible for achievement. Scientific attitude is also one of important factors responsible for achievement in science and other subjects. Some studies were also found related to scientific attitude in relation to achievement. But in Indian scenario very few studies have been conducted related to logical thinking and scientific attitude in relation to achievement of students. Therefore, investigator decided to study achievement in science of higher secondary school students in relation to scientific attitudes and logical thinking. Formal title of the present study has given below:

5.0.2 Title of the Study

Formal title of the present study was

“A Study of Certain Correlates of Science Achievement at Higher Secondary Stage”

5.0.3. Objective of Study

Following objectives were framed for present study:

1. To find out significant difference among high, moderate and low science achievers on scientific attitude of rural male, rural female, urban male, urban female higher secondary school students.
2. To find out significant difference among high, moderate and low science achievers on logical thinking of rural male, rural female, urban male, urban female higher secondary school students.

3. To find out significant difference between male and female higher secondary school students on achievement in science for rural government, urban government, rural private, urban private categories.

4. To find out significant difference between rural and urban higher secondary school students on achievement in science for male Government, female Government, male private and female private categories.

5. To find out significant difference between Government and private higher secondary school students on achievement in science for rural male, rural female, urban male, urban female categories.

6. To find out contribution of scientific attitude and logical thinking on achievement in science of rural male, rural female, urban male and urban female students.

7. To find out contribution of scientific attitude and logical thinking on achievement in science of Govt. and private school students.

**5.0.4 Hypotheses of the Study**

Objective wise hypotheses were framed in null form as follows:

H0\(_{1,1}\) There is no significant difference among high, moderate and low science achievers on scientific attitude of rural male higher secondary school students.

H0\(_{1,2}\) There is no significant difference among high, moderate and low science achievers on scientific attitude of rural female higher secondary school students.

H0\(_{1,3}\) There is no significant difference among high, moderate and low science achievers on scientific attitude of urban male higher secondary school students.

H0\(_{1,4}\) There is no significant difference among high, moderate and low science achievers on scientific attitude of urban female higher secondary school students.
H02.1 There is no significant difference among high, moderate and low science achievers on logical thinking of rural male higher secondary school students.
H02.2 There is no significant difference among high, moderate and low science achievers on logical thinking of rural female higher secondary school students.
H02.3 There is no significant difference among high, moderate and low science achievers on logical thinking of urban male higher secondary school students.
H02.4 There is no significant difference among high, moderate and low science achievers on logical thinking of urban female higher secondary school students.
H03.1 There is no significant difference between male and female rural Government higher secondary school students on achievement in science.
H03.2 There is no significant difference between male and female urban Government higher secondary school students on achievement in science.
H03.3 There is no significant difference between male and female rural private higher secondary school students on achievement in science.
H03.4 There is no significant difference between male and female urban private higher secondary school students on achievement in science.
H04.1 There is no significant difference between rural and urban male Government higher secondary school students on achievement in science.
H04.2 To find out significant difference between rural and urban female Government higher secondary school students on achievement in science.
H04.3 There is no significant difference between rural and urban male private higher secondary school students on achievement in science.
H04.4 There is no significant difference between rural and urban female private higher secondary school students on achievement in science.
H05.1 There is no significant difference between Government and private rural male higher secondary school students on achievement in science.
H05.2 There is no significant difference between Government and private rural female higher secondary school students on achievement in science.
H0.5.3 There is no significant difference between Government and private urban male higher secondary school students on achievement in science.

H0.5.4 There is no significant difference between Government and private urban female higher secondary school students on achievement in science.

H0.6.1 There is no significant contribution of scientific attitude and logical thinking on achievement in science of rural male students.

H0.6.2 There is no significant contribution of scientific attitude and logical thinking on achievement in science of rural female students.

H0.6.3 There is no significant contribution of scientific attitude and logical thinking on achievement in science of urban male students.

H0.6.4 There is no significant contribution of scientific attitude and logical thinking on achievement in science of urban female students.

H0.7.1 There is no significant contribution of scientific attitude and logical thinking on achievement in science of Govt. school students.

