ISSN 0972-429X

25TH ISSUE OF EXCELLENCE

Indian Journal of Science Communication

Communicating Science of Science Communication

Socio-economic philosophy of science: A message to public

Assessing participatory video for developing spirit of innovation

Science, technology, and media: Some revelations

Convergence: Key to creativity in science and communication

Volume 13 Number 1 January – June 2014

Indian Journal of Science Communication

- The *Indian Journal of Science Communication* (IJSC) seeks to promote and disseminate knowledge and activities in the area of science and technology communication and provides a forum for addressing issues emanating from concept to research and practice.
- The phrase 'science communication' covers a broad canvas of communicating all basic and applied sciences, such as health communication, agriculture communication, environment communication, technology communication, innovation communication, etc. It also includes science and media interface with attitudinal, social and cultural implications.
- The IJSC is a peer reviewed half yearly international research journal published twice in a year in January and July.
- The IJSC is brought out and disseminated by Indian Science Communication Society (ISCOS) and catalysed and supported by NCSTC/ DST.
- The NCSTC/ ISCOS assume no responsibility for the opinions offered by the contributors.
- Address for submission of contributions for publication: The Editor, Indian Journal of Science Communication, National Council for Science and Technology Communication, Department of Science and Technology, Govt. of India, Technology Bhawan, New Mehrauli Road, New Delhi - 110016, India. Phone: +91-11-26537976, Fax: +91-11-26590238, E-mail: mkp@nic.in; editorijsc@gmail.com. Refer **Instructions for Contributors**.
- Address for subscription and advertisements: The Coordinator IJSC, Indian Science Communication Society, Chandrika Bhawan, 577-D, Near Dandahiya Masjid, Lucknow – 226022, India, Phone: +91-8090907153; E-mail: info@iscos.org. Payments may be sent by demand draft/ cheque issued in favour of Indian Science Communication Society, payable at Lucknow or online bank transfer. Refer **Subscription Form**.
- The IJSC follows **Open Access** (OA) policy and available online for reading and academic consultation only; it cannot be used for any commercial purpose. The print version is available on subscription.
-
- Price per copy for Individual:

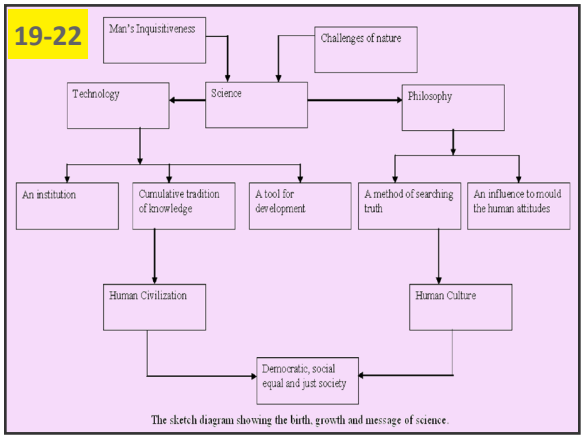
  Inland: ₹ 300
  Overseas: US $ 15

Indian Journal of Science Communication
Indian Science Communication Society
Chandrika Bhawan, 577-D, Near Dandahiya Masjid, Lucknow – 226022, India
Phone: +91-8090907153; +91-11-26537976, Fax: +91-11-26590238
E-mail: info@iscos.org; mkp@nic.in; editorijsc@gmail.com
Website: www.iscos.org

25TH ISSUE OF EXCELLENCE

Indian Journal of Science Communication

CONTENTS



The sketch diagram showing the birth, growth and message of science.

Science Communication Scientist

The term 'science communicator' has been very common for the professionals who are engaged in any kind of science communication activity and by default they are called science communicators the world over. We have been discussing the qualities and attributes of a science communicator for quite some time and it is understood by and large that whosoever is communicating science, especially in popular form can be termed as science communicator.

There has been some discussion over the nomenclature of 'science communicator' as well. Since, science communication is progressing and a variety of science communication activities emerged over the period, the 'science communicator' also deserves to progress and assume distinctions given by the specialty of the task one is handling, as there is a general view that many people do not feel comfortable with this nomenclature, as it does not convey the actual meaning of the kind of task one is undertaking and does not distinguish them from each other for quality and variety.

Further, when we realize that 'science communication' is a 'science', then we must also recognize the existence of the 'scientist' of 'science communication' or 'science communication scientist'. Suppose, if someone is engaged in research studies in science communication, so he or she seems closer to the term 'scientist' rather than 'communicator'! Similarly, if someone is serving as manager by virtue of his or her position in government or non-government organization and not engaged in any kind of popular communication, how can he be attributed to be a science communicator! Therefore, here is an attempt to classify the 'science communication professionals' as per the following categories depending upon the kind of role one is performing:

i) ***Science Communication Scientist:*** *Scientists, social scientists, researchers carrying out research in science communication, doctoral and postdoctoral researchers/ students in science communication undertaking research studies in science communication.*

ii) ***Science Communication Faculty:*** *Professors, faculty members, teachers of academic courses in science communication, trainers of training courses, educators explaining science exhibits, resource persons conducting workshops/ exercises in science communication, academic contributors creating syllabus and writing study materials on science communication, creating web based teaching-learning materials in science communication, creating science kits/ models and explaining them.*

iii) ***Science Communicator:*** *Popular science writers, science journalists, science performers, science programme presenters on radio/ television, audio-visual programme producers, science gallery narrators, science demonstrators, science script writers, science content creators, outreach talkers, storytellers, science cartoonists, science photo journalists, science illustrators.*

iv) ***Science Communication Manager:*** *Government officials, administering/ managing science communication programmes, taking decisions on policy, budget, and infrastructure, NGO office bearers/ workers arranging science communication activities, radio/ television programme officers run science programmes, public relation managers/ officers, service providers such as library, printing, exhibitor, camera, ICT, event manager.*

v) ***Science Activist:*** *Campaigners, reactionaries, negotiation and advocacy persons, NGO activists, persons belonging to lobby groups, pressure groups.*

