A STUDY OF COMMUNITY SCIENCE CENTRES IN GUJARAT

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SYNOPSIS

INTRODUCTION

Education plays an integral role in the development of an individual. It helps in shaping his/her ideas, perception, personality, attitude etc. Education helps to discover him/her as a true human being and gives him /her strength in this physical, psychological, emotional and spiritual world. It gives strength, motivation and inspiration to live a fruitful life. It enriches individual with free mind and spirit. Apart from it, education is considered as a sociological, economical and cultural need of any human being. Education also provides manpower to different sectors of economy in any country.

Science Education is a significant aspect of education. It is an important ingredient of education which makes a person logical and scientific. The importance of science is immense. It helps in transforming societies. The countries of developed world are examples of it. 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. National Policy on Education (1968) states that to accelerate the growth of the economy, science education and research should receive high priority. Science should be an integral part of general education till the end of the school stage. 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. Every effort will be made to extend science education to the vast numbers who have remained outside the limit of formal education. The policy emphasized on the role of agencies working beyond formal education for the development of science education in the country.

National Curriculum Framework (2005) also gives emphasis on importance of science education. Science is a dynamic, expanding body of knowledge, covering ever-new

domains of experience. In a progressive forward-looking society, science can play a truly liberating role, helping people escape from the vicious cycle of poverty, ignorance and superstition. Therefore, special attention is needed to modernization of science curricula and recommended for science centres catering the requirements of the community.

OBJECTIVES OF SCIENCE EDUCATION

Following are the main objectives of science education in schools according to National Council of Educational Research and Training (NCERT) (2006) and National Curriculum Framework (NCF) (2005).

- To acquire understanding of science concepts, principles and laws.
- To impart up to date knowledge in science and to know the facts and principles of science and its applications, consistent with the stage of cognitive development.
- To acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge.
- To develop their curiosity to learn science and inculcate in them a historical and developmental perspective of science and to enable the learner to view science as a social enterprise.
- Relate to the environment (natural environment, artifacts and people), local, as well as, global and appreciate the issues at the interface of science, technology and society.
- Acquire the requisite theoretical knowledge and practical technological skills to enter the world of work.
- Nurture the natural curiosity, aesthetic sense and creativity in science and technology.

MODES OF TRANSACTION OF SCIENCE EDUCATION

Though science education can be provided in formal, non-formal and informal ways, the major share of formal system in providing science education is more which is provided in

schools and colleges making it a part of the curriculum. Hence, a uniform pattern of compulsory science education is provided in the school education. The objectives of the science education at school level may also be applied for the non-formal and in-formal systems.

As per Naik (1977), the formal school is mainly organized to teach something and it is round this specific purpose that everything else, viz., its staff, buildings, equipment and students get organized. The formal school is by and large a full time institution and is meant essentially for non-workers, i.e., children and youth. It is, therefore, utilized more by the well-to-do classes who can afford to send their children to schools earlier and keep them there longer; and for the same reason, the children of the poor who are required to begin their working life early, become its drop-outs. The formal school is manned, by and large, by full-time and professional teachers. The role of a teacher in a formal school is generally that of a superior individual and the general teacher-pupil relationship is of the dominant-subordinate, of the giver-receiver, of the active-passive type. He again 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. The programmes of non-formal education can be built round almost all social, economic and cultural institutions such as farms, factories, shops, libraries, museums, drama, and so on. In fact the capacity of non-formal institutions enables it to tap the immense educational resources of the community which are not utilized by the formal school. In this system, programmes tend to be dominated by concepts of diversity, flexibility and elasticity. The attendance in non-formal activities is generally voluntary: people turn out

and participate in a programme only if they find it relevant and interesting and worth their time and effort.

Rennie et al (2003) says that out-of-school learning is self-motivated, voluntary, and guided by learners' needs and interests, so certain aspects of learning are critical to investigate, e.g., the role of motivation, choice and control, interest, and expectations in the learning process. As cited by Votaw (2008), Falk and Dierking derived a contextual model of learning within informal contexts. In this model, there were three core intersecting elements that contributed to the learning that occurred within the given context. The first element, personal context, included motivation, emotion, interest, attitudes to learning, and existing knowledge and ideas. Since no two people had the exact same experiences, this context was unique for each learner. Much of the personal context embedded emotion and motivation. Falk and Dierking referred to each group as a "community of learners" in which each of these communities was distinctive in how they behaved in certain situations. Students who visited a museum with their family may act differently than when they visited the museum with their friends. The community in which they were learning affected the amount and type of learning that occurred.

