CHAPTER VI

SUMMARY, IMPLICATIONS AND SUGGESTIONS

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6.0 INTRODUCTION

Education plays an integral role in the development of an individual. It helps in shaping his ideas, perception, personality, attitude etc. Education helps to discover him as a true human being and gives him strength in this physical and spiritual world. It gives motivation and inspiration to live a fruitful life. It enriches individual with free mind and spirit. Science Education plays a pivotal role in the context of development of scientific attitude like rationality, curiosity, objectivity, open-mindedness, critical mindedness, intellectual honesty and observation. Scientific thinking in a human being is important for the overall growth in the society. Science boosts the motivation level of an individual and making the mind without superstitions. People must be able to consider the implications of emerging options in science which impinge directly upon their lives, including the ethical, moral, legal, social and economic aspects. A sense of scientific temperament should be entwined in the masses for healthy growth of society. Understanding of natural phenomenon and logical thinking can be achieved through science education. National Policy on Education (1986, revised in 1992) states that science education will be strengthened to develop in the child well defined abilities and values such as the spirit of inquiry, creativity, the courage to question and an aesthetic sensibility. Science Education Programmes will be designed to enable the learner to acquire problem solving and decision making skills and to discover the relationship of science with health, agriculture, industry and other aspects of daily life.

Non-formal Education is one of the method to impart science education. As per National Policy on Education (1986), the non-formal education (NFE) programme, meant for school dropouts, for children from habitations without schools, working children and girls who cannot attend whole-day schools, will be strengthened and enlarged. Modern technological aids will be used to improve the learning environment of non-formal education centres. Naik (1977) says that in a non-formal programme, the central point is

learning: either by oneself or learning together by a group of interested individuals and it is round this focus that everything else viz., staff, buildings, equipment, curriculum, etc. gets organized. The programmes are basically meant for those who want to learn while working and therefore part time. Non-formal programmes can be run by full-time and professional teachers. But they are also run by a very large number of para-professional or non-professional teachers or by volunteers or by anyone who is prepared to share his knowledge with others who desire it. The teacher is engaged as an equal in the joint enterprise of learning along with his students and there is a continuous feedback from the teacher to the students and vice-versa. The students learn from each other while the teacher merely acts as the facilitator.

In the non-formal and in-formal system, there are many agencies in the society either supported by government or private organizations. These agencies provide science education to the citizens of the country irresponsible of the age groups. One of the major functions of imparting science education is done by non government organizations (NGOs) in the form of community science centres, through imparting science education in the country. Science education programs such as demonstrations, science fairs and seminars, nature trails, quizzes, film shows, computer awareness and training programmes, sky observation, vacation workshops, environment related programmes, science exhibition at science centres and museums are designed to meet local educational needs and fill gaps in the local educational systems.

Most part of the learning in Community Science Centres is based on experience and experimentation which makes it easier to understand scientific concepts. The students and public can easily understand scientific concepts through experiential based learning. According to Rautela and Sanyal (2010) science centres render a valuable service to their communities. As a result of visitor oriented activities, science centres have a profound impact on learning, motivation and attitude of a person. The centres strengthen the motivation of students and influence learning strategies as well as attitudes towards science. Science centres provide a medium 1) for building up a trust between the public and the scientific knowledge through dialogue, participation, engagement and experience,

2) to translate a particular scientific information into a fairly comprehensible and relevant mode to the population, 3) to motivate public by educating them on intricate scientific topics, 4) for engaging the general public with scientific issues and play imperative roles in sustaining values in local communities and 5) to provide learning environment and support science education programme of educational institutions. The science centres are meant for creating science awareness and development of scientific temper in the society. It is a hub of scientific discussion on important issues, promoting scientific solutions of their local problems, clarifying the scientific issues confronting the community, eradicating superstitions or unscientific belief and creating awareness on health issues relevant to the society. The science centres provide a significant range of educational, social, cultural and economic benefits to their communities. They serve as educational forums and centres of expertise, providing opportunities for community involvement in their activities through friends' groups, volunteers, project work and in other useful ways. Science Centres comprises of many sections which performs the functions of science popularization. Different science centres have different components but generally it comprises of following components: a) Planetarium b) Science Park c) Exhibits d) Mobile Science Exhibition e) Drama and Play f) Interactive Components and Simulation g) Science Camps

