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Science Communications in India: Role of Public Funded Institutions

At the outset this paper discusses the very relevance of and need of science communication in India. The paper then points out the policy measures of the Government of India for the promotion of scientific temper through science communications. Subsequently having spelled out the various means and modes of science communications, the paper summarizes the role of various public funded organizations (and selectively voluntary organizations) in the context of science and technology communications in India.

Keywords: Science Communication, Modes of Science Communication, Science Communication Network, Scientific Temper, Science Popularization.

Introduction

India has a rich tradition of communication, especially when it comes to communicating to masses. Folk plays, like *Nautanki*, and religious plays like *Ramlila (Hindu mythology)*, folk songs and folk dances are immensely effective as the means of mass communication. *Ramlila* is one of the oldest of religious arts, possibly, which has communicated to millions of people over generations, the code of conduct and ideals of social life. More recently, M. K. Gandhi was possibly the greatest communicator of all times, who aroused people of India to participate in the freedom struggle with their might against the mightiest empire the world had ever seen, and all this was through his extraordinary communication skills, which was so natural to him. '...Every cultural pattern and every single act of social behaviors involve communication, in either an explicit or implicit sense'. The might of mass communication, can be underlined as the root cause of any social change, let alone development. This speaks volumes obout the impact of sustained science communication, on changing the way a society thinks and behaves; a change which we want India to undergo, sooner the better; to get transformed to a nation of scientifically thinking and scientifically aware people. So why not think of institutionalizing science communication activities in our socio-cultural system like, the traditional means of communication are. Arousal of people for developing scientific temper and scientific awareness is a must for national regeneration through mass action, as was the case in freedom movement; unmistakably the only perceivable panacea for numerous miseries of our people.

Historical Perspective

India has a tradition and a treasure of scientific heritage. Various classical scientific works were carried out in Indian subcontinent, in the fields of mathematics, astronomy,

medicine, material science etc, during ancient, medieval and modern periods, which still form a huge treasure of our scientific and cultural heritage (Patairiya, 2002: 08). However, a remarkable gap between scientific knowledge and the common man remained during the entire span of time and almost no effort was made to bridge this gap. These scientific texts were generally written in technical and classical forms and not in common man's language. With the passage of time, despite many political and social ups and downs, scientific knowledge and more precisely custodians of that knowledge mostly remained centered around the corridors of power. This was the time when such knowledgeable gems used to be the *Navratnas* (Nine learned scholars of ancient Gupta empire) of royal courts.

Medieval age, however, saw a remarkable phenomenon. Classically coded scientific literature was made comparatively simpler and written in the popular forms of commentaries and analyzes. One can observe a great tradition of such commentators in the Indian subcontinent, who contributed such secondary scientific literature for generations. Indian history is replete with such tradition. This was indeed an exceptional attempt towards presenting science in comparatively simpler form. Many of India's ancient works, be it '*Aryabhatiya*' of *Aryabhat* or '*Leelavati*' of *Bhaskar*, are available in these forms. This situation is continuing more or less even today and the gap between scientific knowledge and lay persons is still very wide. Scientific knowledge is still confined to the language of the elite and it is very difficult to access such information in common man's language especially in vernaculars.

There have been a few people in various parts of the country, always eager to take science to commoners through their uncommon efforts and with limited resources in recent past before Independence. The formation of Asiatic Society in Bengal has historical significance. *Vigyan Parishad* was established in the United Provinces (now Uttar Pradesh) at Allahabad in 1913, which brings out *Vigyan,* a monthly since 1915 without discontinuity. In Orissa, the *Orissa Bigyan Prachar Samiti* was formed on August, 7, 1949, which began science popularization in Oriya language. Several other voluntary organizations continued to follow. Apart from organizations, several enthusiastic individuals also joined the movement. Some of them were Sir Syeed Ahmed Khan in Aligarh, Ruchi Ram Sahni in Punjab, Swami Satyaprakash in Uttar Pradesh, Shivram Karanth in the south, Hargoo Lal at Ambala, and several others.

After Independence, a number of government organizations also came forward for science popularization. Publications and Information Directorate, New Delhi (now National Institute of Science Communication and Information Resources) began publication of *Vigyan Pragati,* a Hindi monthly in 1952. *Science Reporter* (English monthly) and *Science Ki Dunia* (Urdu quarterly) followed this. National Research and Development Corporation (NRDC) started *Awishkar,* a Hindi monthly and thereafter *Invention Intelligence,* English monthly (both are closed now due to changed policy). Besides that, institutions like National Council of Educational Research and Training (NCERT), Central Institute of Educational Technology (CIET), Consortium for Educational Communication (CEC), Directorate of Agricultural Information and Publication, Indian Council for Medical Research (ICMR), Developmental Education Communication Unit (SAC) etc also started spreading scientific knowledge concerning their areas of interest. Thus, science communication was being taken up at various levels, institutional as well as individual. Indian editions of *Popular Science* and *Scientific American* also stepped in adding to international perspectives to science communication movement.