An assessment and analysis of the above professional distinctions indicate that there is a need of applying different kind of nomenclature for different kind of science communication professionals, as the term 'science communicator' becomes redundant to convey the gravity of the work one is undertaking especially in today's scenario of super specialty in all walks of human endeavours. However, there are examples where a science communication professional is undertaking more than one tasks of science communication, while sometimes there could be overlaps in borderline areas. Therefore, the main identity must be distinguished from one's core contribution!

There are discussions amongst scientific community and every great scientist seemingly concerned over lower science literacy, less coverage of science in media, pathetic level of science awareness, health risks due to ignorance, feticide and infanticide of girl child, age old mis-beliefs and superstitions, and so on, and shows the need of strong science communication programme; you can listen such emotional lectures from many eminent scientists!

However, surprisingly when it comes to putting 'right person to right job', the same set of people bring irrelevant persons to the job authorizing them to shoulder the responsibility of science communication, and the situation continues to worsening! This is perhaps because of the fact that the concept of 'science communication' is largely misunderstood by them and so as the term of 'science communicator'! How can it help, if even general 'appreciation' over the subject is missing! Forget about the 'grip' over the 'core complexities' of the subject! If you are not taking the right train, why to blame the train if it does not take you there where you wanted to go! Hopefully, the nomenclatures attempted above, could provide some clue to clarify the perplexity over the situation!

Dr. Manoj Kumar Patairiya

RESEARCH PAPER

Assessing participatory video for developing spirit of innovation

Vedavati Ravindra Jogi
Media Professional, Rambaug Colony
Navi Peth, Pune - 411030

Aristotle had observed, 'What we have to learn, we learn by doing'. However quite contrary to this observation, in typical Indian Education system, which is mainly examination centric, learning science in school is by rote, which is the most unscientific way of learning science ! It may fetch marks but neither can create scientific temper nor can develop scientific mindset. Breaking away from the conventional path of producing video films for children with professional support, the author has tried to tap the spirit of innovation and creativity in children themselves to produce video clips that have a direct relevance to their studies. The present paper discusses, the objectives, methodology, observations and inferences that could be drawn from personal observations and the products viz. video clips created by the students which throw light on, i) How video being a glamorous medium can give required stimuli to students to study science in school. ii) How each and every stage of video production process can bring about qualitative change in participating child's personality as a 'student of science'.

Keywords: Participatory video media, Exploratory method, Thinking and reasoning, Creativity and innovativeness

Background

While working for Ph.D., the author came across very disturbing facts regarding science education of students coming from socio-economically underprivileged community. Some of them are as follows:

1. Understanding of basic concepts was found very poor. Because, these students who normally speak rustic form of local dialect, find it difficult to understand scientific language of a science text book.
2. These students don't find content in science book interesting, relevant and useful in their day to day life.
3. They are absolutely passive learners. They don't ask questions in class; don't discuss any theory among themselves.
4. Science practical are carried out in most unscientific way. Students are provided all the information including ideal readings and expected findings in advance. They don't explore anything. Instead they just go to laboratory and perform as per instructions. This cannot create spirit of enquiry in students. Moreover there is

no emphasis on experiments with material readily available to them.
5. Students don't read any supplementary book giving scientific knowledge, they don't watch any science based TV programme. They cannot relate to science programmes shown on channels like Discovery or Science clips shown on News channels mainly due to language barrier.
6. Questions asked in routine school examination judge only memory based knowledge which encourages mugging.

What they need

These underprivileged students need some **tool,**

1. Which will give them *experience of learning* and will make them active *partners* in education process. Which will create suitable environment for their thinking and reasoning faculties to develop.
2. With which they can *relate* easily.
3. Which they can *easily use*. There should not be any language or any other barrier.
4. Which will provide them stimuli required to stay at school and help them 'understand' the subject and teach them to *'apply'* that acquired knowledge. In short, will create *suitable environment* for them to study science.
5. Which will help shape up their *personality* as a science student who possesses *spirit of enquiry*.

Introduction

The author has tried to find the answer in 'participatory video' and felt that, Educational videos are good for getting across the facts, but actually getting learners, coming from underprivileged community to create video, would be more effective, as developing video falls within the realm of creative and communication skills. Creativity involves originality which generates invention**.** This was the thought behind this research work.