The phenomenon of science centre expanded which became an important destination for providing informal science education. The important of science education for the community has been realized at the centre and the state level. At present, the Central Government, State Governments, local authorities and different bodies, especially non-governmental organizations have taken initiatives to establish science centres for communities across country. The state of Gujarat has also taken a lead to establish community science centres in the state. The credit for setting the first community science centre in Gujarat goes to the well known scientist Dr. Vikram Ambalal Sarabhai. He established Community Science Centre in 1966 at Ahmedabad in Gujarat. Later, the centre was named as Vikram Sarabhai Community Science Centre (VSCSC) after his death in 1971. The concept spread to other locations of Gujarat and similar Community Science Centres were established gradually in different parts of the state.

The Gujarat Council on Science and Technology (GUJCOST) was established in 1986 under the Education Department, Gujarat State. The objectives of GUJCOST is to promote popularization of science and the spreading of scientific temper among the people.

Community Science Centres in Gujarat are being established as 1) non-governmental organizations which are under GUJCOST and adhere to the Community Science Policy of Govt. of Gujarat, 2) non-governmental organizations which are not under GUJCOST and do not adhere to the Community Science Policy of Govt. of Gujarat and 3) independent science centres, science museums, planetarium and science parks operated by local bodies.

The main objectives of Community Science Centres in Gujarat are to inculcate, nurture and disseminate science among people, development of scientific temper among children and citizen and to increase the public contact with scientific activities. socio-economic development through scientific attitude, to provide scientific activities to students at various stages of their study, o generate scope for activity based learning and to develop kits/teaching aids for the use in school science teaching as well as to improve the quality of science education in schools and to create awareness among the people about harmful and non-scientific activities to society, prevailing superstition, bad customs and to make efforts towards its removal in urban and rural areas.

6.1 RATIONALE OF THE STUDY

The researcher founded that no in-depth study was done on Community Science Centres of Gujarat which focuses on critical analysis of objectives of the centres, examining the extent of the achievement of these objectives, understanding of different issues and problems related to administration, infrastructure, financial management, human resources management and implementation of activities at these science centres. No such studies were reported to reveal the holistic aspects of the Community Science Centres in

a specific geographical area like a state or a country. No studies were found to be considered as learning lessons in case of effective management of Community Science Centres in Gujarat. A need of research has been raised where the functioning of Community Science Centres in Gujarat should be studied in detail. A critical analysis of objectives of these centres was required. It is important to know how non-formal way of education was imparted in these centres. The study of extent of the achievement of objectives and different functions as well as science popularization programmes of the centres was important aspects which required research. This was very identical in nature and serves special purpose for community education in the modern time. It was also important to study the functions and problems faced by these centres.

6.2 STATEMENT OF THE PROBLEM

A Study of Community Science Centres in Gujarat

6.3 OBJECTIVES OF THE STUDY

The study was designed with the following objectives:

1. To critically analyze the objectives of the Community Science Centres in Gujarat.
2. To study the extent of objectives achieved by the Community Science Centres in Gujarat.
3. To study the functioning of these Community Science Centres in Gujarat terms of General Administration. Financial Management, Human Resource Management, Infrastructural facilities
4. To study the problems faced by the community science centres in Gujarat.

6.4 EXPLANATION OF TERMS

Community Science Centre: These are science centres working as non government organizations to provide science education to students and public in a non-formal way.

6.5 DELIMITATION OF THE STUDY

Following were the delimitations of the present study:

- The research was delimited to study of Community Science Centres in terms of infrastructure, financial management, human resources management and effectiveness of programmes in science education.

6.6 IMPLICATIONS FOR THE REVIEW OF RELATED LITERATURE

The researcher reviewed total 56 studies in which 4 are Indian while 52 are foreign. The reviewed studies were mainly on the sub themes like 1) Science Centres 2) Science Museums 3) Non-formal Programmes and Field/Camp Based Experiences 3) Informal Education Programmes 4) Activity based educational programmes.