In order to integrate, coordinate, catalyze and support the efforts of science communication and science popularization, at micro as well as macro levels in the country, the Government of India established the National Council for Science and Technology

Communications (NCSTC) in 1982 as an apex body. NCSTC began its activities in 1984. The prime objectives of NCSTC are — to communicate science and technology amongst all the sections of the society, to inculcate scientific and technological temper amongst masses and to promote, catalyze, support and orchestrate such efforts in the country. In the year 1989, the Department of Science and Technology, Govt. of India, established an autonomous organization named *Vigyan Prasar*, which undertook the task of mass scale development and dissemination of software for popularization of science and technology, such as TV programmes, audio cassettes, CD-ROMs, publications etc. The National Council of Science Museums under the Ministry of Culture is also contributing in this direction by setting up of science centers, science exhibitions, science fairs, science cities and science museums etc. Ministry of Environment and Forests has planned to create environmental awareness through Ecology Clubs in schools. All India Radio, Doordarshan, and other TV channels broadcast and telecast various science programmes. Central and state governments, Birla Group and Jawaharlal Nehru Memorial Fund have established several planetariums at various places in the country. Various other attempts towards science communication and science popularization are being made at governmental, non-governmental, private and individual levels.

Current State of Affair

Currently several approaches and mediums are being tried and utilized by various agencies in India, both government and non-government, for S&T popularization. As a result a lot of infrastructure, software and human resources are now available in the country. Various means and modes of communication have been utilized in India by the science communicators to reach out to the masses. Every form has its own significance and utility keeping in mind the vast diversities existing in the subcontinent. A summary of these communications tools employed for S&T popularization and inculcation of scientific temper is provided in the following paragraphs:

Science communication has drawn the attention of policy makers, planners, scientists, technocrats and media personnel during the past decade world over and so as in India. Over the years, there has been a remarkable increase in science coverage in different mediums of mass communication, be it print, electronic, folk or interactive media. Several national/regional dailies have started weekly science pages and magazines are covering science columns. *Vigyan Prasar* started a unique activity and was providing ready-to-print science page to medium scale newspapers periodically in Hindi and English. Some 21 newspapers were incorporating the same page in their editions.

A variety of programmes are now available on AIR, like Radioscope, Science Today, Science Magazine, Science News etc; the interest was triggered by two joint NCSTC-AIR radio serials 'Method of Science' and 'Human Evolution'. On TV, 'Turning Point' a science based programme was able to catch attention of viewers. Besides the University Grants Commission (UGC), the National Council for Educational Research and Training (NCERT), Indira Gandhi Open University (IGNOU), and NCSTC also had developed science programmes from time to time. Several voluntary agencies like Kerala *Shastra Sahitya Parishad* (KSSP), KRVP, *Eklavya* etc are actively involved in taking science to the people by way of folk forms, street plays, theater, puppetry, folk songs, skits etc. In fact, print and electronic

media have certain limits, but the illiterates or neo-literates can also be enlightened through the use of folk medium, as it has no limitation, and offers two way channel of communication, which was proved to be very effective during the *Jathas* (great congregations) *Bharat Jan Vigyan Jatha* (BJVJ) — 1987, *Bharat Gyan Vigyan Jatha* (BGVJ)-1990 and *Bharat Jan Gyan Vigyan Jatha* (BJGVJ) — 1992.

Other mediums of science communication, like exhibition, *Vigyan Mela*, slide shows, lectures, demonstration, and planetarium are also part of the ongoing science communication/popularization movements in the country. A variety of popular science softwares have been produced. A number of potential science communicators are being trained through full time academic courses in science and technology communication and short term science writing/journalism workshops to bridge the gap, who can in turn take up responsibilities of different science communication programmes/activities (Patairiya, 2001).

Several government and non government agencies such as NCSTC, NCSM, Council of Scientific and Industrial Research (CSIR), Indian council of Agricultural Research (ICAR), ICMR, NCERT, All India Radio (AIR), *Doordarshan* (Govt. TV Channel), NBT, CBT, UGC, KSSP etc are putting in effort towards dissemination of scientific information and inculcating a scientific temper among people. Although much has been achieved, the picture is not so rosy and there is an urgent need to work towards putting in every effort to make science communication activities more effective and sufficient both in terms of quality and quantity and a lot is still to be achieved.