Experimentation

1. Around 65 high school students from underprivileged community were trained in videography. With low cost video equipment, they were imparted basic knowledge of skills like video camera operations, editing, direction and script writing using different formats like documentary, drama, etc.
2. Then they were divided into 5 sub groups comprising of roughly 12-13 students in one subgroup showing interest and skills in different video production activities. Each group produced a video film on a concept selected from their text book of science. Thus, 5 films on concepts in science text books for class VIII and IX were produced by these students under the guidance of the author who is a media professional herself. Content selection, script development, preparing required material for the film, recording, editing, etc., was done by students very enthusiastically.
3. All the 65 students viewed these films and tried to evaluate their own work.
4. After viewing session students were given a test based on concepts taught through films. Test comprised of both objective as well as subjective questions judging understanding and application of the acquired knowledge and science process skills like observing, analyzing, and drawing inferences, etc.

Observations

1. Students were quite receptive to video technology. Glamour associated with video medium provided required stimulation for study.
2. While developing a film, they discussed the subject, communicated with teachers and themselves, removed obstructions in learning process making learning process more interesting for them.
3. They felt the need to visit school library for collection of information and research for the film.
4. Even those students who didn't possess good reading and writing skills could participate in video production wholeheartedly and could acquire knowledge in-spite of being fully literate.
5. While developing a script on 'Chemical Bonds' students did lot of brainstorming which made them understand their problem in studying chemistry that, 'there are too many names of elements, compounds, etc., in chemistry. Understanding a problem was the first step towards

solving it. Students dramatized the theory, personified the elements and compounds, called each other by names Mr. Chloride, Miss. Oxygen, or Miss Hydrogen, etc. and wore the name plates. Thus while rehearsing and shooting the films, automatically theory was learnt wholeheartedly.

6. While developing a script on 'Force & Pressure', initially students tried to use same drama format used by their other classmates, who had produced films on Chemistry. They did not find the same format effective while rehearsing the drama. Brain storming made them understand the difference between Physics and Chemistry.

   Physics is not an information based science like Biology or Chemistry.
   Instead, concepts and logic behind them are of prime importance.
   If those concepts are not clear then mugging of theory is also not possible.

   They chose drama- in-classroom format in which teacher (role played by a student) performed **'**Practicals**'** and students **'**Asked**'** questions. Reflection of student's educational needs was found in the reason behind choosing this format. According to them this was the *'ideal way' of learning Physics***'** which *does not happen* in their routine class.
7. In a film on 'Acid-Base-Salt' (Chemistry), Neutralization reaction in which acid and base chemically react with each other to form salt and water was pasteurized as, 'fighting between acid and base leading to disappearance of two and water and salt appeared on the screen' which gave naughty playful touch appropriate to their age, to the whole theory. This can be termed as the best example of, ***Science through child's eye*** . Viewers found it very easy now to remember this theory.
8. After viewing the films all the 65 students tried to evaluate their own work and expressed their feelings that 'Next time we will do better job. We will correct the mistakes which we have committed this time.' This type of 'urge for self development' is never displayed by them in regular School session.
9. Concepts not understood in each standard go on accumulating to such an extent that, by the time students reach high school they are unable to understand even 10 % of the new concepts taught in the school. While developing scripts for the films, students realized that they need to understand certain concepts which they had studied in previous standards and had not understood.' Hence they referred to previous standard books, and tried to understand those concepts which they never do in their routine school work.
10. Some of the students who normally don't show any interest in routine school Class work and don't do well in school examinations, could pick up video technique very fast and did very well in the test given after the activity. It was observed that they did well mainly in method-of-science skills.
11. Changes observed in students' behaviour after taking part in video production Activity-Students started using school library. Their active involvement in day to day classroom activity increased. They started demanding more number of practical sessions in their school. They searched for good science programs on television and found that 'there are no good Science programs for high school students'. They expressed their desire to see science based programs on TV in their own mother tongue 'Marathi'.

Inferences

1. Video is a channel of communication from the mind of the producer (sender) to the mind of the viewer (receiver).
   AND
   Meaningful communication can take place only when sender and receiver are able to reach media synchronization. In this experiment, Producer (sender) and viewer (receiver) both were,
   1) coming from same background,
   2) studying in same class and
   3) having same knowledge level ,
   4) talking same language,

   Hence, adverse factors like 1) mismatched language of communication, 2) use of symbols/ examples not familiar to students, 3) volume of content which student *cannot grasp* at a time

Learning goes naturally

Collective wisdom could be better

were considerably reduced.
Students expressed Science concepts in their 'own language', with own symbols and experiences, thus brought their form & content into the developed video material.

2. Many students who can't score well in Science in routine school examination are looked upon as dullards, which is wrong because all the aspects of intelligence are not judged in routine school examination e.g. Science process skills.

Importance of participatory video activity in science education

1. Video Production process requires synchronizing head and hands together which is vital for learning science.
2. It is possible to sharpen various skills like communication, science process Skills, etc., and shape up attitudes, e.g cooperative working attitude in the process of acquiring proficiency in various tasks in video production.
3. Students can be under control of their own learning according to their own needs, own speed, pace, capacity to grasp the concept and apply that acquired knowledge into practice.
4. While looking through camera lens, students can grasp exactly *'what is to be focused'* and while editing a film they understand **'***what is to be picked up and highlighted'***,** in effect, they realize - *'what is to be studied'***.**

Recommendations

Participatory video activity is important for participatory learning rather than passive learning; suitable visuals are more effective rather than verbal explanations; and exploration helps develop spirit of innovation rather than mugging**.** It is therefore suggested that:

1. With the help of participatory video, school education should be remolded to the mode of *'learning by discovery'* and *'learning by doing'***.**
2. This experiment can be replicated in other schools for underprivileged students. Video network can be formed among schools run by Municipal Corporations or district authorities, etc.