Duensing and Jeanne (1999), Medved and Oatley (2000), Sandifer (2003), Botelho and Morais (2005), Sommerkamp (2005), Tlili (2006), Rennie and Wiliams (2006), Davidsson and Jakobsson (2007), French (2007), Mathew (2008), Makwana (2008), Davidsson (2009), Falk and Needham (2010), Daneshamooz (2013), Meshoulam and Feinstein (2013), Morentin and Guisasola (2013), Lelliott (2014), Senturk and Ozdemir (2014), Weiland (2014) and Falk et al (2014) carried out studies of Science Centres to know impact of them on students and public. The activities and programmes of these institutions proved to be supportive in education. However, these studies only revealed findings about activities and did not reveal the problems faced by the centre in achieving the objectives.

Rix and McSorley (1999), Rivera and Dian (2002), Melber (2003), Suzuki (2005), Meisner et al (2007), Stroud and Sewand (2008) and Kazama and Ogawa (2014) did study on science museums. The studies concluded that science museums were an important place for science popularization.

Studies conducted by Vasava (1998), Kuo and Pi-Chu (2005), Ricks (2006), Votaw (2008), Preusch (2009), Riedinger (2011), Wenger (2011), Ball (2012), Zandstra (2012) and Birmingham (2013) conducted studies on the impact of non-formal programmes and field/science camps on students. These non-formal programmes, field trips and camp tour were found effective in enhancing science knowledge of the students, teachers and public. However, the studies did not reflect the nitty-gritty of science camps and how these camps were different from the formal science education tour.

Havasy (1997), Thomas (2000), McCreedy (2003), Robertson (2003), Randol and Meyer (2005), James and Sylvia (2007), Simpson (2007), Brackney (2008), Tomasek and Morton (2006), Goodman (2009), Roseler (2013), Dawson (2014) did studies on effectiveness of informal programmes. The focus was on what was the role of informal educational programmes in educating students and public. The informal programmes were very successful in creating awareness about science.

The studies by McCarthy (2004), Palmer and Joel (2007), Holstermann et al (2009) , Kralina (2009), Roberson (2010), Ford (2011) and Amin (2011) focused on activities conducted informal institutions for better understanding of educational concepts in non-traditional way.

The researcher found the research gaps while studying the review of literature. The studies did not reveal to what extent the objectives of these informal and non-formal programmes were achieved and the problems faced by the learners during the process. The researcher was unable to find the studies done for Community Science Centres in Gujarat. He only found that a study was conducted on one science centre (Community Science Centre-Vadodara) only. No in-depth study was done on Community Science Centres of Gujarat which focused on critical analysis of objectives of the centres, extent of the achievement of these objectives, different issues and problems of administration, infrastructure, financial management, human resources management and implementation of activities. From the studies abroad, no such studies were reported that revealed holistic

aspects of Community Science Centres. Hence the investigator had undertaken the study to research on Community Science Centres operating in Gujarat starting from the objectives of these centres, their functioning, level of achieving objectives and the problems faced by them.

6.7 METHODOLOGY

This research study was a survey type study where data is analyzed qualitatively and quantitatively. The researcher identified the objectives of the study and on the basis of them, a methodology was chalked out.

6.7.1 Population

The population for the research study consisted of 25 Community Science Centres in Gujarat (as in year 2014). Following are the different science centres running under different administrations.

6.7.1.1 Community Science Centres under Gujarat Council of Science and Technology (GUJCOST)

(A) There are 18 Community Science Centres in different districts of Gujarat which are established by different trusts as non-government organizations and falls under Gujarat Council on Science and Technology (GUJCOST).

The Community Science Centres under GUJCOST are established at two levels:

1) Regional level
2) District level.

1) Regional Community Science Centres under GUJCOST: There are three Regional level Community Science Centres under GUJCOST established at Vadodara, Rajkot and Bhavnagar.

The regional Community Science Centres performs its functions in urban and rural areas of district where it is located as well as in the nearby districts of central Gujarat.

2) District level Community Science Centres under GUJCOST: There are 15 District level Community Science Centres under GUJCOST. The science centres at Jamnagar, Gandhinagar, Sabarkantha, Amreli, Junagadh, Anand, Surat, Surendranagar, Banaskantha, Patan, Porbandar, Dang, Kutch, Bharuch and Narmada are of district level catering the need of only specific districts.