It is, however, disappointing that Indian science magazines, like Science Today, Bulletin of Sciences, Times of Science & Technology have been closed and Indian editions of some foreign magazines, like La Recherche and Scientific American have ceased their publication, after bringing out a few issues. Whatever may be the reason, it is clear that science has no territorial boundaries, and so is true for the science communication activities. As far as coverage of science and technology in mass media is concerned, in developing countries, like India, it will increase in near future significantly, as very fast and rapid developments are taking place. On an average, the science coverage in India is around 3–4 %, which we intend to enhance up to 10–15 %, as per a resolution of the Indian Science Writers' Association. So far, 5 Indian science communicators have won UNESCO's Kalinga Prize for outstanding contribution in the area of science communication/popularization. In terms of international comparison, in India the efforts put in by NCSTC, KSSP, and other organizations/individuals, like *Vigyan Jatha*, Children's Science Congress, explanation of so called miracles etc, are widely acclaimed and have no match and are unique and first ever in the world. There is a wide scope of a broad spectrum of science communication activities in future to better serve the mankind.

Science Policy and Science Communication

Jawaharlal Nehru, the first Prime Minister of India, introduced the concept of 'scientific temper' in modern India. He dreamt of the children of the country acquiring scientific temper (Pattnaik, 1992: 7–8). Accordingly the Constitution of India has a special provision 'to develop the scientific temper, humanism and the spirit of enquiry and reform' as one of the 'Fundamental Duties' mentioned under Part IV A, Article 51 A (h).

(a) **Scientific Policy Resolution:** Prime Minister Nehru presented the Scientific Policy Resolution on March 4, 1958, which has been a guiding factor for development of science

and technology in the country. Special attention was given to the scientific approach in the resolution, which reads as follows:

> "It is only through the scientific approach and method and the use of scientific knowledge that reasonable material and cultural amenities and services can be provided for every member of the community, and it is out of recognition of this possibility that the idea of a welfare state has grown."

(b) **Technology Policy Statement:** To give direction to the technological development in the country the Government of India announced the Technology Policy Statement in January 1983. The spirit of innovation and awareness about balance in technological development and environment was given special importance, among other features in the statement.

(c) **The Sixth Plan:** The promotion of scientific temper and dissemination of scientific information among people was given due importance in the report of the working group on science and technology for the sixth plan (December 1980). Special provision was made for science popularization under science and technology chapter in the Sixth Five Year Plan, approved by the National Development Council. Consequently the NCSTC was formed in 1982. Thereafter, the NCSTC was given the mandate for formulation of policy, programmes for science communication in the country. The need for national science communication policy was emphasized in the first convention of the Indian Science Writers Association (ISWA). Efforts were under way in the NCSTC for formulating a science communication policy.

(d) **Reviews of NCSTC Activities and Programmes, 1989, 1996, 2002:** The Department of Science & Technology, Govt. of India has formed different review groups to review NCSTC activities and programmes and to suggest future strategies for science communication from time to time. The First Review Group formed under chairmanship of noted physicist and science fiction writer Dr. Jayant V. Naraliker had given its report in 1989. The Second Review Group had worked under chairmanship of Dr. S. Z. Qasim noted ocean scientist and member, Panning Commission (Science & Technology) and gave report in 1996. The Third Review Group had Prof. S. K. Joshi, noted physicist and former Director General, CSIR as its chairman, which gave its report in May 2002.

(e) **Science and Technology Policy 2003:** Govt. of India has announced a comprehensive 'science and Technology Policy 2003' that carries a section on "Public Awareness of Science and Technology" (Govt. of India, 2003: 25).

Modes of Science Communication

The process of science communication can be interwoven into five principles. Generally science communication incorporates efforts for popularization of science, promotion of scientific temper and technological temper and diffusion of technology/innovations. Let us go into the details of the mediums of science communication:

(a) **Print Media:** Such as newspapers, magazines, wallpaper, books, posters, folders, booklets etc.

(b) **Audio/Visual Media**: Mainly radio and TV, besides, films, slide shows, bioscope etc.

(c) **Folk Media:** It has been a common observation, that through folk media, it is possible to achieve penetration to the segments where other media have limitations. Puppet shows, street plays skits, stage performances, folk songs and folk dances like, *nautanki* and other traditional

means of communication belong to this category. This media is cost effective, entertaining and offers two-way communication.

(d) **Interactive Media:** Science exhibitions, science fairs, seminars, workshops, lectures, scientific tours, conferences, *vigyan jathas* etc. The advantage here is being man-to-man and two-way communication.

(e) **Digital Media:** information technology has given birth to comparatively a new media, known as digital media. It includes Internet, CD-ROM, multimedia, simulations etc. This is proving to be an effective medium and it can illustrate difficult concepts through text, audio, graphics, video, animation and simulation. It has also made science communication simpler to handicapped segments of the society. This new media has given birth to a more instant and global mode of communication in the form of 'social Media', involving social and individual networking sites.

