CHAPTER-V

FINDINGS, SUGGESTIONS AND CONCLUSION

5.1 Findings of the present study:

5.1 (a) Findings for the First and Second Objectives of the Present Study:

(i) Gender:

Regarding gender of a scientist, both high school and junior college students of Lower Assam perceived scientist as a male.

(ii) Height and Complexion:

Regarding height and complexion, non-stereotypic images are found in the present study for both high school and junior college students. It means that for being a scientist colour and complexion cannot be a barrier.

(iii) Hair and Facial Hair:

It is found that high school students and junior college students perceive that scientists have either long hair, wild hair or bald, and lower percentages are found for short hair for both the level. Regarding mustache and other facial hair, the percentage of high school responses have found as 69% and for junior college it is 59.67% and the percentage of shaved category are 31% and 33.33% respectively, which is similar with the previous studies.

(iv) Age:

Regarding age of a scientist, students of both the level thought scientists are either middle aged or old aged.
(v) **Wearing:**

Regarding wearing of a scientist, students perceive that scientist always wear lab-coat, generally use to wear eye glasses. In case of use of gloves, tie and head phones by scientists the percentage of positive response of the high school students and junior college students were less.

(vi) **Friendliness, Talkativeness, Patience and Smiling:**

Among the students of both the levels, maximum responses got for scientists are either less friendly or unfriendly, either less talkative or keep silence, scientists are either less smiling or frown but have more patience. On the other hand for more friendly, more talkative, more smiling the percentage were less. These findings represents that the majority of students perceive that scientists’ personal characteristic is different from normal people.

(vii) **Intelligence:**

Regarding intelligence, students have perceived more intelligence as a characteristic of a scientist.

(viii) **Responsibility:**

In case of responsibility of a scientist students in both the level perceive that scientists are less responsible or irresponsible towards their family life or social life which is also a stereotypic image of scientist.
(ix) Open-mindedness

In case of open-mindedness of a scientist 61% of high school students and 49% of junior college students viewed scientists as less open minded or conservative.

(x) Religiousness:

In case of religiousness of a scientist, students perceive scientist as less religious or irreligious, which are also stereotypic in nature.

(xi) Marriage:

Regarding marriage of a scientist, 59% of high school students and 62.33% of junior college students viewed that scientists do not want to marry as they always remain busy in their research work and that is why they are not interested in marriage life.

(xii) Symbol of Knowledge:

Regarding symbol of knowledge, respondents drew books and pen in pocket respectively as symbol of knowledge for a scientist. Among the other symbols of knowledge like Files and Clip Board got relatively lesser percentage for both the levels.

(xiii) Symbol of Research:

In case of symbol of research 70.67% of the total high school responses showed test-tube, bickers etc. as a symbol of research, whereas it is only 45 percent for junior college. About other indicators of symbol of research the responses were lesser in percentage.
(xiv) **Symbol of Technology:**

Another interesting finding is the presence of computers in their drawings. It is also noted that Computer and test tube are common items in most of the drawings as perceived by the students. Other indicator got lesser percentages.

(xv) **Relative Captions:**

In case of the relative captions used by scientists, responses are lesser in percentage for various type of relative captions.

(xvi) **Indication of Secrecy:**

In case of indication of secrecy category, maximum responses got for ‘no indication’ in both the levels.

(xvii) **Working Place:**

Regarding working place of a scientist, students have drawn a scientists working alone in an indoor environment like inside a laboratory surrounded by test-tubes, various types of flasks, beakers and burners with flames; shelves, machineries etc. Most of the drawings in both the level show that scientist is chemical scientist working with some test tube in a laboratory.

(xviii) **Activities:**

Regarding activity of a scientist, moderate responses got for reading, writing along with laboratory work. It is very surprising that there are very few students (5.17% of high school and 7% of junior college) who know that a scientist can also be a teacher.
(xix) Educational Qualifications:

Regarding qualification of a scientist, a variety of responses were got for both the level. Thus the results indicate that both the high school and junior college students do not have realistic perception towards scientists rather they have stereotypic perceptions.

5.1 (b) Findings for the third objective of the present study:

There is no statistically significant difference between the perceptions of high school and junior college students’ towards scientists (p>0.05).