6.7.1.2 Community Science Centres outside Gujarat Council of Science and Technology (GUJCOST)

A) There is one Community Science Centre at Ahmedabad in the name of Gujarat Science City. It is established by State Government of Gujarat and managed by Gujarat Council of Science City under Department of Science and Technology, Government of Gujarat.

B) There is one Community Science Centre at Dharampur Taluka of Valsad district in the name of Community Science Centre- Dharampur established and managed by National Council of Science Museum (NCSM), Government of India.

C) There are seven Community Science Centres which are established as non-governmental organizations by different organizations. They are not under GUJCOST and perform its function independently.

1) Vikram Sarabhai Community Science Centre at Ahmedabad which is established as non-government organization.
2) Vigyan Nagari at Bhavnagar City established by private trust.
3) Lokbharti Community Science Centre run by Lokbharti Gram Vidyapeeth.
4) Science Centre operated by Surat Municipal Corporation.
5) Narmadanagar Community Science Centre at Bharuch managed by Gujarat Narmada Fertilizers Company.

6.7.2 Sample

There are total three regional level Community Science Centres under GUJCOST. One Regional Community Science Centre was selected randomly i.e. Community Science Centre at Vadodara. The researcher selected three district level Community Science Centres out of 15 Community Science Centres randomly. The selected centres were Prayosha Community Science Centre at Dang, C.C.Patel Community Science Centre at Anand and Community Science Centre at Amreli. Both Community science Centres, one run by State Government of Gujarat and managed by Gujarat Council of Science City under Department of Science and Technology, Government of Gujarat and other Community Science Centre at Dharampur established and managed by National Council of Science Museum (NCSM), Government of India, were taken as the sample. Three Community Science Centres were taken randomly from the five independent science centres managed by different bodies.

Thus, total nine Community Science Centres-one regional level Community Science Centre under GUJCOST, three district Community Science Centres under GUJCOST and five independent Community Science Centres were taken as sample. All the nine heads and 22 staff members of all nine selected Community Science Centres also constituted as sample. The students, teachers and the general public who visited the science centre on the days when the researcher went to these centres for data collection were considered as the sample for the present study. A total 73 teachers, 237 students and 168 public were constituted as sample.

6.7.3 Tools for Data Collection

The researcher developed an observation schedule to observe the implementation of activities of the selected Community Science Centres. Semi-structured interview schedules were prepared for students, teachers and general public visiting science centres to know about the performance of the centres. A semi-structured interview schedule was

prepared for head and staff of centres to know about the facts related to the activities and performance of the centres.

6.8 PROCEDURE FOR DATA COLLECTION

The researcher personally visited the selected Community Science Centres to collect the data. The researcher visited each Community Science Centres of the sample for one week time period for data collection. Total four days were spent for observing activities at the centre, two days for interviews and one day for overall observation at the centre. Hence nine weeks were spent by the researcher for the purpose of data collection. The researcher used the prepared tools for the purpose of data collection.

6.9 DATA ANALYSIS

The data was analyzed using quantitative and qualitative methods. The quantitative data was used to know the opinion of students, teachers and public on the liking of activities of Community Science Centres. The qualitative data was analyzed to know the general administration, infrastructural facilities, financial management, human resources management and implementation of activities. The percentage was used to analyze the data.

6.10 OBSERVATIONS DURING THE RESEAERCH STUDY

The researcher had observed various activities organized by Community Science Centres. He also did overall observations of management of activities, infrastructural facilities and human resources management of Community Science Centres. The observations of the researcher are as follows.

- The science centres had different tools like charts, animated cartoons, film shows, astronomy education activities and demonstration of experiments to impart non-

formal science education. The lecture and demonstration method were used during conduction of activities at science clubs for school students.

- One of the important tools of science centres was models and exhibits. There were small and huge working and non-working exhibits in science centres which were used to understand scientific concepts. The students were attracted with models and exhibits. The schools did not have such type of exotic exhibits for imparting science education. The students understood scientific concepts with fun with performing hands-on experiments on exhibits. The public could update and revised the knowledge on science by visiting centres and participating in its events. Thus science centres contributed in science education with sprinkling of fun and entertainment.