That apart, we are popularizing science through our 22 regional languages, to penetrate into local populace effectively. Selection of target audience is highly significant. Our science communication efforts are aimed at various target groups, such as, common men/women, children, students, farmers, workers or specialists etc. Various forms for presentation are being used to make science communication more interesting and enjoyable, such as science news, report, article, feature, story, play, poem, interview, discussion, lecture, documentary, docu-drama, scientoon (science + cartoon), satire etc.

Following are some of the important modes and means of science communication in India:

1. Popular S&T literature (articles/features in daily newspapers, periodicals; newsletters and specialized S&T magazines: comic strips, picture-cum-story books, wall charts etc).
2. Exhibitions of S&T themes (temporary, permanent and mobile).
3. Science Train- Science Exhibition on Wheels.
4. S&T and Natural History Museums (with permanent galleries on basic topics, on country's heritage and on famous discoveries and inventions, among others).
5. Science Centres and Parks (participatory and interactive activities and demonstrations to learn about S&T principles, applications and to encourage development of a spirit of enquiry among children and adults).
6. Contests (quizzes, essays, scientific models, toy and kit making, public speaking, debates, seminars etc).
7. Popular lectures on S&T subjects (for general public, for children a students at schools, colleges, universities and other institutions).
8. Tours (guided tours around botanical, zoological gardens, museums, planetaria, bird sanctuaries etc).
9. Planetaria (including mobile ones; sky watching with naked eyes or telescope to learn about planets, stars and other celestial objects).
10. Radio broadcasts (for general as well as specific audiences).
11. Television telecasts (for general as well as specific audiences).
12. Audio/Video-Programmes (on tapes and cassettes for special or general audiences; slide shows, bioscopes.
13. Digital software, CD-ROMs etc (for special or general audiences).
14. Science Films (for general and specific audiences).
15. Folk forms (song, drama, street plays, puppet shows, march, festival, fairs, jathas etc).
16. Science Club activities etc.
17. Low cost kit/toys and other hands-on-activities (with specific training modules).

Non formal Science & Technology Education.

Role of Various Organizations

Various Government, non Government and voluntary organizations are playing significant role in science communication. Some of them are described here.

(a) **National Council for Science and Technology Communication:** The NCSTC is an apex body of the Government of India for promotion, coordination and orchestration of science and technology communication and popularization programmes in the country, with two major objectives like; popularization of science and technology and stimulation of scientific and technological temper among people. Programmes began in right earnest with the finalization of the VII Five Year Plan and the first meeting was held in early 1984.

It has ten major elements, viz., (i) training in science and technology communication, (ii) software development, (iii) information networks/ databases, (iv) field projects, (v) incentive schemes, (vi) research in science and technology communication, (vii) international cooperation, (viii) women component plan, (ix) environmental awareness, and (x) policy advices. A number of training programmes have already been organized and supported to train people/ resource persons in various tasks of science communication as well as in different media. A number of science communication software items for electronic as well as for non-electronic media have been developed and disseminated to the users. Information networks developed and a number of research projects have been undertaken.

Besides a number of projects/ programmes, a mega project on science and technology for promoting voluntary blood donation has been formulated by NCSTC. Preparation of an annotated bibliography of popular science publications in all major Indian languages was undertaken. A project to develop self sustaining science communicators, who can generate income by selling software, produced by and with support of NCSTC was formulated, besides a Software Jatha.

(b) **Vigyan Prasar (VP):** It was set up by the Department of Science and Technology, Government of India, as an autonomous registered society in 1989 for taking up large scale science popularization tasks. Its broad objectives may be summarized as follows: (i) to undertake, aid, promote, guide and coordinate efforts in popularization of science and inculcation of scientific temper among the people and to increase the knowledge, awareness and interest about science and technology among all segments of the society, (ii) to provide and promote effective linkages on a continuous basis among various scientific institutions, agencies, educational and academic bodies, laboratories, museums, industry, trade and other organizations for effective exchange and dissemination of scientific information, (iii) to undertake the development of software materials for different media, so as to enable the masses to better understand, appreciate and comprehend abstract scientific principles and practices, and (iv) to organize research projects, courses, workshops, seminars, symposia, training programmes, fairs, exhibitions, film shows, popular discussions, street plays, quizzes, song-dance-dramas etc, in furtherance of the objectives of the organization.

(c) **National Council of Science Museums (NCSM):** Having its headquarters in Kolkata, NCSM is an apex body of science museums and science centers in the country. It has a National Science Centre in New Delhi, and some 30 regional science centers, including Lucknow, Bhopal and Bhubaneswar etc. A Science City has been set up in Calcutta by NCSM. Several states have also setup science cities under collaboration with NCST, i. e. Gujarat Science City, Ahmedabad, Pushpa Gujral Science City, Kapurthala, Punjab etc.