SCIENCE IN NON FORMAL EDUCATION

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. As per Kumar (2013), pedagogically, it is found that there are at least four rich themes in education theory that is specially related to the various forms of learning activities found in science centres and museums-curiosity or intrinsically motivated learning in education, multiple modes of learning, play and exploration in the learning processes and the existence of self developed world views and models among people who learn science. Generally in the traditional science teaching in Indian schools, there is a

tendency of teachers to teach abstractions, definitions and explanations of phenomenon that, for the most part, students have never had the opportunity to explore. They usually put explanations before firsthand experience of natural phenomena, whereas science centres, which are hub of non formal science education in the country reverses the process. They present phenomena in the form of exhibits that are interactive and manipulable, exhibits whose express purpose is to enable visitors to explore and experiment.

Community Science Centres makes learn science as 'Learning by Doing' and 'Keep it simple make it fun' principles which provoke, entertain, attract and engage the visitors through guided exploration and facilitated activities. The environment displays and the outcomes involved in a visit to a science centre form an extremely complex but interrelated total experience that is unique to each visitor. This fact alone ought to be enough to convince formal educators of the value of such visits. State of the art labs allow guests to participate in more complex experiments. Programs for school groups extend and deepen the educational impact of exhibits. The science centres and museums have expanded our role in communities by partnering with schools and community organizations to extend science learning into places where students already spend their time after school. Children and teens can discover new interests, develop new skills, prepare for college and learn about careers in science and engineering. Science Centres and Museums are thus developing into a new kind of public learning centre, fulfilling some of the public-education role that modern universities have neglected.

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 expos of the science centres and museums are designed to meet local educational needs and fill gaps in the local educational systems. Demonstrations seek participation of students, thus providing an opportunity for learning life-science as inquiry. They are excellent motivation factors in learning. Demonstrations are helpful in explaining skills which explain even minor points which students can observe. They promote relevant and useful

discussion in the classrooms, giving opportunity to ask questions, to make critical observations and suggest measures to improve. It is essential that a demonstration must be relevant and purposeful and the purpose must be appreciated by the students. A demonstration must sustain interest among the students. An effective demonstration can lead to thinking and students can ask searching questions. After the completion of the demonstration the students should analyze their observations or should study the recorded data and attempt to come to conclusions.

SCIENCE EDUCATION FOR COMMUNITY

Science Communication to the masses is essential to educate public about different scientific aspects. Science popularization is necessary so that public do not remain ignorant about various scientific phenomena occurring in their surroundings or outside atmosphere. Science Communication has a great potential in shaping the lives of the people and making their decisions more informative and rational.

Science and Technology Policy (2003) emphasize the importance of science and its popularization among masses. It states that there is a growing need to enhance public awareness about the importance of science and technology in everyday life and the directions where science and technology is taking us. Science, Technology and Innovation Policy (2013) also focus on public awareness and public accountability of Indian Science, Technology and Innovation sector. It states that public understanding of science is an important dimension for introducing and reaching the benefits of modern science and technology to the people. The civilizational aspect of science or scientific temper needs to be promoted across all sections of the society systematically.

Salvi (2002) states that science communication is a much neglected field in India. There is a crunch of good science communicators who can disseminate science to general public. From high school onwards, communication skills are given the least priority among science students. Hence science students lack this skill which proves hindrance to science communication. Scientists also are engrossed in their research work. So they do

not pay heed to communicate science to layman. Community benefits from concrete science communication encouraging them to build scientific attitude. Development of scientific temper and scientific attitude in daily life among the people are very much important for socio-economic development of the citizen. It is important to create awareness among the people about removal of prevailing superstitions from the society through scientific approach so that socio-economic development can take place. Most part of the learning in Community Science Centres is based on experience and experimentation which makes it easier to understand scientific concepts.

EXPERIENTIAL LEARNING

As per Association for Experiential Education (2011), the characteristics of Experiential Learning are as follows.