■

RESEARCH PAPER

Lack of awareness and apathy to sleep health issues

Md. Dilshad Manzar
Centre for Physiotherapy and Rehabilitation Sciences
Jamia Millia Islamia, New Delhi - 110025

Dr. M. Ejaz Hussain
Centre for Physiotherapy and Rehabilitation Sciences
Jamia Millia Islamia, New Delhi - 110025

Sleep health problems are widely prevalent in almost all demographics of Indian population. The situation is more challenging because of lack of awareness among health professionals and the population at large. The study presents the result of an e-mail based survey involving people mostly from higher education group, though, the response rate (subjective indicator of awareness) was poor. It is therefore, suggested to adopt remedial paradigms like introduction of sleep health course structure in clinical sciences and launching of comprehensive awareness programmes for the society at large.

Keywords: Sleep disorders, Course structure in clinical sciences, Awareness programmes

Introduction

Human sleep health awareness situation is not encouraging in the country[1-4] even though, different groups have shown critical prevalence level of sleep problems in the Indian population[1, 2, 5-9]. Some of the representational studies dwelling into the subjects of prevalence of sleep problem and/ or lack of awareness about sleep health issues have been summarized in table 1.

The literature available about sleep health and its awareness among health professionals show that situation is far from ideal with almost all of them (studies) concluding with the advocacy of immediate implementation of remedial measures. Krishna *et al* using the Pittsburgh Sleep Quality Index (PSQI) on 67 medical students showed high prevalence of poor sleep quality[9]. Sivagnanam *et al* surveyed 650 final-year medical undergraduates for basic and clinical sleep knowledge. The study reported an insufficient knowledge coupled with strong recommendation to develop an educational strategy to improve knowledge as well as clinical handling of sleep-related problems[3]. A study for the subjective evaluation of the behaviour, attitude and knowledge of sleep medicine among resident doctors concluded that there was an acute need for including sleep medicine in their curriculum[4].

Almost none of the sleep laboratories in the country are putting up web-pages devoted to the subjects of public sleep health awareness and volunteer recruitment, which is usually very common practice at international sleep laboratories. The situation exists in spite of encouraging reports of inter-

net use by both patients and medical professionals for accessing health related information[10, 11]. The study was designed to assess the sleep health awareness (subjectively) in educated population.

Subjects and methods

The study has been by the institutional ethical committee as part of ongoing research project. A methodology was devised for indirect assessment of quantifying the receptiveness and the consequent responsiveness to an established questionnaire instrument[12] by carrying out an e-mail based survey. This was ensured by minimal interface with the subjects by e-mailing the PSQI scale with some co-relational information about sleep disorder and some chronic diseases (in about 150 words). The veracity and authenticity of e-mail was ensured by adding complete detail of the authors' affiliation as signature. 850 e-mail addresses of faculties, administrators[13] and staffs of one of the centres of the university[14] were used. The method ensured almost complete liberty

Table 1: Summary of sleep problem prevalence study on Indian population

Author	Bharti *et al*	Ravikiran *et al*	Suri *et al*	Suri *et al*	Vijayan *et al*	Zarir *et al*
Year	2006	2011	2008	2008	2004	2004
Social Demographics	_	Rural	Urban	Urban and rural	Rural	Urban
Age group, sample size	3-10 years, 103	(2-6 years, 252) (7-12 years, 261)	School going children of Delhi, 2475	Adult population of Delhi and NCR, 2475	Adult (above 18 years), 6908	35–65 years, 658
Gender	65 M & 38 F	(124 M & 128F); (129 M and 132 F)	M and F	M and F	3562 M and 3346 F	658 M
Type of study	cross-sectional prospective	cross-sectional	epidemiological	epidemiological	epidemiological	two-phase cross-sectional prevalence study
Methodology	Questionnaire developed by authors	Kannada translation of "Bears instrument"	Paediatric Sleep Questionnaire (Ron Chervin et al.), University of Michigan and Polysomnography sleep study	Chervin and the Stanford Sleep Clinic questionnaire and Polysomnography sleep study	Multiple choice Questionnaire developed by authors	Questionnaire developed by authors
Results	42.7% had one/more of sleep problems like sleep walking, sleep talking, night mares, sleep terrors, bruxism, nocturnal enuresis & sleep disordered breathing	51% affected with one/more of Bears parameters	47.5% affected with one/more of the 10 parameters in the Questionnaire	55% affected with one/more of the 12 parameters in the Questionnaire	11% had breathing symptoms	19.5% had sleep disordered breathing & 7.5% had OSAHS

Table 2: The result of e-mail based survey

Total number of e-mail addresses	Functional e-mail addresses	Non-functional e-mail addresses	Number of response	Number of non-response	Number of e-mail reply without survey response	Response rate %	Non-response rate %
850	594	256	3	591	1	0.005	99.995

to respond or not to respond with the participants.