(d) **National Institute of Science Communication and Information Resources (NISCAIR):** Formerly it was known as the Publications and Information Directorate (PID). It was renamed as National Institute of Science Communication (NISCOM) on September 26, 1996 and further transformed into NISCAIR, incorporating INSDOC. It brings out eleven professional scientific journals, besides three popular science journals, *Vigyan Pragati* (Hindi monthly), *Science Reporter* (English monthly) and *Science Ki Dunia* (Urdu Quarterly). It has also brought out an encyclopedic series, titled, The Wealth of India, a compendium of knowledge on the economic products and industrial resources of the country. The institute also undertakes the publication of popular science books in Indian languages. Monographs on different scientific subjects are also published from time to time.

(e) **Science Communication Networks:** An All India People's Science Network (AIPSN) was catalyzed in 1987–1988, with 27 constituent voluntary organizations, which organizes All India People's Science Congresses and is also known as All India People's Science Movement. The NCSTC Network was brought into existence in 1991 with the objective of taking popularization of science activities to all nooks and corners of the country. Presently it has over 70 organizations, including government, NGOs and voluntary organizations. It is now known as National Science and Technology Communication Network (NSTC-Network). There is the need of a Science Media Network.

(f) **Voluntary Organizations:** There are several voluntary organizations in India interested in science communication programmes. Some of them even existed when there were no efforts from the side of state to popularize science. *Kerala Shashtra Sahitya Parishad, Karnataka Rajya Vigyan Parishad*, *Vigyan Parishad* at Allahabad, Vikram A. Sarabhai Community Science Centre at Ahmedabad, Eklavya at Bhopal etc, are among important voluntary organizations involved in science popularization movement in the country. The Indian Science Writers' Association brings out a newsletter and organizes meetings with prominent scientists as well as media persons.

(g) **Indian Science Writers' Association (ISWA):** The ISWA was founded by a group of highly motivated and enlightened science writers and journalists in April 1985, some 26 years ago, with a view to develop and nurture science writing profession in the country. Now, ISWA has some 500 members from across the country comprising science writers, science journalists and science communicators from various Indian languages. In pursuit of its broad objectives, the ISWA undertakes a broad spectrum of activities on science writing, science journalism and science communication. ISWA is an active, vibrant and visible organization. The following para carry glimpses of its activities:

Since its inception, the ISWA has been publishing an occasional newsletter to have a channel of communication with members spread all over the country. It has initiated ISWA Chapters at various places in the country. Some 10 ISWA chapters have come up so far, which are undertaking various kinds of activities, like training in science writing and science journalism involving students, teachers, journalists and scientists. The ISWA had introduced a Millennium Lecture Series. A number of lectures have been organized so far on various frontline areas of science and technology. The ISWA confers ISWA Fellowships and ISWA Awards on distinguished persons for recognizing their efforts towards promotion of science popularization in the country. The ISWA organizes national seminar every year on some current topic, concerning science and technology. Some of them were; Post GATT India, What is Wrong with Indian Science, Patenting System and Intellectual Property Rights, Challenges in Public Appreciation of Science in Digital Age etc, with a view to discussing and addressing the issues and problems emerging in this field. An exhibition on

Popular Science Periodicals in Indian Languages is also part of these activities. It also publishes the directory of ISWA members from time to time. The Directory is sent to various scientific and media organizations in India and abroad.

ISWA has been working in collaboration with government and non government organizations and has linkages with various agencies interested in science popularization, such as, the CSIR, NCSTC, National Institute of Science Communication (NISC), ICAR, ICMR, Society for Information Science, Indian Science Communication Society (ISCS) etc. We have organized training programmes with the Department of Atomic Energy and other organizations. Efforts are being made to make joint programmes, with Indian Space Resarch Organization (ISRO), British Council Division and UNESCO etc, including visits of ISWA members to various scientific establishments for writing/reporting on various R&D activities in the country. We are looking forward for more such joint programmes in future and are planning to have many more activities to strengthen ISWA as well as the efforts towards the cause of popularization of science and inculcation of scientific temper among masses. ISWA is an active partner of India-Brazil programme on public communication of science, technology, culture and society.

Highlights

Following are the highlights, where major achievements were recorded in the area of science communication in India:

(a) **Human Evolution:** A 144-part radio serial *Manav Ka Vikas* jointly produced by NCSTC and AIR was broadcast on Sunday mornings simultaneously from nearly 84 stations all over the country in 18 Indian languages during June 1991 — February 1994. Among the listeners there were 100,000 children and some 10,000 schools registered as dedicated listeners. They were provided kits, posters etc as supplementary material. Two unique radio bridge programmes of 30 minutes duration each were broadcast live through the satellite on February 13th and 20th, 1994. Selected children, who had assembled at five different places in the country, participated in these programmes which included questions, answers and discussions.