- All nine Community Science Centres had small and large exhibits which were conceptualized to learn scientific principles. It was observed by the researcher that Community Science Centres in Vadodara, Anand, Dang as well as Vigyan Nagari at Bhavnagar had common exhibits on subjects like illusion and optics. There were varieties of exhibits on these two topics only. It was observed that science centres remained complacent by showcasing only exhibits and became inactive in infusing scientific temperament in students and public. They remained inactive in science popularization because of lack of institutional vision in science education, few activities, lack of staff and resource persons as well as less support from students, teachers and public.

- Community Science Centre at Vadodara and Vikram Sarabhai Community Science Centre at Ahmedabad had regular and summer vacation science club activities because these centres were very resourceful in terms of staff, resource persons and infrastructure. In other seven science centres, there were no regular and summer vacation science club activities because there were no specialized resource persons who knew activities for robotics, craft, making scientific models and toys as well as mathematics. There were no science educators and science

communicators who could be resource persons for doing non-formal science education activities as in regional science centres.

- All Community Science Centres had fixed working hours. However, Community Science Centre at Amreli and Community Science Centre at Dang did not worked for whole day. Community Science Centre at Amreli remained open only for few hours in morning and evening while completely closed in the afternoon from 12 to 5 pm due to unavailability of staff members. The people did not take interest in gaining knowledge from the science centre. Community Science Centre at Dang also faced the same problem of not working for the full day time. When the staff and head were on leave, it remained closed as there was no human resource to take care of the centre.

- The researcher came to the conclusion that all nine Community Science Centres conducted non-formal science education activities remarkably. But due to lack of technical resources and inability to manage activities properly, the activities were not conducted properly. For e.g., At Community Science Centre at Amreli. a mathematics quiz called 'Kaun Banega Mathematician' was not managed properly.

- Hands-on experiments were important tool for making understand scientific concepts at science clubs. In case of Community Science Centre at Vadodara, the concept of hands-on experiments was not really utilized. Students did the activities like drawing and painting as well as web-kids on their own while in model making, the staff member of the science centre or the resource person performed the experiments. This was because the model making activity required skills for making the specific models. The students were not mentally prepared to make scientific toys like periscope, kaleidoscope, multiple refraction and flying squirrel.

- Vigyan Nagari at Bhavnagar was inactive in organizing activities for science. The organization had very few activities to offer to students. The centre did not promote itself to create awareness on its objectives of science popularization. The organization did not utilize their laboratories and other science educational resources to its full strength.

- The researcher found that the behaviour of staff members of all nine centres was very cordial during demonstration of science education activities. The students were also sincere and paid attention to the activities. However there was murmuring followed by shouting during demonstration of experiments. The topics of activities at all nine centres were not based on the syllabus of the schools. However some topics and its experiments were related to syllabus which was merely co-incidental.

- Gujarat Science City at Ahmedabad was an important organization for the popularization of science. All the constituents and sections were effective means for communicating science. It was a complete package of science, entertainment, education and tourism. The exhibits were prepared for education and entertainment. The method of simulation, working models, gigantic exhibits and films were excellent tools for understanding scientific concepts. The mission of edutainment was being fulfilled. However, the researcher found that Gujarat Science City was positioned itself more as a tourist destination and thus the objective of science education had taken a back seat.

- The researcher observed that Gujarat Science City at Ahmedabad and Community Science Centre at Dharampur boast of too many working models and exhibits. All the panels and exhibits at halls and sections were loaded with information and knowledge. The students and public were confused with heavily stacked scientific concepts and information. It was too heavy for them to collate knowledge of all disciplines of science.

- The staff of science centres, where huge exhibits are placed in hall of science and science park, especially in Community Science Centre a Dharampur and Gujarat Science City at Ahmedabad, did not communicate the scientific concepts of exhibits to students and public. They remained inactive in attending students and public. The staff responded that, due to interactive panels and working models, they were rest assured that public will understand by themselves.