Results

The results are shown in the table 2. Out of a total of 850 e-mail addresses, 594 e-mail addresses were found functional; however, only 3 e-mail addressee chose to answer the PSQI based survey. The response rate was 0.005% and the non-response rate was 99.995%. One e-mail recipient objected to the unsolicited survey e-mail. The PSQI score of the three subjects was 17, 9 and 4 respectively.

Discussion

The methodology may be an interesting tool especially for epidemiological studies to evaluate awareness, where non-participation may be taken as an indicator of non-awareness. However, the rather simplistic translation of non-responsiveness with lack of awareness of the subject may be farfetched. Sheehan reviewed in 2001 that the response rate of e-mail based surveys had decreased since 1986 to 2000 from 61.5% to 24.0%. It depends critically on variables like survey length, respondent contacts, design issues, research affiliation, compensation, pre-notification and survey follow-ups. It is therefore, imperative to use the tool with requisite modification for optimum response rate[15].

The response rate of 0.005% among people of higher education to an established subjective sleep evaluation tool do not augur well for sleep health in particular and holistic dimension of health in totality. The situation prevails in spite of Delhi being centre to the very best of country's human sleep research workforce. However, the non-participation may have also been influenced by non-frequent e-mail access, in-efficient management of electronic account (should be a marginal reason because study group was educated population but 30.12% of non-functional e-mail addresses seem to suggest it), busy schedules; preoccupation with more urgent personal/ professional priorities, absence of pre-notification, and survey follow-ups. However, the overwhelming quantum of non-participation may still be more reflective and in consonance with earlier findings of lack of awareness about sleep health issues[3, 4, 9].

Conclusion

The high prevalence of sleep problems in almost all the demographics of population studied, lack of awareness and knowledge among health professionals, non-inclusive use of electronic media by sleep research groups may all be decelerating the sleep research and negatively affecting the holistic dimension of health services as a whole. It is therefore, imperative to adopt a comprehensive sleep health course structure in clinical sciences and awareness programmes for the society at large with more possible usage of electronic media.

References

1. Ravikiran, S.R., Kumar, P.M. and Latha, K.S., Sleep problems in preschool and school aged rural Indian children, *Indian Paediatrics*, 48(3), pp 221-3, 2011.
2. Suri JC, Sen MK and Adhikari T, Epidemiology of sleep disorders in school children of Delhi: A questionnaire based study, *Indian Journal of Sleep Medicine*, 3(2), pp 0973-340X, 2008.
3. Sivagnanam G, Thirumalaikolundusubramanian P, Namasivayam K, Gitanjali B, Sugirda P and Rajeswari J, Study of the knowledge, beliefs, and practice of sleep among medical undergraduates of Tamilnadu, India, *Medscape General Medicine*, 6(4), pp 5, 2004.
4. Meshram SH, Meshram CS, Mishra GS and Bharshankar R, Behaviour, attitude and knowledge of sleep medicine among resident doctors in university hospitals of Central India: A questionnaire based

study, *Indian Journal of Sleep Medicine*, 2(4), pp 0973-340X, 2007.
5. Bharti B, Malhi P and Kashyap S, Patterns and problems of sleep in school going children, *Indian Pediatrics*, 43, pp 35-8, 2006.
6. Suri JC, Sen MK and Adhikari T, Epidemiology of sleep disorders in the adult population of Delhi - A questionnaire based study, *Indian Journal of Sleep Medicine*, 3(4), pp 0973-340X, 2008.
7. Vijayan VK, Mittal A, Tyagi P, Fahim M and Rahman M, Prevalence of sleep related breathing disorders in rural population of Delhi, India. *The Indian Journal of chest diseases and allied sciences*, 126, pp 902S-b, 2004.
8. Zarir FU, Amita VD, Sharmila GL and Chandrajeet IS, Prevalence of sleep-disordered breathing and sleep apnea in middle-aged urban Indian men, *American Journal of Respiratory and Critical Care Medicine*, 169(2), pp 168-73, 2004.
9. Krishna P and Shwetha S, Sleep quality and correlates of sleep among medical students, *Indian Journal of Sleep Medicine*, 3(2), pp 0973-340X, 2008.
10. Akerkar SM, Kanitkar M and Bichile LS, Use of the internet as a resource of health information by patients: A clinic-based study in the Indian population, *Journal of Postgraduate Medicine*, 51(2), pp 116-118, 2005.
11. Lal P, Malhotra R, Ahuja C and Ingle GK, Internet use among medical students and residents of a medical college of North India, *Indian Journal of Community Medicine*, 31, pp 293-4, 2006.
12. Buysse DJ, Reynolds CF III, Monk TH, Berman SR and Kupfer DJ, The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research, *Psychiatry Research*, 28, pp 193–213, 1989.
13. Jamia Millia Islamia [homepage on the Internet]. New Delhi: [cited 2011 Aug 19]. Web-mail directory; [about 29 pages]. Accessed from http://www.jmi.ac.in/emaildirectory.pdf [cited 2011 Aug 19] and now available at http://old.jmi.ac.in/2000/emaildirectory.pdf [cited 2011 Sep17].
14. Jamia Millia Islamia [homepage on the Internet]. New Delhi: Staffs directory; [cited 2011 Aug 19]. FTK-Centre for Information Technology; [about 3 screens]. Accessed from http://www.jmi.ac.in/cit/cit.htm [cited 2011 Aug 19] and now available at http://old.jmi.ac.in/2000/cit/cit.htm [cited 2011 Sep17].
15. Sheehan KB, E-mail survey response rates: A review, *Journal of Computer Mediated Communication* [serial on the Internet]. 2001 Jun [cited 2011 Aug 15]; 6(2): [about 8 p.]. Available from: <http://onlinelibrary.wiley.com/doi/10.1111/j.1083-6101.2001.tb00117.x/full>