(b) ***Bharat Ki Chhap*:** The NCSTC has produced a number of TV programmes on scientific subjects. A 13-part film serial on the history of science and technology in the Indian subcontinent and its impact on the world, titled *Bharat Ki Chhaap*, originally in Hindi was produced by NCSTC and telecast on Doordarshan in 1989. Regional language versions were subsequently produced in Tamil, Malyalam, Telugu, Gujarati, Marathi, Bengali and Kannada, along with an English subtitled version.

(c) ***Vigyan Jatha:*** *Bharat Jan Vigyan Jatha — 1987* and *Bharat Jan Gyan Vigyan Jatha — 1992* (BJGVJ-92) were catalyzed by NCSTC, could be considered as the biggest ever science and technology communication movements attempted anywhere. The main themes of BJGVJ-92 included health, water, environment, appropriate technology, superstitions, scientific thinking and literacy. Science and technology communication software, on the main themes of the *Jatha*, was developed and duplicated both at the central and state levels, which included brochures and posters for publicity, poster sets on water, environment and housing, booklets on topics such as the preparation of science posters and charts, puppet plays, low-cost exhibitions etc. Some 2,500 government/non-government organizations were actively involved. The *Jatha* covered nearly 40,000 locations in about 400 districts touching

almost a third of the country's population. During the course of *Jatha*, various modes of science communication, especially folk forms, publications, lecture-cum-demonstrations etc, were employed for science communication among people in far-flung areas. Subsequently, regional *Vigyan Jatha* was organized to cover a geographical region on a focused science theme relevant to the area.

(d) **Children's Science Congress:** The first National Children's Science Congress (NCSC), with the focal theme 'Know your Environment' was organized by the NCSTC Network in December, 1993. The children were selected on the basis of their presentations on their scientific projects at the district level Congresses, followed by state level presentations and finally for the National Congress. The main aim of the congress was to provide open laboratory of the nature for learning with joy and to adopt the method of learning-by-doing. The other objectives were to extend classroom learning to inculcate an understanding of the environment, its problems and prospects and to help find feasible solutions. Participation was open to children of the age group 10 to 17 years. Till now 18 such congresses have been organized at different places of the country; and it has become an annual feature like Indian Science Congress. Selected groups of children from NCSC present their project reports in the Indian Science Congress. Further selected children from National Children's Science Congress visited Germany in connection with Germany Festival in India and India Festival in Germany in 2001.

(e) **Scientific Explanation of so called Miracles:** This is a very popular programme implemented across the country, wherein various tricks and miracles are demonstrated and explained by trained science activists to make the gullible people aware of the scientific tricks/facts behind the so called miracles, so that they can be saved from cheating by the self styled god men. In the event of so called milk miracle, when religious deities started drinking milk in 1995, the author of this paper demonstrated the phenomenon on television news and the hoax was refuted.

(f) **Science Communication Courses:** In order to develop trained manpower in the area of science communication, training/educational programmes are being offered at various levels in our country, which are catalyzed and supported by NCSTC: i) Short term courses, which are of 3 to 7 day's duration; the participants are all science activists and enthusiasts, whether students of science at higher level or not; ii) Medium term courses, which are of two to four month's duration; usually for those wanting to improve their science communication skills; and iii) Long term courses, which are of 1 to 2 year's duration; run at different universities/institutions and offer post graduate degrees or diplomas in science communication. Besides, a correspondence course and an online course in science journalism of one year duration are also available. The main aim is to develop as many science communicators as possible to meet the present and future challenges and requirements. 30 universities/institutions are running these courses with NCSTC's initiative. Recently, UGC has also introduced science communication under its thrust areas of studies.

(g) **Centres for Science Communication:** Centres for Science Communication at Lucknow University (U. P.); Devi Ahilya University (M. P.); Cochin University of Science & Technology (Kerala), and Krishna Kant Handiq Open University, Guwahati (Assam) were established to promote higher studies and research in S&T communication/public understanding of science.

(h) **Science Communication Archives:** A Science Communication Archives at Madhavrao Sapre National Media Repository & Research Centre, Bhopal has been started to preserve and retrieve science manuscripts, publications and other information products to facilitate researchers in S&T communication.

(i) **Indian Journal of Science Communication:** An international peer reviewed research journal in science communication is being published since 2002, which has an International Advisory Board and peer review system and offers print, electronic and open access edition available at < *www.iscos.org* >.