H0.7.2 There is no significant contribution of scientific attitude and logical thinking on achievement in science of Private school students.

5.0.5 Rationale of the Study

Education is a strong key of development in all spheres of the world. It is a key of success of any individual and any nation. Due to the significant role of education, recently international organizations have clearly been paying more attention to achieve goal of education for all. Education is related to achievement of students in different subjects. Science is one of the very important subjects in school system and higher education. Science helps us to break superstitions and conventional ideas and develop scientific attitude, analytical thinking and logical thinking in learner. Science is considered as a development of culture and a synonym of progress. Science is introduced heavily in our life. Many incidents are occurring around us and in most of incident science appears. Use of scientific instruments and knowledge is necessity of life. Without science it is difficult for a man to continue with his life because every where is science. Therefore, the demand of present time necessitates that all students in schools or in
community must have some understanding of science and technology along with its latest role in society. Science education in school curriculum, especially at secondary and higher secondary school stage, is a necessity because science education gives training to individuals in scientific method and helps to develop a scientific attitude and inculcates in them a spirit for scientific enquiry. But it is very shocking that in present world of science and technology a good number of students are failing at secondary and higher secondary level. Therefore, in front of teachers, administrators, educators, policy makers and researchers, a striking question has sustained since long time that how student achievement level in science and other subjects can improve and overcome failure.

The main reason behind failure in examination is lack of concept formation, concept attainment and concept understanding in science subjects or other subjects. Formation/attainment/understanding of concepts in any subject is mostly an individual affair. It is also influenced by a number of socio-psychological, biological, environmental and demographic variables. Attitude and logical thinking ability are two main individual factors play significant role in understanding of concept and thereby achievement in science.

Since, logical thinking and scientific attitude play significant role in science achievement, therefore, investigator decided to study achievement in science of higher secondary science students of Sangrur District in relation to scientific attitude and logical thinking.

5.0.6 Delimitations of the Study

Due to limitation of time and financial assistance the present study was delimited in following manners:

1. Only higher secondary students had been selected.
2. Students had been selected from Sangrur District (Punjab) only.
3. Only science students had been selected.
4. Only 400 students had been selected for final study.
5. One dependent variable (achievement in science subjects) and five independent variables (scientific attitude, logical thinking, sex, habitation/locality, and types of school) had been selected for present study.

5.0.7 Concept of Terms Used in the Study

Achievement

Achievement is the learned knowledge of a learner. The learner gains knowledge in school in different subjects through subject teachers. The school provides a wider variety of activity to develop physical, mental and spiritual heal including subject knowledge. Attainment of these aspects is known as achievement.

Achievement in Science

Science is comprised of physics, chemistry, biology, and earth science. Understanding and attainment of concepts in science subject is known as achievement in science. Achievement in science had been operationalized in terms of student's score on science achievement.

Attitude

Attitudes are function of what we think and what we feel about object, place, person, etc. Attitudes have emotional content and vary in intensity and generality according to the range of objects or situations over which they apply. It is a mental state, more or less enduring, representing a tendency to react favorably or unfavorable toward designated class of stimuli is attitude.

Logical Thinking

The study of cognitive process has an important area of psychological and educational investigations. Generally terms like logical reasoning, logical thinking and cognitive developmental level are in used for similar purpose. Logical thinking is a process of solution of a problem in which one uses reasoning consistently to come to a conclusion. Problems or situations that involve logical thinking call for structure, for
relationships between facts, and for chain of systematic reasoning that make sense. Piaget’s (1953) introduced four stages are known as the sensory motor, pre-operational, concrete operational and formal operational.

**Science**

Science is a school subject, comprising of a course in physical and biological sciences. Physical science consists physics, chemistry and earth science. Biological science consist zoology and botany. Science is search for cause of natural phenomena and other events for knowledge and truth. It is a product of human activity in the form of systematic and organized body of knowledge. It is an investigation of observation, identification, and theoretical explanation of the phenomenon occurring in nature.

**Scientific Attitude**

The scientific attitude is a scientific act or thought. It is way of thinking in scientific way. Reliable, practical and scientific opinions, beliefs, feelings, thinking and appreciations are known as scientific attitude.