■

ARTICLE

Science, technology, and media: Some revelations

Anshu Arora
Research Scholar, Science Communication, Department of Mass Communication
Punjab University, Chandigarh

Science and technology go hand in hand in the modern world due to its social, economical and technological strength, more precisely, Information Communication Technology (ICT) bringing world societies closer and offering an instrument to change. The growing importance of ICT in key areas - productivity and innovation, modernization of public services, such as health, education and transport has changed the modern way of life across the world. ICT provides a main tool to reduce discrimination and to empower people in almost all walks of life, enhancing capacity to communicate and participate in decision making.

Technology has gone further even saving lives and addressing medical problems. Hospitals and medical health care centers are equipped with sophisticated machineries, but there were instances that many of the para-medical staff does not know to operate these equipments some time. Moreover, if they know to operate, they do not know how it works. Even if they know its working mechanism, in many cases they do not know the scientific concept behind the machine. This kind of technological and scientific ignorance leads to number of uncertainties sometime fatal and beyond control. Generally, it is not expected from medical staff to know everything about the machine, there is no harm but advantage in knowing more about it.

Similarly, advancement of the technological sector in the world leads to making lives more comfortable, but sometime can cause disasters that could be avoided by technological awareness.

Communication has never been so easy, and on our finger tips as it is today. The printing press, telephone, internet are all some of the latest technologies which have lessened the barrier of location for people living in different parts of the world. When we talk on phone, or use internet, it feels very normal because we are in a situation where the blessings of technology are overwhelming. At the same time, overuse of these gadgets can create health problems or can cause technology addiction to children, which can be avoided with a simple does of awareness and attitudinal change. Thus, a major benefit of technology for the upcoming generations can be ensured.

The basic lifestyle in every aspect of our daily lives, the kind of housing, transport, fashion and entertainment, all depend on technology development. If we say, that it is the time when the world has reached the pinnacle of these fields, it is worth mentioning that the only thing behind it is the developments in technology. On the other hand, ironically, the impact of technology has taken over our lives and penetrated to our habits, which are limiting human powers and making people over dependent. Our children must be educated of the perils of overuse of motor vehicles, electricity, mobile phones, and rational use of technological gadgets to not only minimize overuse but also save energy and avoid resultant health implications too.

The invention of computers and communication aids has been a breakthrough. It has revolutionized the field of communication, entertainment, music, films and multimedia performances and even virtual events have started taking place over the internet. Technology has basically changed the meaning of life and has minimized struggle making life simplified than it was years ago. It also gave birth to a new set of issues that require immediate attention. Over communication especially on social media led to more confusion, expectation, tension, struggle and conflict. It can be viewed as one of the many

other contributory factors creating social disasters in the current times. These, if not tackled carefully with necessary awareness, could be more damaging to our social fabric in the years to come.

Media studies definitions are changing quickly as digital technology evolves. Mass media, advertising and marketing communications are discovering new directions. Mass communication carries a message created by a person or a group of people sent through a transmitting device (a medium) to a large audience or market. Mass media is used for any kind of mass communication. Until recently mass media was clearly defined and was comprised of books, newspapers, magazines, radio, movies, television and internet. However, in the present scenario, mass media is no longer that simple. The continuing revolution in communication and media technology is producing more competition. The media houses have dedicated teams and groups who carry regular market, industry, and clientele assessment to reap profit. As an audience, many a times you are not sure whether you are watching, listening or reading a genuine news story or it is an 'advertorial (advertisement-editorial)' being sold to you by the industry-media nexus to serve their purpose. Similarly, one can find many such media innovations, i.e. 'informercial' (information-commercial), 'sponsored feature', or 'this part of news is brought to you by…' Obviously, those who are paying for that have the upper hand to sell their ideas to influence and eventually rule your mind!

Mass media are a liberating force because they can break the bonds of distance and isolation and transform people from a traditional society to an aware society. Thus, the mass media can create a climate for change and development. The point to be carefully dealt here is what kind of 'development', negative or positive, we should be looking for.

Information communication technologies offer huge potential to the developing world creating opportunities for people in low-income group. Large telecommunication companies are willing to invest in new markets. Policy and regulation frameworks help create ICT infrastructures, to assist governments communicate with central, regional, and local level. It provides more transparency, fight corruption, as well as strengthen businesses. Developing new technology breeds new questions. Should cell phones be included in a definition of mass media? What about video and computer games? Is "world of warcraft" a mass medium? Considerable debate surrounds this topic at the moment and the answer is still not entirely clear. New media technology theory began at the same time as the introduction of computer. The interplay and associated new developments are referred to as media convergence. New forms of media result from integration of multiple media (Mc Luhan, E., Zingrone, F., 1995, pp. 179) and the dilemma continues. As a matter of fact, the market has no dilemma over it, by and large it is a matter of debate for intellectuals; market is gaining from this confusion and extracting money out of your pocket. Let's educate ourselves of the hidden teeth of such markets, sooner the better!