- Experiences are structured to require the learner to take initiative, make decisions and be accountable for results.
- Throughout the experiential learning process, the learner is actively engaged in posing questions, investigating, experimenting, being curious, solving problems, assuming responsibility, being creative and constructing meaning.
- Learners are engaged intellectually, emotionally, socially, soulfully and/or physically. This involvement produces a perception that the learning task is authentic.
- The results of the learning are personal and form the basis for future experience and learning.

IMPACT OF SCIENCE CENTRES ON COMMUNITY

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.

Ghose (2010) suggest that science centres encourage critical analysis of social, cultural, technological and natural environment and to inculcate an ability to identify the problems and work towards appropriate solution with scientific attitude for the welfare of mankind. Science Centres supplement curriculum education in schools and colleges as well as impart non-formal education to the community as a whole. They develop a spirit of inquiry by encouraging curiosity and questioning processes promoting and supporting innovative ideas and activities. It assimilates information relating to mutual interaction of science, technology and society and disseminates the information through exhibits and activities.

SCIENCE CENTRES PROMOTING SCIENTIFIC TEMPER

As per Chowdhury (2013), science is ‘reasoned knowledge’ about facts, things, persons, natural phenomena and social behaviour. ‘Temper’ is a particular state or habit of mind especially with respect to disposition. Therefore scientific temper represents a spirit of inquiry based on logical reasoning. The ability to think objectively, logically and

analytically leads to the development of scientific temper. It is by nurturing scientific temper that one can be liberated from dogmatism, irrational beliefs and superstitions. The science centre is often overlooked as a channel for science popularization. Though it is often dismissed as an educational attraction for children or as a tourist destination, it has as much potential for promoting scientific temper. One advantage is that it is a place for communication as much as it is a method, and so can act as a physical forum or hub for such activity. Its exclusive mission is to aware public on topics relating to science and technology for developing a scientific temper. Its ability to deliver multisensory learning experiences also gives it an edge over other media.

Science Centres evolved as activity oriented institutions with hands-on interactive exhibits, and organized activities, involving visitors in experimentation so that they discover science by themselves. On the other hand, exhibits could be developed to supplement formal education in schools, as well as for non-formal education of the public. On the other hand, exhibits could have broad based social relevance for creating scientific temper in the community. Parallel to the exhibits, science centres organize extensive activities, both in house and outreach for schools and communities.

Rautela (2013) says that science centres are places where construction of meaning takes place and scientific and technological advances are understood in right contexts. Although trust in scientists remains high, science centre audiences do not automatically accept that all scientific advances mean progress for everyone. They want to engage with scientists and to understand the long term implications of their research. There is thus a need for dialogue between scientists and public during the course of the scientific progress that leads to development and societal change.

Chowdhury (2013) says that superstitious beliefs have retarded human progress from time immemorial. In order to combat superstition and to uncompromisingly defend rationality and good science, science centres and museums are spearheading various anti-superstition campaigns in the form of awareness, demonstrations, workshops, popular lectures, film shows etc. There are several false beliefs prevalent in our society regarding

solar eclipse. Some people even lock themselves up in their homes to avoid “the bad rays’ from the eclipse,” Many also take a dip in holy rivers to cleanse themselves after the eclipse and some avoid cooking and eating during the eclipse. During the time of eclipse, science centres and museums make elaborate arrangements for the observation of Solar or Lunar Eclipse and organize several other activities like popular lectures, quiz etc. to aware people that eclipse poses no danger to humankind. The science awareness programmes are aimed at stimulation and nurturing scientific attitudes and temperament among people. These are for popularization of science among children, teachers and people besides introduction of new and interesting activities. The other activities include exposing students to the fascinating world of science through face to face interaction with eminent scientists, demonstration lectures by eminent experts from various fields and to provide opportunities for children to create science toys, watch fascinating experiments, science films and participate in delightful activities like aero-modeling, origami and sky watching. The potential of science centres across the country as instruments and agents of percolating scientific temper, innovation and therefore socioeconomic development is underutilized. Though non-formal education through science centres took root in India more than 50 years ago, the impact of these institutions has been less compared to global precedents.

Ghose (2010) says that science centres do not believe in Top Down system of teaching-learning process with demands blind acceptance of authoritative explanation and information. They believe in Bottom Up system where the people have to build up their understanding of science through hands-on minds-on process. Science centres believe in the dictum of 'do it', then 'observe it' and 'accept it' without raising any question. Blind acceptance is a 'no-no' in interactive science centres.