**5.0.8 Plan and Procedure of the study**

**Method of Research**

Method of any research is a planning and structuring the strategy of investigation in proper way. In other words it is a scientific and planed way to conduct research. The method of present investigation was a survey type research employing an *ex post facto design*.

**Population**

A population is an entire set of individuals, events or objects, which may be finite or infinite. XII grade students of Sangrur District of Punjab were considered as population for present study.
Sampling and Sample

A sample is the part of the population. A well chosen sample consists most of the characteristics of a particular population. Sampling is a process of selection of representative sample from population of the study. Using purposive sampling technique 400 science students of grade XII had been selected from ten higher secondary school of Sangrur District of Punjab.

Tools of Research

In order to meet the objective of the present study the following tools were used:
1. Scientific Attitude Scale prepared by Shailaja Bhagwat (2006) had been used to measure scientific attitude of higher secondary school students.
2. Logical Thinking Test prepared by Sujeet Kumar and Shikha Tiwari (2012) had been used to measure the logical thinking of higher secondary school students.
3. Science Achievement Test constructed and standardized by R. D. Singh (2006) had been used to measure achievement in science of higher secondary school students.

Data Collection

First of all investigator selected 10 schools purposively from Sangrur District of Punjab state. After this, investigator contacted to principal for permission of data collection. After permission of principals of selected schools, investigator was collect data from students with the help of class teachers.

Statistical Techniques

Including descriptive statistics, correlation, analysis of variance, t-test and multiple regression analysis were used for analysis of data of present study. For this purpose data were analyzed by computer using Microsoft excel and SPSS package.
5.0.9 Results of the Study

1. Significant difference was found among high, moderate and low rural male science achievers on scientific attitude for rural male higher secondary school students.

2. Significant difference was found among high, moderate and low rural female science achievers on scientific attitude for rural female higher secondary school students.

3. Significant difference was found among high, moderate and low urban male science achievers on scientific attitude for urban male higher secondary school students.

4. Significant difference was found among high, moderate and low urban female science achievers on scientific attitude for urban female higher secondary school students.

5. Significant difference was found among high, moderate and low rural male science achievers on logical thinking for rural male higher secondary school students.

6. Significant difference was found among high, moderate and low rural female science achievers on logical thinking for rural female higher secondary school students.

7. Significant difference was found among high, moderate and low urban male science achievers on logical thinking for urban male higher secondary school students.

8. Significant difference was found among high, moderate and low urban female science achievers on logical thinking for urban female higher secondary school students.

9. No significant difference was found between male and female on achievement in science of higher secondary students of rural Govt. schools.

10. No significant difference was found between male and female on achievement in science of higher secondary students of urban Govt. schools.
11. No significant difference was found between male and female on achievement in science of higher secondary students of rural Private schools.
12. No significant difference was found between male and female on achievement in science of higher secondary students of urban Private schools.
13. No significant difference was found between rural and urban on achievement in science of higher secondary students of male Govt. schools.
14. No significant difference was found between rural and urban on achievement in science of higher secondary students of female Govt. schools.
15. No significant difference was found between rural and urban on achievement in science of higher secondary students of male Private schools.
16. No significant difference was found between rural and urban on achievement in science of higher secondary students of female Private schools.
17. No significant difference was found between Govt. and private higher secondary rural male students on achievement in science.
18. No significant difference was found between Govt. and private higher secondary rural female students on achievement in science.
19. No significant difference was found between Govt. and private higher secondary urban male students on achievement in science.
20. No significant difference was found between Govt. and private higher secondary urban female students on achievement in science.
21. Contribution of logical thinking of rural male students was found 34.52% of variance on achievement in science. In the presence of logical thinking contribution of scientific attitude was not found significant.
22. Contribution of logical thinking of rural female students was found 24.47% of variance on achievement in science. In the presence of logical thinking contribution of scientific attitude was not found significant.
23. Contribution of logical thinking of urban male students was found 11.11% of variance on achievement in science. In the presence of logical thinking contribution of scientific attitude was not found significant.
24. Contribution of logical thinking of urban female students was found 13.90% of variance on achievement in science. In the presence of logical thinking contribution of scientific attitude was not found significant.