- All nine Community Science Centres was found inactive in arranging science programmes on daily basis due to lack of institutional vision in science education, staff, head and non-formulation of activities. The research concluded that working exhibits and demonstration of scientific experiments were specialties of science centres except Community Science Centre at Amreli and Gujarat Science City at Ahmedabad. Community Science Centre at Amreli did not have working exhibits and demonstration of experiments. Gujarat Science City did not had demonstration of scientific experiments.

6.11 MAJOR FINDINGS OF THE STUDY

Following are the major findings of the present study.

- All Community Science Centres imparted non-formal science education to students, teachers and general public as per their objectives of functioning. The centres had achieved the objectives of science education with their available resources and knowledge.

- In all centres, there was dearth of science communicators to impart non-formal science education to students and public. The lack of staff at science centres hindered science popularization activities. The attrition rate among these science communicators is very high in these centres.
- The research found that teachers did not actively participate in science activities at science centres as they were more engaged in school and personal work. They did not give priority to learning at science centres. The principals also did not inspire

teachers to visit science centres. The school principals and teachers only participate in the activities at science centres only when they were instructed by higher authorities to do so.

- All the Community Science Centres were found financially sound but the Community Science Centres under Gujarat Council on Science and Technology (GUJCOST) wanted more grant from Gujarat Government for organizing more science activities.

- All Community Science Centres mainly catered their services to local students and public. However, Community Science Centre at Dharampur imparted science education across Gujarat while Vikram Sarabhai Community Science Centre at Ahmedabad imparted science education activities across India. All nine Community Science Centres conducted outreach activities for science popularization and eradicating superstitions. However, Gujarat Science City at Ahmedabad had no outreach activities.

- It was easier and comfortable for the students, who were enrolled in science clubs, in smaller groups to ask questions related to science to staff or resource person of the centres in comparison to their classes in schools where individual students did not do this. The conduct of experiments in the science centres by students individually helped in boosting their confidence. The science clubs at Community Science Centres helped in expressing the students' thoughts and sharing them with others.

- All Community Science Centres had very less science experiments for students. Mostly these were restricted to magnetism, optics, temperature and pressure. No original experiments were conceptualized by science centres except Vikram Sarabhai Community Science Centre at Ahmedabad. The experiments were found copied from internet. In rainy season, the activities and events at centres, especially outreach activities, were cancelled due to heavy rain.

- All science centres were well versed in astronomy education activities which were beneficial to students and general public. The science centres provided knowledge on astronomy with credibility and helped in reducing exaggerations among people about the celestial bodies like planets of solar system, moon and constellations. They helped in making understand public on difference between astronomy and astrology. They knew the handling of telescopes and binoculars and its maintenance as well as observation of celestial objects. The school teachers did not know all this nitty-gritty's of astronomy education. Moreover, the astronomical observation had to be done in late evening and night. The school teachers were engaged in their personal work and family commitments. They had no time for astronomy activities for students. Also, the schools could not run in evening or night, especially for astronomical observation. Thus, Community Science Centres were proved valuable in imparting astronomy education.

- The public and students watched the exhibits on astronomy and movie in planetarium because they felt exaggerated about sky, clouds, sun, moon, stars and universe. They had a specific visualization in mind about images of universe, solar system, planets, moon, sun and earth. They believed that the planets like Jupiter, Venus and Mars were gigantic in nature when seen from human eyes. Due to images communicated by media like documentaries on television, internet and print media, public felt these exaggerations. The images in media were manipulated in colour, shape and size with the help of computer software. The people, by consuming media, understood and perceived the image of celestial objects (planets of solar system and other formation in the universe) as seen in media. The astronomy programmes of science centres had succeeded in breaking this false belief of the public about universe. The images of celestial objects were seen very small from eyepiece of telescope in counter to images seen in multimedia. As the telescope showed the object as per the focal length of the lens, the gigantic image in minds of public broke down.

- The research study showed that the students who came to participate in science club activities at Community Science Centres at Anand and Vadodara decreased drastically. So centres faced shortage of students. The resources of the centres meant for students like children books, magazines, chemicals used for performing experiments and kits were unutilized. The parents did not send their children to centres as parents gave priority to tuition classes. The students were well grossed in tuition so that they could not devote time to centre's activities.