Interactive science centres emphasize through its hands-on exhibits and activities, that science is not just some theories or mathematical equations or even some test tube experiment. As per Ghose (2010), science is a logical thought process through which we can understand the laws of nature. The concept of science develops in a child's mind through observation of nature-e.g. sunrise and sunset, flowing river etc. In this

observation a child uses all five senses to fathom the mysteries of nature. At a more matured age the young mind gets intrigued with laws of nature relating to sound, light, heat, etc. With further maturity in thinking, visitors try to correlate the scientific phenomena with their understanding of life relating to environment, ecology, biotechnology, etc.

As per Chowdhury (2013), India with a tradition of skepticism and a heavy baggage of superstitions and religious dogmatism has repeatedly rediscovered itself. After independence 'spreading scientific temper' was propounded as the basis for science communication. Globalization, privatization and economic structural changes, instead of reinforcing, have pushed the agenda constructing a scientifically tempered society to the back burner. As a nation-state she needs to redefine the notion of scientific temper in the present context, and implement its constitutional duty to spread 'scientific temper, spirit of enquiry and humanism'. It is important to note that four premier institutions have pondered upon and revisited the statement of scientific temper; the emerging understanding shall constitute the bedrock of all the science communication activities that they undertake in future.

As per Islam (2013), 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, on local economies, on social processes and on policy making at official level. The personal impact means enhancing the knowledge or skills of an individual or group; economic impact is a measurable contribution to the economy of the surrounding community; societal impact means any identifiable impact on social processes at the individual or social level; political impact encompasses any influence at the decision making level or in gaining mileage. The science centres are institutions that offer hands on science learning environment. They strengthen the motivation of students and influence learning strategies, attitudes towards science and the career choices of young people. The centres are among the major tourist attractions all over the world. They are also prime elements in cultural tourism.

As per Iyer (2013), many students may not be interested in the curriculum, but everybody is interested in those things that they believe, relate to their own existence. This basic self interest, if allowed to flourish in specially designed environments like science centres, can lead to a wide variety of discoveries motivated by curiosity based on internal needs. If we want to allow students to pursue their own interests, we need to provide them with a way to get their questions answered. Many of the free choice environments that are specially designed at science centres are in fact specifically designed to bring students to the point that they want to know something. In other words create a space where one can explore, and discover, rather than teach directly, is the fundamental premise under which science centres operate.

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

HISTORY OF SCIENCE MUSEUMS AND CENTRES-INDIAN SCENARIO

In India, the Indian Museum (1814) developed its first industrial collection from the Great Exhibition of Calcutta (1883-84). For full fledged science museums, India had to wait for more than half a century when in the early 1950s, a nucleus science museum was set up in a small area in the National Physical Laboratory with science educational exhibits collected from an exhibition of the UNESCO. Around the same period, Central Museum (later renamed Birla Museum) was set up in Pilani, Rajasthan, with a mixture of art and science exhibits through the generosity of House of Birlas.

In 1956, K.S.Krishanan, director of the National Physical Laboratory (NPL), New Delhi, brought in R.Subramanian for setting up a nucleus science museum in NPL. Subramanian set up the museum which displayed crystal collection, automatic telephone exchange and spark generator. The museum was closed down in 1960s. In 1956, the Council of

Scientific and Industrial Research (CSIR), decided to set up the first major multi-disciplinary science museum at Kolkata. Thus, Birla Industrial and Technological Museum (BITM) was opened in 1959. With inauguration of the BITM, the movement of science museums and centres in country started. A similar Visvesvaraya Industrial and Technological Museum (VITM) was opened for public in Bengaluru in 1965. These two museums were strongly influenced in their approach by the Deutsches Museum at Munich (1903-1906), Germany and the Science Museums in London and Chicago.

A task force of the Planning Commission in the meanwhile (1973-1974) assessed the activities of the science museums functioning under the CSIR and recommended certain course of action for the rapid growth and sustenance of science museums in India. This paved the way for forming a separate autonomous body, the National Council of Science Museums (NCSM) in April 1978. Thus, the first science centre called Nehru Science Centre in Mumbai came into existence.

SCIENCE CENTRES AND SCIENCE MUSEUMS-PRESENT SCENARIO

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. National Council of Science Museums, an institution established by Central Government is very active in establishing Community Science Centres acroos India.