5.1 (c) Findings for the fourth objective of the study:

There is no statistically significant difference between the perceptions of male and female students’ towards scientists (p>0.05).

5.2 Suggestions and Recommendations:

(a) In the present study, during interview when students were asked from where they have got the idea about the scientists they have imagined and drawn, it was found that maximum responses got for text books in both high school and junior college students (i.e. 70% and 64.33% respectively). It was also found that the second maximum response got for life stories of scientists in both the cases (i.e. 49% and 46.67% respectively).

In this regard two books namely “Hundred Reasons to be a Scientist” (writings of hundred scientist all over the world, published by ‘The Abdus Salam International Centre for Theoretical Physics (ICTP), 2006) and “Lilavati’s Daudgter: Women in Science in India” (writings of hundred indian female scientist published by Indian Academy of Sciences, 2008) can be suggested to included in the curriculum of class IX and X as a
rapid reader, which may be helpful for the students to get rid of those stereotypic perception which prevents them from the attraction of scientist profession. From these two books they will be aware of both current male and female scientists equally of their local state, nation and all over the world and may get many answers of what makes a successful career in science and can perceive that it is possible for them also to become a scientist from such an area

(b) When students were asked, “who do you see around as a scientist?”, 68.67% of the total high school students and 91% of the total junior college respondents answered as ‘Nobody’. So it can be suggested that to make students perception clear regarding, gender, age of a scientist, personal images and other stereotypic images of a scientist, some young scientists both male and female (free from other stereotypic images like shaved, friendly, smiling, talkative etc.) can be invited in their institution or can arrange some residential camps for science. In these programs, they can share their experiences related with their research, childhood, school, teacher, family, children, society, responsibility, religion etc. which will make a positive impact on the students. Such types of residential camps for science are common in most of western countries (Gulshen- 2011) but in India especially in Assam it is a rare case.

(c) There should be some educational tour to the local and national science and research institutions, so that they can have actual experience regarding research and scientists. So visit to those institutions will be helpful for them to make a clear perception towards science and scientists (regarding their working place, symbol of research, symbol of technology, their types of activities and other related characteristics) and develop a desire to do research in future.
(d) Curriculum of science education along with ‘science text books’ can be revised to make their perception clear and realistic. Here we can take the example of Turkey. Turkish Ministry of National Education revised Science Curriculum in 2004. Turkish perspective of teaching science was totally changed to be ‘doing science’ than rather just reading about it. The main approach in the new science curriculum was to make their students “think like a scientist” and teacher would also use a student as scientist.

(e) The adolescent students have innate curiosity and intuitive ideas about the world around them. Science classes have to tap this potentiality and the teacher should try to develop such type of curiosity in them, which may create interest towards science and scientists. Teachers should be excellent pedagogues and should know how to motivate the interest of their students.

(f) To bring out their potentialities, students should know the every way to get into the science and to expose their talent or creativity and there should be some opportunities for them who have potentialities in district level and they should be reinforced by giving special guidance, special scholarship, special coaching, special laboratory facilities for experimentation or other necessary facilities like supplying books or journals related to their talent etc.

(g) Now a days in Assam also, maximum high school and higher secondary schools have computers for students but internet facility is not available. So it should be made available and students should be familiar with the websites like url:http://indianwomenscientists.in/, url:http://www.ias.ac.in/womenscience etc., from which they can get the latest knowledge and news about inventions, scholarships, workshops, seminars, government opportunities and facilities, latest news of science and scientists etc.
(h) Here the researcher want to suggest that we the government, the curriculum planner, parents and the school jointly should try to focus about this profession and take every possible strategies to make students interested and change their perception towards this profession, so that they can plan for it from their school level as it is well known that to make a work/dream successful we need a plan. Where there is planning, there is a motivation and which is always pushing an individual towards his/her goals.

5.3 General Discussion and Conclusion:

Analyses part of the present study gives us findings that there is high stereotypical image towards scientists among both the high school students and junior college students of lower Assam as scientists are male, middle or old aged, less friendly or unfriendly etc.