(j) **Public Debates on Current S&T Issues:** Public debates on current affairs in S&T where public requires adequate awareness to take decisions in matters, like, Bt Cotton, Bt Brinjal, Nuclear Controversies, Iodized Salt etc, were initiated. A recent debate on "Public Awareness of Nuclear Energy Controversies" was able to attract a house full at 11th meet of Public Communications in Science and Technology (PCST-2010).

(k) **Technology Communication:** More often, we talk about science communication and scientific temper and less on technology communication and technological temper. A major initiative was taken by NCSTC on 'Technology Communication', including hands-on science, with the objectives: (i) to inculcate a technological temper; (ii) to develop and nurture the spirit of innovativeness, and (iii) to focus on technological approach to problem solving. The programme has 3 major elements: (i) orientation of artisans and techno-students towards innovativeness; (ii) identification of areas of innovation and developing innovative ideas; and (iii) technology awareness. The module was successfully tested and being implemented across the country.

(l) **Science Fiction:** The first ever National Discussion on 'science Fiction: Past, Present, Future' by Indian Science Fiction Writers' Association and Indian Association of Science Fiction Studies at Varanasi during November 10–14, 2008 to emphasize role of Science Fiction and S&T communication.

(m) **Science Communication through Digital Media / Blogs / Social Media:** A module on S&T Communication through Digital Media on various popular science topics were developed including science Webcast and Podcast. A series of training programmes on science communication through visual media was organized across the country.

(n) **Science Communication through Cultural Events:** The module includes: (i) Workshop for Developing Scripts and Exhibits; (ii) Demonstration of Exhibits at Religio-cultural Events, i. e. *Shiva Ratri, Durga Pooja, Ganpati Festival, Eid, Pongal* etc; and (iii) Road Show / Procession / Prabhat Feri.

(o) **Campaigns on Total Solar Eclipses:** Science popularization programmes built around the total solar eclipses on the belt of totality for viewing total solar eclipses in 1995, 1999 and 2009 have been hugely successful.

(p) **Year of Scientific Awareness (YSA 2004):** With an initiative taken by DST, the Year 2004 was observed as Year of Scientific Awareness across the country; followed by Year of Physics 2005, Year of Planet Earth 2008, and Year of Chemistry 2011.

(q) **Indian Science Communication Congress (ISCC):** With a view to providing a platform for encouraging scholarly interaction between science communication researchers and practitioners, scientists and communicators, science communication faculty members and students etc, for further advancement of science communication profession, the Indian National Science Communication Congress was started in 2001. Since then 10 annual congresses (2001–2010) have been organized so far involving over 2,000 researchers, scientists, journalists, including international delegates. A special session for young researchers from over 50 universities has been an attractive feature of the ISCC. The aim is to establish S&T communication as an independent discipline of scientific knowledge and expertise and promote research. The ISCC-2011 was organized in November 2011 at Pune (Maharashtra).

(r) **Science Communicators' Meet at Indian Science Congress:** The 1st Science Communicators' Meet was organized at Indian Science Congress, Visakhapatnam, 2008; followed by 2nd Science Communicators' Meet at Indian Science Congress, Shilong, 2009; 3rd Science Communicators' Meet at Indian Science Congress, Trivendrum, 2010; and 4th Science Communicators' Meet at Indian Science Congress, Chennai, 2011. The programme is being implemented through Indian Science Congress Association. The 5th Science Communicators Meet is being organized as part of Indian Science Congress at Bhubaneshwar in January 2012.

(s) **11th PCST-2010:** The 11th International Conference on Public Communication of Science & Technology (PCST-2010) was organized in India in December 2010 with International Network on Public Communication of S&T, Australia attracting 600 science communication experts from 51 countries.

(t) **6th HSCI-2009:** The 6th International Conference on Hands-on Science (HSIC-2009) was organized in India in October 2009 with International Network on Hands-on Science, Portugal attracting 350 delegates from 20 countries.

(u) **Online Science Communication Networks:** Online science networks are immensely beneficial for connecting science communication professionals and bringing them together in India and abroad:

i. *sciencefictionwriters@yahoogroups.com*
ii. *popularsciencewriters@yahoogroups.com*
iii. *iswaindia@yahoogroups.com*