25. Contribution of logical thinking of Govt. higher secondary school students was found 37.181% of variance on achievement in science. In the presence of logical thinking contribution of scientific attitude was not found significant.

26. Contribution of logical thinking of Private higher secondary school students was found 15.381% of variance on achievement science. In the presence of logical thinking contribution of scientific attitude was not found significant.

5.1 CONCLUSIONS

Following conclusions were found in the present study:

1. Significant differences were found among high, moderate and low science achievers on scientific attitude for rural male, rural female, urban male and urban female students.

2. Significant differences were found among high, moderate and low science achievers on logical thinking for rural male, rural female, urban male and urban female students.

3. Significant differences were not found between male and female, rural and urban, and Govt. and private higher secondary school students on achievement in science.

4. Only logical thinking contributes significantly to achievement in science for rural male, rural female, urban male, urban female, Govt. and Private school students.

5.2 EDUCATIONAL IMPLICATIONS

Findings of the present study are very fruitful for teacher educators, school administrators, teachers and curriculum planners. Educational Implication for scientific attitude and logical thinking are given below:
For Scientific Attitude

In the present study, significant difference was found among high, moderate and low science achievers on scientific attitude for rural male, rural female, urban male and urban female students. Since attitude, particularly scientific attitude, play important role in development and understanding of science subjects. Therefore, teachers, teacher educators, administrators and educational planner should try to develop scientific attitude of students through activities.

1. Secondary and higher secondary school teachers are product of teacher training colleges or teacher education institutions. Therefore, this is responsibility of teacher training institutions to develop scientific attitude of pre-service teacher because they are prepared for school. They can be able to develop scientific attitude in their student during formal teaching. Teacher educators are life of institutions; therefore, this is responsibility of teacher educators that they should be trained pre-service teachers in scientific attitude through various activities related to scientific attitude. These activities should be based on dimensions of scientific attitude.

2. This is reality that today teacher education programmes are not functioning properly. In most teacher education institution students are taking B. Ed. degree through non-attending system. Some student can do M. Ed. and inter in Teacher education system. Can we think that these teachers can be able to develop scientific attitude of pre-service teachers? Taking this point in view training of teacher educators in scientific attitude is also an urgent need for teacher education system. For this purpose, knowledgeable persons in this field should be invited time to time that can develop scientific attitude of teacher educators and pre-service teachers of the institutions.

3. Role of teachers working in secondary and higher secondary is also very important in development of scientific attitude of their students. They can plan activities related to scientific attitude and apply on students with care and self-supervision.

4. Seminar on development of scientific attitude should be frequently organized by teacher institutions. Workshops are also organized to gain experience and practical
knowledge about development of scientific attitude of teacher educators and pre-service teachers.

5. This is responsibility of curriculum planners that they prepare such curriculum that cater scientific attitude of students. For this, activities related to scientific attitude should be introduced in curriculum of secondary and higher secondary school students.

6. School administrators should organize seminar on development of scientific attitude in school.

7. Science fair should be organizing in schools to develop interest in science subjects and scientific attitude of students.

8. Programmers in teacher education institute and schools should be organized to develop scientific attitude and logical thinking of teacher educators, teachers and students.

9. Teachers should be encouraged to adapt scientific approach like enquiry, guided discovery and projects.

10. Teachers should organize seminars for student on burning scientific topics.

11. Aspect related to scientific attitude should be developed among students include those activities through which their curiosity gets satisfied, they get rid of their superstitions, they begin to participate in activities.

12. An important tendency which is found among all human beings and especially in children is curiosity. Children are curious to know about various things around themselves in their daily life. Teacher should provide such arrangements in the classroom and in school that students can get maximum opportunities to satisfy their curiosity.

13. Teacher should provide opportunities to maximum students for close observations and they should be provided equal opportunities to get involved in the conducting experiment in the school.

14. Teacher should provide the task of collecting evidences and beliefs based on their self-observations, experiences and experimentation with the aim to test the validity of superstitious beliefs.
15. Teacher should encourage the students to find out the evidences on which they base their beliefs.