But hundred years ago, portraying a scientist or researcher as a male was quite natural, because there were so few women in science. In every sector of science, number of female students is increasing; even women are also receiving higher degrees like Ph.D. Still we can say that number of women scientists in fundamental research is not increasing in India as a whole and specially in Assam. A study conducted by ‘Society for Environment and Development’ on “Status of women Scientists in S&T/R&D Institutions in Delhi” and submitted to ‘National Commission for Women’ reported that number of women coming for scientist’s profession shows only negligent increase. And it is well known that for Assam in general and Lower Assam in particular, the scenario is more pathetic. This may be the reason that students perceive scientists as male.

Joyanti Chutia, former director of Institute of Advanced Study in Science and Technology (IASST), Guwahati, shares her experiences with research in ‘LILAVATI’S DAUGHTER’ as “I was surprised to know that Marie Curie was the first woman to
receive the Nobel Prize, because till then I thought that only men could become great scientists.” Thus it can be stated that perception matters in selecting profession and because of such gender biased perception many scientifically-gifted women may not take research as their profession. So, to make this type of perception clear women scientists along with male scientists should be known by the students may be through seeing scientists in person or through their text books, T.V serials, movies, Magazines, Newspapers, and Internet etc.

One study conducted by Flick (1990) on residential programme in which young university scientists came to the classroom to interact with the students. The programme was found to be effective in developing students’ images of scientists as a children’s role model. And role model plays an important effect on students’ interest, attitude and choice. For example-Professor Mambillikalanthil G. K. Menon, Tata Institution of fundamental Research, told, “When I was young, my choices on what I would like to do in life covered a range of possible careers: science, medicine, law, history, administration and business management. The commitment to go in for science essentially came from change interaction, when I was about 16 year, with Professor C.V. Raman who had won Nobel Prize for discovery of the ramen effect. He told me that there was nothing as exciting as science pursue in life. I was so taken up with that encounter that I decided to follow his advice.”

Another scientist from Jawaharlal Nehru Centre for Advanced Scientific Research, India Chintamani N. R Row said, “I had heard of famous scientists and was aware of the aura they carried with them. Seeing and hearing a great scientist in person in the form of Nobel laureate C. V. Raman during my high school years made a great impact. C.V Raman once took me around his laboratory with two other students when I was 11 years
old. I was truly amazed by the manner in which scientists like C. V. Raman could raise questions about Nature and the material world. I developed a desire to do research when I was an undergraduate student.”

Yoichiro Nambu (a scientist), Enrico Fermi Institute, Chicago, USA, stated in the book “Hundred Reasons to be a scientist” (pp170-171) “In my infancy my father gave me books and magazines on science for children. And Thomas Edison became my hero.”

Thus from the above statements of different scientists it can be accepted that seeing scientists in person and their work in live can make the students’ perception clear towards scientist. Therefore students should have opportunities to visit museums, research centers, meet scientists, planetariums etc.

Again it is also true that along with other factors, teacher has a great role in making students’ clear perception towards scientists. When a science teacher teaches in a classroom or in a laboratory or gives lecture with demonstrations, the students may get a similarity of the teachers’ activities with a scientist or when they do themselves such type of activities they may imagine themselves as scientists. Mason, Kahle, and Gardner (1991) stated that classroom learning environments can change pervasive social stereotypic images of scientists.

James. W. Cronin, USA wrote, “…I recall my experience in becoming a scientist…I suppose that I had a natural interest in science that was just part of my nature, but so did many others…But my interest in physics was really stimulated by an extraordinary teacher at the Highland Park high school. Mr. Marshall demonstrated to us that physics was an experimental science and that was a great deal of laboratory work expected in the class.”
Since science means special knowledge or systematic knowledge, which follows observation, questioning, perception, experiment, and then establish knowledge with reasoning. Curiosity and intuition of human being is the root of all these primary ideas. Intuition is the direct perception of truth, fact etc. independent of any reasoning process. The adolescent students have innate curiosity and intuitive ideas about the world around them and science classes have to tap this potentiality and the teacher should try to develop such type of curiosity in them, which may create interest towards science and scientists.

Therefore, teachers should be excellent pedagogues and should know how to motivate the interest of their students. And for this, equal opportunity should be given to all students to do science inside the classroom or outside the classroom. If some students whether girls or boys find some difficulties in some areas of science then the teacher should search some alternate ways of making the subject accessible.