Rather than taking it upon themselves to teach visitors complicated scientific information or to provide authentic scientific experiences, 'third generation' science centres show visitors how to explore and think about and use scientific information to form well-supported opinions. They also encourage debate on topical and contemporary issues on science and technology. Science centres also address national priorities such as

developing a scientific temper and innovation culture by providing platforms in leisure time to have face to face with innovators and innovations and make grass root level innovations themselves. Real labs are provided to young students to experience real scientific enterprise with a purpose to motivate them to pursue careers in research and make innovations.

The state of Gujarat has also taken a lead to establish community science centres in the state.

OBJECTIVES OF COMMUNITY SCIENCE CENTRES

Followings are the general objectives of the Science Centres-

- 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.
- To 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.
- 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.

COMMUNITY SCIENCE CENTRES IN GUJARAT: HISTORICAL BACKGROUND

The credit for setting the first community science centre in Gujarat goes to the well known scientist Dr. Vikram Ambalal Sarabhai. Vikram Sarabhai felt the need to build a scientific temperament among public especially children. He was keen for setting a community science centre in which general public mostly school children could learn

science by doing demonstration on various scientific phenomenon. He established Community Science Centre in 1966 at Ahmedabad in Gujarat. The mission was to explore the magic of science beyond textbooks. 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. It is functioning as an autonomous body registered under Societies Registration Act from February 2000 under the Department of Science & Technology, Govt. of Gujarat. The objectives of GUJCOST is to promote popularization of science and the spreading of scientific temper, attitude among the people of the state to identify areas in which science and technology can be utilized for the achievement of the socio-economic objectives like backwardness, unemployment and poverty and of addressing itself to the problems of the rural area, and under -privileged sections of society and to devise policy guidelines for academic and field policies for the purpose of strengthening the planning and programming amenities for the development of Science and Technology. GUJCOST organizes various activities like Science and Technology (S&T) related seminars, workshops, science quiz, Mathematics-science question-answer programme, celebration of S&T days and forming science clubs. They are involved in science research projects and creating awareness about patent and intellectual property rights.

COMMUNITY SCIENCE CENTRES IN GUJARAT: PRESENT SCENARIO

There are 25 community science centres in Gujarat (as in 2014). The Community Science Centres in Gujarat are being established in following manner:

- Community Science Centres estaablished and managed by non-governmental organizations (NGOs). These centres are under GUJCOST and adhere to the rules and regulations of GUJCOST.

- Community Science Centres established by private trusts which work independently and are not under GUJCOST.
- Community Science Centre established by State Government.
- Community Science Centre established by Central Government.
- Community Science Centres established by local authorities.

REVIEW OF RELATED LITERATURE

Review of Related Literature is an important part of research. In this research study, the investigator had gone through review of literature related to science popularization. The researcher referred different e-resources, journals, books, research thesis and dissertations. Thus the research done across country and abroad was referred and the studies done on science education for community were referred in detail. The investigator glanced into objectives of research, research methodology and findings of other investigators.

The researcher has classified the Review of Related Literature into five sub themes:

1) Science Centres
2) Science Museums
3) Non-Formal Programmes and Field Camp Based Experiences
4) Informal Education Programmes
5) Activity Based Educational Programmes.

IMPLICATIONS OF THE REVIEW OF RELATED LITERATURE

Duensing and Jeanne (1999) and Sommerkamp (2005) 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 do not reveal the problems faced by the centre in achieving the objectives.

Rix and McSorley (1999), Rivera and Dian (2002) and Melber (2003) did study on science museums. The studies concluded that science museum is an important place for science popularization.

Studies conducted by Vasava (1998), Kuo and Pi-Chu (2005), Ricks (2006), Votaw (2008) and Preusch (2009) revealed the impact of non-formal programmes and field/science camps on students. These non-formal programmes, field trips and camp tours were found effective in enhancing science knowledge of the students, teachers and public.

Havasy (1997), Thomas (2000) and McCreedy (2003) did studies on effectiveness of informal programmes. The focus was on the role of informal educational programmes in educating students and public. The informal programmes were found very successful in creating awareness about science.

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

The research 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. It was only found that a study was conducted on one science centre (Community Science Centre-Vadodara). No in-depth study is done on Community Science Centres of Gujarat which focuses 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 reveals holistic aspects of the Community Science Centres. Hence, the investigator undertook the present study to research on the 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.