- The pubic understand that science was a teaching subject rather than an important aspect to live life. They considered God was the creator of scientific concepts. Community Science Centres failed to explain that the concepts were a natural phenomenon and had nothing related to God.

- The parents enrolled their children in the science centres so that the children can be engaged in some activities for learning and during that time the parents can do their household. The research found that students enrolled at science centres did not attend activities at the science centres when they were in standard 10 and 12 as they were giving more priority to their board examinations. The students responded that during that time, they were engrossed in their own study and did not get time to visit the centres.

- The infrastructural facilities at all nine centres were found remarkably well except Community Science Centre at Dang. The Community Science Centres which were set up independently had their own building facility while Community Science Centres at Vadodara worked in a building given by state government on lease. Also Community Science Centres in Dang and Amreli worked in a building given by state governments. The infrastructural facilities were very poor at Community Science Centre at Dang as it did not have their own water connection for washroom, poor potable drinking water facility and lacked cleanliness.

6.12 PROBLEMS FACED BY THE COMMUNITY SCIENCE CENTRES

The research found that all nine Community Science Centres faced the problem of human resources management. There was dearth of science educators and science communicators to work at science centres and to conduct non-formal science education activities. There was no staff available for conducting science experiments at centres, schools and to do the outreach programmes. There was a dearth of subject experts for conduction of activities such as robotics, art and craft and rocketry. The technical persons for maintenance and repair of working activities were also not easily available. There was a major problem of telescope repair because it had to send to other parts of India for repair. Thus there were difficulties during astronomical events.

Moreover, there were specific problems of different Community Science Centres. At Community Science Centre in Amreli, the children and public broke the exhibits at science park in a mischief. Hence the centre had to bear the cost to repair them. The centre sometimes faced voltage fluctuation problem. Hence, during astronomy education activities at planetarium, there was chaos and activity was not done properly. As there were no working models, the centre could not manage properly to make the students understand the science concepts to students, teachers and public.

Community Science Centre at Dang did not have its own vehicle. Hence, the staff went for outreach activities to far flung tribal areas of Dang on their own vehicle. The resource persons were not available for activities in Dang. The centre invited experts from other parts of Gujarat, mostly from Surat. The head and staff of the centre put lots of efforts to conduct science activities as tribal people were apathetic to learn science.

All nine centres did not face financial problems but Community Science Centre at Anand sometimes had financial problem as the grants from GUJCOST came late. Thus it faced difficulty in conducting programmes due to shortage of funds.

Community Science Centre at Dharampur faced the problem due to the interruption in the supply of electricity. Also, the centre did not get technical persons for the maintenance of the exhibits as it was located in taluka area.

6.13 DISCUSSION

Community Science Centres had contributed in imparting science education to students and public. Every science centres had its own identity, whether they were under Gujarat Council of Science and Technology (GUJCOST) or under State Government or Central Government or worked independently. Community Science Centres had created their distinctiveness by chalking down scientific activities and conducting science popularization events and programmes. Community Science Centres mainly catered to the needs of students. The activities, programmes and events of centres were organized keeping in mind the needs of the students. This was done as science centres considered that students were main target audience for them and were prospective science experts of the future. The conceptualization and operation of science activities were very unique which school teachers did not know. Astronomy was a subject which was given very much importance in all nine Community Science Centres.

The researcher observed that the public considered science as a 'teaching' subject and they had a view that science was helpful to students only. The parents did not relate science with their daily life but visited science for their children’s interest. The people considered only environment, plant and trees as science. The meaning of science for them was restricted only to science topics on computers, environment and space science. Also the meaning of astronomy was restricted to sky, sun and stars only. Community Science Centres had helped in making the meaning of science in a broad manner and understanding varied disciplines of science in a holistic manner. However, the researcher observed that people were confused with the concept of science portrayed by exhibits at centres. They were not ready to understand the science conveyed to them as they were restricted to the meaning of science in a very narrow manner.

The research study showed that in schools, students did experiments in hurry. So they enrolled in science centres for performing experiments individually and peacefully. The special lectures of scientists and stalwarts at science centres helped students to get exposure of world of science. They got stimulus to search for scientific models on internet for construction of their knowledge.