Though it is thought that all individuals have the potentiality to become great if they put them in hard work but generally students believe that genius is an innate quality and not something that anyone can achieve the same. A famous psychologist Watson said “give me 10 child and tell me which one should be what and come after 20 years I will make them same”. So, it is clear that if the students have clear perception towards scientist from their high school level then they can believe that they may have the potentiality to become scientists and can lead normal social life like others and they also may be interested to select scientist profession.

J.W. Cronin, Enrico Fermi Institute, Chicago, USA expressed, “I believe that in any spot in the world there are potential scientists born every minute. We loss them because of the lack of opportunity or deliberate discouragement, especially for women in many
countries. (66-67 “Potential Scientist are Born Every Moment”). Scientist Abdus Salam, who is the founder of International Centre for Theoretical Physics Trieste in 1964, which provides the possibility for scientists to remain in their own country for the bulk of the time, but come to the centre to carry out ideas and can return to their own country, charged with a mission to change the image of science and technology in their own country-said, “developing countries must realize that scientific men and women are a precious asset. They must be given opportunities, responsibilities, for the scientific and technological developments in their countries”. Jawaharlal Nehru also mentioned about the responsibility of government to the scientist. In the report sep-2007-sep 2009 of International Centre for Theoretical Sciences, India (ICTS) mentioned that there is a need in India today to inspire students to take up careers in the basic sciences. (w.icts.res.in)

Here we can mention one name-Vladimir. I. Keilis, a scientist connecting with the theory of Seismic waves- tremors in the earth generated by an earthquake, who encourages young people to be scientists as, “All new brands of industry from defense to entertainment stem from fundamental research. Among past examples are antibiotics, electronics, bio-technology, synthetic fibers, the green revolution, and genetic forensic diagnosis, to name just a few. And now only the basic research could give us new sources of energy; new mineral deposits; efficient defence from terrorism; cure from cancer; new forms of transportation. People trained in theoretical physics are head hunted by financial institutions; those trained in frontiers of biological research become founders and directors in the pharmaceutical industry. So knowledge of basic science will give you a head start in whatever career you choose”.

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Government of India has also taken some steps in this regard. For example: In the Annual Report 2012-2013, Govt. of India, Department of Science and Technology reported that National Science and Engineering Research Board (SERB) started its full function during the financial year 2012-2013. More than 1000 research grants were sanctioned for young scientists. It is mentioned that Innovation in Science Pursuit for Inspired Research (INSPIRE) is a flagship scheme of the Government of India for strengthening human capacity for research. Under the scheme, more than 8 lakh awards for the age group of 10-15, ~ 1.5 lakh internships for age group of 16-17, 28,000 scholarships for undergraduate studies in sciences for youth in the age group of 17-22, about 2150 research fellowships for doctoral research and 270 faculty awards for post doctoral researchers under the age of 32 have been supported. (www.dst.gov.in)

But at the time of data collection it was also seen that maximum schools do not have any laboratory except a few private schools located at big towns/cities. Some higher secondary schools where there are science streams have laboratories but high school students are not allowed to enter there or do any experiment. Therefore they have lack of knowledge about scientist and their activities. Therefore it is necessary, every school should have well equipped laboratory.

However good news is that for popularizing science amongst the students of secondary and higher secondary sections, RMSA have been organizing science exhibitions at district level named “Bigyan Jeuti” since 2012. Other new endeavour of RMSA, Assam is to introduce Mobile Science Laboratory in four districts (on pilot basis). It has also aimed to provide a secondary school within a radius of 5 km and a higher secondary school within a radius of 7 km of every habitation. (www.rmsaassam.in/activities.html)
Again a good step has been taken by the “Shishu Shiksha Samiti Assam” to develop scientific attitude among students. It is organized at prantia level in each year. The minimum duration of this exhibition is four days. Along with the exhibition quiz competition on science, training for power point presentation of model etc. are also organized. Renowned scientists are invited to deliver lectures in some selected subjects among the students gathered from various parts of Brahmaputra Valley. But it is not popularized, it needs more publicity and it should be held at the district levels not only at the city level.