RATIONALE OF THE STUDY

Science is not a mere tool for the materialistic development and prosperity of a country, but science education generates analytical thinking and rational outlook and sharpens insights. Science is very important as a subject in education. It inculcates scientific attitude much needed in a country like India where caste, creed, custom and ritual persists. India is a country where superstitions are deeply penetrated in human mind. The general masses need science education to eradicate these practices. Science popularization is necessary for general masses so that people develops national cohesion as well as scientific temper in them. The science centres play an important role in eliminating such behavior. Kothari Commission (1964-66) stated that in a world based on science and technology, education determines the level of prosperity, welfare and security of the people. The Commission has recommended that science education at all levels should be strongly reinforced through study of applications to local environment and industry. Therefore, special attention is to be paid to modernization of curricula improvement of laboratories and emphasis on experimental and field work. For community point of view, it recommended setting up audio-visual and mass communication centres, now renamed as media research centres so as to provide for integrating of information and communication technologies in the delivery of education.

Community Science Centres applies active learning approach in popularizing science. At these centres, learning is done in the natural atmosphere so that students and general community can have deep insight into the scientific principles and their applications in the day-to-day activities. The participatory approach of these centres makes science easy to learn. Science demands observation skills and curiosity for experimentation. A great sense of visualization and critical mindedness is needed to understand science. Community should possess or develop these qualities in them for strengthening scientific inclination. Community Science Centres are the models in which the purpose of science

education is served in an integrated manner. These centres impart science education to all type of learners irrespective of their chronological age, keeping in mind, the school children and general public. The centres spread awareness on science through different science communication activities. These centres are generally voluntary community partnership services with the government machinery for the spreading of science education among the general community. There is a need to understand the functioning of these centres in achieving the objectives set for them and the problems faced in achieving these objectives. There are different types of community science centres functioning in Gujarat; commercial, funded by the Government of Gujarat, central government funded and self funded. It is also imperative to know the functioning of these different types of science centres in the state.

From the available literature review, the researcher came to know that no in-depth study is done on community science centres of Gujarat which focuses on detail 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.

A need of research has been raised where the functioning of Community Science Centres should be study in detail. A critical analysis of objectives of these centres is required. It is important to know how non-formal and informal way of education is imparted in community science centres. The study of extent of the achievement of objectives and different functions as well as science popularization programmes of the centres is important aspects which require research. This is very identical in nature and serves special purpose for community education in the modern time. It is also important to study the functions and problems faced by these centres. Hence, the investigator undertook the present study to research on the community science centres operating in Gujarat and to

have learning lessons through the case studies of well managed and poorly managed science centres in the state in achieving their said objectives.

STATEMENT OF THE PROBLEM

A study of Community Science Centres in Gujarat

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.

METHODOLOGY

A proper methodology is important for conducting the research study. This research study was a survey type study where data was analyzed qualitatively and quantitatively. The researcher identified above mentioned objectives of the study and on the basis of them, the following methodology was chalked out.

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.

- **COMMUNITY SCIENCE CENTRES UNDER GUJARAT COUNCIL OF SCIENCE AND TECHNOLOGY (GUJCOST)**

(A) There are 18 Community Science Centre 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.

Table 1 shows details about it.

Table 1: List of District Level Community Science Centres in Gujarat under GUJCOST.

Sr. No.	District	Name of Community Science Centre
1.	Amreli	Girdharbhai Sangralay District Community Science Centre
2.	Anand	C.C.Patel Community Science Centre
3.	Banaskantha	District Community Science Centre
4.	Bharuch	Param Community Science Centre
5.	Dang	Prayosha Community Science Centre
6.	Gandhinagar	Nisarg Community Science Centre
7.	Jamnagar	M.D.Mehta District Community Science Centre
8.	Junagadh	Shri Brahmanandji District Community Science Centre
9.	Kutch	Kutch Mitra Community Science Centre
10.	Narmada	Manthan Narmada Community Science Centre
11.	Patan	Punabha District Community Science Centre
12.	Porbandar	Shree Sahajanand Swami District Community Science Centre
13.	Sabarkantha	Pramukhswami District Community Science Centre
14.	Surat	Jay Bharti District Community Science Centre
15.	Surendranagar	Dr. Homi Bhabha District Science Centre

The district Community Science Centres performs its functions in urban and rural areas of district where it is located.