16. Science is a practical subject, for which, provision of educational trips and tours should be made from time to time. Teachers should encourage all the students to participate in such activities.

17. Various reference books related to scientific attitude should be provided by schools and teacher education institutions to their students.

18. Science teacher cannot play effective role in developing scientific attitudes among the students unless and until he possesses such kind of attitudes. Therefore, this is duty of the science teacher to adopt scientific attitude in him through various scientific approaches for imparting information related to scientific attitude.

19. Scientific attitude is not related to only science subject but important for every person. It is a way of thinking in write way, therefore, scientific attitude should be develop in each students at secondary and higher secondary level.

Related to Logical Thinking

In present study significant difference was found among high, moderate and low science achievers on logical thinking for rural male, rural female, urban male and urban female students in favour of high achievers. Science teachers should be aware of the fact that cognitive development is not completely dependent on biological factors, but also the particular activities stimulated and reinforced by the cultural and educational environments. Teachers' and teacher educators’ duties in this process are to develop logical thinking of students using various logical activities in classroom and outside of class. Administrators and curriculum planner can also play significant role in development of logical thinking of students. Following action should be taken by teacher educators, teachers in school, administrators and curriculum planners to develop logical thinking in teachers:

1. The previous researches indicate that logical thinking is important for attainment and understanding of concepts. Formal operation thinking is necessary for understanding abstract or formal concepts. For effective learning, therefore,
curriculum should be planned in such a way that the structure of content is matched with the level of intellectual development of students.

2. The present study indicates that, even in XII-grade science students there exist differences in logical thinking in students at the same class level. This suggests that science teachers should be trained in Piagetian theory as it applies to science instruction, and train teachers to help students to acquire formal logical thinking skills.

3. Due to the high speed of scientific development, it becomes impossible to keep the important and abstract concepts in abeyance at the higher secondary level and hence, they need to be taught as far as possible with the help of pseudo-examples (Rai, 1990).

4. Students should be trained in developing of logical thinking because in the absence to formal operational level of cognition students cannot grasp formal or abstract concepts and also cannot think divergently. For development of formal operational reasoning teacher should aware students about different dimensions related to logical thinking, particularly related to formal operational thinking. Teacher can develop higher logical thinking through providing problems related to higher logical thinking.

5. Investigator suggests that teachers should create congenial atmosphere in classroom where his pupils learn with confidence and freedom from fear, catch their interest and self-evaluate their efforts. Teacher force should be on understanding of concept not on rote process.

6. Teacher should always ask questions related to higher level of questions. Because researches indicate that students are not attaining higher level of concept. To develop higher level of cognition teacher should ask questions related to understanding, application, analysis synthesis and evaluation. Because presently not only teacher but also teacher educators providing only information/knowledge in classroom.

7. To develop logical thinking in student’s teacher should develop habits like observations, experimentation and draw inferences in students.
8. If teacher wants to enhance logical thinking skills in their students then they need to understand between various types of statements like conditional, converse, inverse or contra positive.

9. Workshop should be organize in teacher education institutions and schools related to development of logical thinking of students.

5.3 SUGGESTIONS FOR FURTHER RESEARCH

On the basis of findings and discussions of the present study it is suggested that following problems may be undertaken in future:

1. Similar studies should be conducted in other subject areas such as biology, earth science, arts and social science subjects.

2. This study should be conducted on the large sample including different districts and state.

3. This study should be conducted with including some other important variables like science process skills, learning environment and learning style.

4. A study should be conducted related to development of several programmers and learning material for development of scientific attitude.

5. A study should be also conducted related to development of several programmers and materials for development of logical thinking of secondary and higher secondary school students.

6. Since logical thinking and scientific attitude are affecting achievement in science therefore correlation studies should be conducted among scientific attitude, science process skills and logical thinking of secondary and higher secondary students.

7. Experimental studies should be conducted to show the effect of different cognitive and non-cognitive factors on achievement in science.

8. This study should be conducted using self constructed and standardized achievement in science test based on all six dimensions of Blooms taxonomy.