6.14 CONCLUSION

All nine Community Science Centres of Gujarat were performing the functions of science popularization with the help of science activities, exhibits and models. The models, exhibits, science programmes and events were used as tools to impart science education in non-formal method. Those were considered as great means for experiential learning. The science centres had contributed immensely by conceptualizing and implementing science education programmes for students and community. However, the researcher felt that the hands-on experiments and activities for science popularization were very less and all nine Community Science Centres did not have strategy for future goals in science learning. There was no addition of updated exhibits keeping pace with advancement of science and technology. The activities and exhibits were decades old which had lost present relevance. The activities and exhibits on progression of science and technology in Artificial Intelligence, Virtual Reality and innovative technology were found missing in Community Science Centres.

Community Science Centres became complacent in their duty of science education by displaying exhibits, charts and models only. The centres and its staff were inactive in imparting science education to students and public by not giving interpretation of exhibits. They did not provide learning materials to students, teachers and public. There was scarcity of science educators and science communicators who could conceptualize and make learn science activities for students as well as community. The research also concluded that all nine science centres catered to students only. Major programmes and activities of the centres were made keeping students as the target audience. The public programmes had remained confined to specific events like World Environment Day,

science exhibition, astronomy events and some outreach activities. The centres had not chalked out strategies on how to make science acceptable in public.

The research concluded that the schools did not have activities and programmes which were done by Community Science Centres. The schools did not have constituents of science education like planetarium, simulator rides and gigantic halls of science. These lacking and loophole in schools was advantageous for science centres. The students were attracted towards them to learn science with fun and entertainment and strengthen their understanding in science. However, the students who visited science centres were not serious in learning science and they created chaos, especially during the visit at centres.

All nine Community Science Centres need to boost their activities in science for students, teachers and public. They should keep pace with the growing science and technology with the help of their resources and expertise.

6.15 IMPLICATIONS OF THE STUDY

Non-formal education has taped the immense educational resources of the community which were not utilized by the formal school. They helped in enriching the education to masses with their free-choice learning approach.

Community Science Centres have contributed in science education in a non-formal method. The activities, programmes and learning resources of the centres have huge potential to provide science education to students and public. The mixing of fun and entertainment in education is important to hold attention of students. The public should also know the importance of science in day to day life.

The students learn science in more effective manner by doing experiments at Community Science Centres. They can understand scientific phenomenon with the help of interactive and non-interactive exhibits and working models. The science education activities, events and programmes can be used for strengthening science learning for students and public.

Truths, facts and reasoning on science can prove worth for healthy society. Community Science Centres are institutes for learning science in an innovative way by portraying models. They bridge a gap between scientific institutions and society. The science centres can contribute in spreading science to masses. Science Centres can report scientific research in a lucid manner and thus help in communicating science to students and public. They can act as a catalyst in forming science policy for our country.

The research can be a great help for science centres for framing their strategies of science communication to reach out students and public more effectively. The science centres can focus on publishing teaching and learning material for students which can be used by them for reinforcing the scientific concepts in curriculum. The research work can be a torch-bearer to bring closure traditional and non-formal education.

6.16 SUGGESTIONS FOR FURTHER RESEARCH

The research was an attempt to critically analyze the objectives of the Community Science Centres in Gujarat, to study the extent of objectives achieved by the Community Science Centres in Gujarat, to study the functioning of these Community Science Centres in Gujarat in terms of general administration, financial management, human resource management, infrastructural facilities and planning and implementation of activities and to study the problems faced by the community science centres in Gujarat. Community Science Centres has been functioning as non-formal educational institutions and imparting science education to students and public. The further research can be done by expanding the survey to other districts of Gujarat or other states of India where science centre has been set up. There is a scope for research where a comparative study can be done between independent Community Science Centres, Community Science Centres under Gujarat Council on Science and Technology (GUJCOST) and Community Science Centres under State and Central Government to know their effectiveness in science education. A case study of any one Community Science Centre can be done in detail and its critical analysis can be studied. A rating scale can be developed to know how students rate the teaching done by science educators of science centres.