- **COMMUNITY SCIENCE CENTRES OUTSIDE 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 five Community Science Centres which are established as non-governmental organizations by different organizations. They are not under GUJCOST and perform its function independently. Table 2 shows details about it.

Table 2: List of Independent Community Science Centres in Gujarat.

Sr. No.	Location	Name of Community Science Centre	Name of the organization who operates the centre
1.	Ahmedabad	Vikram Sarabhai Community Science Centre	Independent centre which is managed as an NGO
2.	Bhavnagar City	Balvant Parekh Vigyan Nagari	Monghiben Balvihar Trust
3.	Sanosara Village, Ta.-Sihor, Dist.-Bhavnagar	Lokbharti Community Science Centre	Lokbharti Gram Vidyapeeth
4.	Bharuch	Narmadanagar Community Science Centre	Gujarat Narmada Fertilizers Company
5	Surat	Science Centre, Surat	Surat Municipality Corporation

All these 25 Community Science Centres constituted as the population for the present study. All the Heads, Staff of all the stated 25 Community Science Centres constituted as the population for the present study. The students, teachers and public who visited these centres were also constituted as the population of the present study.

Sample

The sample for the present study was taken randomly from 1) Commuity Science Centres under GUJCOST and 2) Community Science Centres which are outside GUJCOST. Stratified random sampling method was used to select the sample institutes.

Selection of sample from Community Science Centres under GUJCOST

The researcher had selected sample Community Science Centres under GUJCOST by following manner:

Selection of sample of regional level Community Science Centres under GUJCOST

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.

Selection of sample of district level Community Science Centres under GUJCOST

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.

Selection of sample of Community Science Centres which were outside GUJCOST

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 staff of all nine selected Community Science Centres also constituted as sample. Students, teachers and the general public visited the science centre on the days when the researcher visited science centres were considered as the sample for the present study.

TOOLS FOR DATA COLLECTION

The following tools were constructed by the researcher for the purpose of data collection for the research study to achieve different objectives.

Observation Schedule

The researcher developed an observation schedule to observe the implementation of activities of the selected Community Science Centres.

Semi- Structured Interview for students, teachers and general public

Semi-structured interview schedules were prepared for students, teachers and general public visiting science centres to know about the performance of the centres.

Semi-structured Interview for Community Science Centre personnel

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.

All the tools were validated by the experts.

PROCEDURE 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. 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.

DATA ANALYSIS

The data was analyzed using quantitative and qualitative methods. The quantitative data was used to know the opinion of students 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. Mainly, frequency and percentage were used to analyzed the data.

MAJOR FINDINGS

On the basis of analysis and interpretation of data, following major findings were drawn.

Community Science Centres were established as non-profit charitable trust under Societies Registration Act. All nine Community Science Centres had infrastructural facilities like halls of exhibits, science laboratories or specific space for conducting experiments and lecture hall. The common programmes undertaken by all nine Community Science Centres were formation of science clubs in schools, National Science Drama Competition, National Science Seminar, Popular science talk, Training workshops for students and teachers of science and mathematics subjects, District level Children Science Congress, Biotechnology awareness programme, Outreach Activities, Celebration for Special days, School Visit, Night Sky Watching Event, Eradication of superstitions, Science fair and exhibition as well as Water Conservation programme.

The researcher came to the conclusion that all nine Community Science Centres of Gujarat performed the function of non-formal science education as per their objectives. All nine centres were active in science popularization for students and general public. They were committed in imparting science education. All nine Community Science Centres catered to local students and public.

Though all nine centres were active in science education the extent of objectives achieved were not fulfilled in a true manner. The research study confirmed that the objectives were achieved in a partial manner. The researcher identified the reasons why the science centres were not able to fulfill the objectives properly. Community Science Centre-Vadodara and Vikram Sarabhai Community had regular and summer vacation science club activities because these centres were very resourceful in terms of knowledge 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, art and 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 remained open for whole day on working hours. However, Community Science Centre-Amreli and Community Science Centre-Dang did not worked for whole day. Community Science Centre-Amreli remained open only for few hours in morning and evening while completely closed in noon from 12 to 5 pm due to unavailability of staff members. As the campus of science centre was owned by Gujarat Government, the general public came to toilet which was near the science centre. They never cared to visit the science centre which was in campus only. The people did not take interest in gaining knowledge from the science centre. Community Science Centre-Dang also faced the same problem of not working in a 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.