Challenges

In spite of well planed and well structured efforts of science communication in India, there are certain challenges before us, to be met. In spite of repeated and multifold efforts of spreading scientific information and inculcation of a scientific temper among Indian people, even today there prevail lots of superstitions among people who are still ignorant about common scientific principles of day-to-day life. Hence illiteracy and ignorance are major challenges. India's literacy rate has increased as compared to earlier times, though it has not reached the desirable level. Scientific literacy is drastically low in the country. The science communication has still not succeeded in attracting the media to the extent that it could appear on the front page or become a lead story, like the politics, films or sports. The coverage of science in print as well as in the broadcast media has not arrived even up to a minimum desirable level (Patairiya, 2001). It is rather disappointing to note that leading science magazines are ceased to be published, like *Science Today, Science Age, Bulletin of Sciences, Research and Industry*, *Invention Intelligence, and Awishkar etc* and Indian editions of foreign science magazines, like *Vigyan* (Scientific American), *World Scientist* (La Recherche) etc, could not survive. Several in Hindi and other Indian languages' science magazines have faced the same fate. India has 22 recognized regional languages. Hence, communication in many languages is yet another great challenge. The quality of scientific translation could not achieve the level of excellence in most instances; of course due to lack of equal command and training in both the languages and non availability of appropriate terms in regional languages.

Mass media has its commercial compulsions, which superimpose all the science communication efforts and leave a negative impact in the minds of the audiences. Instead of including scientific information, they prefer to generate more revenue by including non scientific, meta-scientific or occult information etc (Bruce, 2005).

The science writing is still dry and boring. And interesting styles of writing, like fiction, poetry, satires, skits, discussions etc, have not found adequate space and time in the media. Even most of the science writers could not contribute sufficiently such an interesting science material to the newspapers/magazines. Merely occasional appearance of something in the name of science fiction cannot serve the purpose.

In view of the present pace of science communication programmes, their potential and impact towards shaping the lives of the people and making them more informed and rational, nobody would be able to afford not to have the scientific information confronting day-to-day life of the people, as it will be going to become essential and integral part of most of the human activities in the near future. That is why, even today, almost every parent is intending to provide modern scientific and technological knowledge to his or her child. There may be ample scope for unevenness, deprivations, limitations and lack of effectiveness of various science communication programmes and activities, but, despite various constraints and impediments, it may not be unrealistic to expect that science communication has a promising future in India and other developing countries.

Beyond the Boundaries

As obvious in the preceding paragraphs, India has been able to take initiatives in a number of newer programmes in the area of science communication, which were not tried out elsewhere and can take lead in these innovative areas. Similarly, we would also like to welcome other new ideas, methodologies, programmes available in other parts of the world and we can work together to better serve the mankind. Recently we have been able to develop cooperation at bilateral and multilateral levels with different countries. Of course there is ample scope for furthering such efforts in developing countries, especially in South Asian Countries in matters of science communications. We can take initiative in mobilizing like minded people in these countries to form Science Writers'/Journalists' Associations in their respective countries, with the help from international organizations, in order to enhance scientific literacy and scientific temper, which are considered to be the basic elements for development of any society in a more coherent manner.

A common science and technology news and features pool can be formed to facilitate writers/journalists to get/exchange information on scientific research and developments for further dissemination through mass media. There is a great shortage of properly trained science writers, journalists, communicators, illustrators in various parts of the world, though, a number of training programmes are conducted at various places. Therefore, more training programmes are needed, which may preferably be conducted jointly to give more opportunity to developing countries and their participation must be ensured. That apart many more joint collaborating programmes in the area of science communication can be worked out and implemented for further advancement of science communication to better serve the people.

Conclusion

Looking at the population, size and make up, variety of languages, urban-rural, digital divides, prevalent disparities, poverty, illiteracy, inadequate opportunities and services, poor reach of mass media, and so on, India is poised with many challenges, that offer opportunities and possibilities in S&T communication.

In developed countries, "the science museums, planetariums, exhibitions, lectures, audio-video media and high-end technological application" approach dominates the 'state-of-the-art' in this field, which is capital intensive and urban oriented. In India, same results are achieved through "folk forms, *Vigyan Jatha*, print and visual media, road-shows, and people's involvement" approach, which is cost effective and fits into our social milieu. However, India is not lagging behind in modern approach and has been able to make world records, especially in case of Science Express — Science Exhibition on Wheels. India was able to win international bids and organize international forums — 6th HSCI-2009, and 11th PCST-2010. Many developing countries are more or less following western approach but it is refreshing to note that after organizing these forums in India, not only developing but several developed cdountries are willing to try Indian models. Moreover, if scientific literacy implies disseminating knowledge of science, its wonders, its scope, its application etc, then perhaps in Indian context scientific and technological temper has more meaning and relevance. What we would like to see is that the Indian population at large, particularly the illiterate and backward rural community, develops a scientific outlook rather than being told about facets of science alone that allows informed and logical application of S&T and elimination of superstitions and ignorance. In India, therefore, a more organic approach has taken shape and is making inroads. Use of local languages, dealing with everyday S&T problems, using surroundings and environs at home, in field and outdoors, learning by doing, are some of the elements of this parallel approach of science communication and popularization movement in India.

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