In his famous book Understanding Media, Marshall McLuhan discusses the impact he expects electronic media to have on the world. Since then the emergence of a 'global village' has become a universally accepted idea. One of the great hardships endured by the poor, and by many others, who live in the poorest countries, is their sense of isolation. The new communication technologies promise to reduce that sense of isolation, and to open up access to knowledge (The World Bank, World Development Report, 1999, pp. 9). Developing countries are going to speed up the information flow and offer education where it has never been before, teach literacy and technical skills widely to reach the unreached. Mass media are a liberating force because they can break the bonds of distance and isolation and transform people from a traditional society to an aware society. Thus, the mass media can create a climate for change and development. The point to be carefully dealt here is what kind of 'development',

negative or positive, and would it be pertinent to find the attributes to clearly understand and focus upon what kind of change we should be looking for, because media too is no more remained a charity in the age of mistrust.

Despite the fact that networked electronic media are favored for rural development, they obviously do not have the same reach and levels of access and accessibility as the traditional electronic media do. Another distinction between media is the type of information and content they are able to convey in a message, thereby significant differences between traditional and networked electronic media can be distinguished. Based on the two above mentioned distinctions between electronic media combinations are suggested for use in science communication, both to improve the quality of the information provided and to change existing information and communication structures.

Both radio and television were expected to affect a major change in information provision in rural areas in developing countries. So far only radio can be said to play a role in rural development. Television coverage is still limited in rural areas of developing countries, and broadcasts focus mainly on entertainment, though 'Krishi Darshan' of Doordarshan is quite popular in rural and urban areas. Broadcast media provide information with all intrinsic disadvantages: one-way communication with a few possibilities for feedback, physical distance between sender and receiver, and reinforcement of the existing power structure. Further weaknesses of broadcast media are the difficulty of retaining the information for later use and the susceptibility of messages to alternative interpretations. Radio is most widely used in rural areas, primarily because of its versatility which allows for its use in various types of communication efforts. The presence of community radio and the availability of small transistor radio sets allow 'easy and affordable access' and are portable. The role of these radio stations consists of providing an alternative, more independent, source of general information, as well as offering information on issues of local interest through discussions and interviews with representatives of local interest groups, testimonies of individuals on their experiences. With higher level of credibility with the local population but the essentially one-way information flow of the broadcasts limit the use of radio to fullest extent.

Television, unlike radio, more often uses satellites, with most developing countries allowing the reception of satellite transmissions. At the same time the costs of reception equipment, for example satellite dishes, and the related technical infrastructure is far more discouraging than of radio. Most television stations are based in major cities, or even in other countries, which exacerbates electronic mass media's negative factors: one-way communication, lack of feedback opportunities and the physical distance between sender and receiver. The main advantage of television, in conveying messages, is the additional characteristic of visual information, which allows for a slightly different type of information. However, difficulties for retaining information are similar to radio. So far basic telecommunication services are not widely available in rural India, or if available only at relatively high cost. Therefore, the role of this medium is rather limited.

Of the various types of computer mediated communication only the internet, and its most popular applications e-mail and the web are considered here. Internet is now an accepted phenomenon in almost all developing countries. So far the contribution of the internet to science communication mainly exists through websites, blogs, and online discussion groups only, usually focusing on information access, using sources of information available on the web. Subsequently, this pool of information created online can be made available in print form as well to increase its capacity of audience's retention and later use.

Opportunities for the internet in development, as far as providing individual access is concerned, are limited. Other aspects of the internet that presently limit its use in rural areas are computer illiteracy, high cost and limited availability of equipment (e.g. computers, terminals, modems), and perhaps most importantly the relative lack of appropriate local content and local operational skills.

Credibility of both the sources of information (the sender) and the information itself is potentially greater for basic communication and the internet, because receivers know the sender or can select the sender or both.

Exchanges of information obviously encourage tapping into existing sources of local information, knowledge and experience, thereby decentral-

izing the power structure. In the short run, however, discouraging costs of internet access, the emphasis on a paternalistic information provision and the tendency of internet providers to focus on commercial activities and profit seem to lessen the possible contribution of the internet. In general, the contribution of the internet to development is minimal.

ICT is pervasive, cross-cutting and can be applied to full range of human activity from personal to business and government. It is multifunctional, flexible, allowing tailored solutions, personalized, localized and globalized to meet diverse needs. It fosters dissemination of science and other knowledge by separating content from its physical location. This flow of information is largely impervious to geographic boundaries allowing remote communities to integrate themselves into global networks and making information, knowledge and culture accessible. The "digital" and "virtual" nature of many ICT products and services allows for zero or nominal costs. Replication of content is virtually free regardless of its volume, and nominal costs for distribution and communication are near zero, provided you have internet accessibility.

ICT's power to store, retrieve, sort, filter, distribute and share information seamlessly can lead to substantial efficiency gains in production, distribution and knowledge management. It streamlines supply and production chains and makes many business and professional processes and transactions leaner and more effective. The increase in efficiency and subsequent reduction of costs brought about is leading to the creation of new products, services and distribution channels within traditional industries, as well as innovative business models and new industries. Intangible assets like intellectual capital are increasingly becoming the key source of value. With the required initial investment being just a fraction of what was required in the more physical asset intensive industrial economy, barriers to entry are significantly lowered, and competition increased.