The research study showed that the students who came to participate in science club activities at science centres sometimes decreased drastically. So centres faced shortage of students. So the resources of the centres meant for students like children books, magazines, chemicals used for performing experiments and kits were unutilized. Also, the students and school teachers also did not participate in the centres' activities because teachers did not care for activities as they were not ready to devote time for learning at centres for family commitments. Moreover, principals did not give leave to school teachers for teachers' training programes as well as students' visit to centres. When

authorities of education department of state government issued a circular to participate in centres' activities, then and then only principles and schools got stimulus to visit the centre. Moreover, the parents did not send their children to the centre 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 researcher founded that the behaviour of staff members in science education activities was very cordial. On the part of students, 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. The text of exhibits and models of all nine Community Science Centres were in English and Gujarati. So the students and public could easily understand the principle behind the model.

The research concluded that all nine science centres had a staff that was well versed in astronomy observation. They knew the handling of telescopes and binoculars and its maintenance and observation of celestial objects. The school teachers, especially science teachers did not know all this nitty-gritty's of astronomy education. Hence the students, teachers and public were beneficial from the know-how of science centres. 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, in this case, science centres were proved valuable in imparting astronomy education. The science centres were useful for availing learning resources for students because in some schools, the education materials and apparatus as well as chemical substances for doing scientific experiments were not available. Thus the centre filled the gap between learner and learning aids.

The students did not pay attention to learn scientific principles from exhibits which were placed in halls of science and Science Park. They touched, slapped and beat the exhibits. They kicked and slapped the exhibits or models and moved away. However, the exhibits

did not get badly affected because it was protected and covered with a glass structure. The students responded that they consider the exhibits and models as their own property and in enthusiasm they beat them. The students jostled to play with interactive exhibit and in this mess the science learning was vanished. The students pressed the 'on and off' button of the working models and walked away from the exhibit. They had a fight with each other for doing demonstration with interactive exhibits. It was also found that most of the students and public did not read the text which was meant for understanding the corresponding exhibits.

The pubic understood that science was a teaching subject rather than an important aspect to live life. They considered science as an act of God and hence, they were not able to digest the scientific concepts. The public did not have scientific temperament. The parents mixed science with religion and spiritual aspects and thus scientific principles got very low priority. The people mostly worked in service sector and thus they had apathy for science subjects. The teachers had narrow mind and they felt insecure about the experts of the science centres.

The infrastructural facilities at all nine centres were remarkably good except Community Science Centre-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-Dang as it did not have their own water connection for washroom, poor potable water drinking facility and lacked cleanliness.

All nine centres did not face financial problems but Community Science Centre Anand sometimes had a problem as the grant from GUJCOST came very late. Thus it faced difficulty in availability of finance for conducting programmes.

The Director or Executive Director was the head of Community Science Centres. The post of Director was full time, except in case of Community Science Centre-Anand where

it was honorary. The staff worked full time or part time as per the need of the centres. The minimum qualification for head and staff was a post graduate or graduate in science respectively. Mostly the staff handled all science activities at all nine centres but at Vikram Sarabhai Community Science Centre had a specific staff for specific activities at laboratories. I.e. the physics, chemistry and biology laboratories were handles by science educators who had degree in physics, chemistry and biology respectively. Different resource persons were called for specialized science and art activities at all nine centres.

All nine Community Science Centres faced the problem of human resources management. There was dearth of science educators and science communicators who can work at science centres and conduct non-formal science education activities. There was no staff available for conducting science experiments at centres, schools and outreach purposes. 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 gigantic activities were also not easily available. There was a problem of telescope repair also because it had to send to other parts of India for repair. Thus it faced difficulty during astronomical events.

CONCLUSION

Community Science Centres of Gujarat had performed the functions of science popularization with their science activities, exhibits, models and learning resources. The models, exhibits, science activities, programmes and events were tools to impart science education in non-formal method. They were great means for experiential learning. The science centres had contributed immensely by conceptualizing and implementing science education programmes for students and community. The research showed that the science centres mainly catered to students only. Major programmes and activities of the centres were made keeping students as the target audience. The non-formal science education activities at the centre are like value addition in students' knowledge. The centres were good in infrastructure, finance and human resource management despite problems like dearth of science educators and technical maintenance.

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