The practical aspect however is more alarming as witnessed by many during failure of northern grid of power supply that caused elongated blackout in more than 20 states in India recently. It revealed that if the power supply is blocked for these servers and UPSs for a considerably long period, the data stored in those systems will be washed out and cannot be restored. Whether our media and data managers are aware of the fact and do they have any alternatives available with them in case of loss of such big data!

Through the creation and expansion of networks, ICT can transcend cultural and linguistic barriers by providing individuals and groups the ability to live and work anywhere, allowing local communities to become part of global societies irrespective of their nationality, culture, and regulatory structures within and between nations. Adopting an ICT as enabler strategy often demands a more comprehensive approach because there is a need to go beyond the requirements of a single sector and to facilitate a more general deployment of a technology. The main component that is important for a strategy to address with some variation in range and scope depending upon the focus of the strategy. These characteristics suggest that it has the potential for bringing in the development, however, the fact that it can assist development efforts, it does not mean that it will necessarily do so. It largely depends on the people whosoever controls it.

For example, the dream project of preparation of Voter ID Cards has shown some interesting instances, i.e. there were a large number of daughter in-laws of less than 3 years' old, fathers are only 3 years elder than sons, innumerable discrepancies in gender columns, husbands as fathers for many, and so on. No reason here to blame technology, but the circumstances, attitude of functionaries, and availability of incorrect data are to be blamed for such issues. Scientific and technological awareness and scientific attitude can offer answers!

A comprehensive and holistic approach is the most effective way to benefit from synergies and ensure the impact of technology. Although each of these components produces benefits, because they are interrelated, they work better if addressed together as part of a coordinated strategic approach. Even with India's explicit software sector export focus in place since the decades together and despite the abundant supply of English speaking, skilled IT professionals, it was only when competitive international connectivity and enterprise incentives were put in place that software production could really take off. Human capacity specifically creation of knowledge or technical workers is important for both the production and use, but more important is to creating the knowledge creators rather than workers.

Creating a favorable environment for enterprise is instrumental in stimulating growth. Infrastructure development, particularly global connectivity, is a prerequisite to leveraging the benefits of the global economy, improving domestic productivity, and attracting foreign investment. A transparent, inclusive and open system associated with increased enterprise activity, improved infrastructure, content development and applications that specifically address the developmental communication needs of the population generate greater synergy and positive multiplier effects in the form of enhanced public appreciation of science and technology.

The new media are instruments of open debate and discussion in the society, engaging citizens in a continuing exchange of ideas about current issues. Governments are using communication technologies to improve their public services to access social benefits and information. It also offers new ways in education and facilitates dialogue between government and citizens as well. The problem here is that in case of a conflicting argument, what role the media should play; should it be a moderator, a facilitator, an advocacy agent for public, a government arbitrator, or a judge? Finding an answer would be crucial.

A multimedia approach for mass communication is required to educate people at large, as any single medium has limitations, thus suggesting an approach combining different media could be workable. The choice for information centers has weaknesses like the unfamiliarity of information centers, lack of credibility of information source, low level of physical access, and limited 'reach' of information within coverage area in remote and rural areas. The involvement of electronic mass media of course still does not solve the problem of limited access to information centers, or the limited reach and coverage of those centers. Although no combination of electronic media can completely compensate for that weakness of information centers, the combination of radio and television can provide some information available in the centers to people in remote and rural areas. Although, the information given by these centres is useful especially in agriculture sector, but the local wisdom of farmers and traditional knowledge are still valid and cannot be ignored completely.

The way media are, or can be used, assume that development requires social change, implicating a transformation in information-related power structures. This theory focuses on control over communication (time, place, and subject) and information (storage). Emphasizing the control aspect of information flows, it reveals the power structure underlying the flow of information, as well as the extent to which information flows reinforce, or possibly transform, the power structure. Subject and time of communication process are controlled by them, which also control the source of information. Obviously, there is strong chance of release of only controlled or 'engineered information' for public consumption that may not give a real picture of a situation.

Through careful use of the media richness characteristics of mass media, more complicated and technical information can be made available via broadcasts. Mass media, such as radio and television are most suited to convey basic, information on campaigns such as health care, education, agricultural programmes, and development initiatives, etc. Mass media will create awareness and through audience participation, discussion forums, and debates, they can further elaborate on an issue. Radio is more widespread and should thus be the initial medium. Television broadcasts should be added later, using the specific advantages of combining audio and visual aspects. Mass media create limited conversational patterns through audience participation, but individual and networked electronic media will have to provide more detailed and specific information, geared towards smaller groups. Individual, networked media should be used to facilitate and support conversational patterns, as they change the power structure and decentralize generation of and control over information (flows). Instead of focusing on information provision, the emphasis would shift to information sharing or interactive communication. In addition, information sharing should take place at local levels, mainly using locally produced information, knowledge, and experience.

Since the new ICTs also have significant disadvantages, in particular with respect to reach, access, cost, credibility, and familiarity, combining basic communication services and the internet with the existing electronic mass media (radio and television) is imperative to arrive at an optimal communication for development effort. The concept of media richness demonstrates that, with respect to content of the messages, a combination of all electronic me-

dia has distinctive advantages over the isolated use of individual electronic media.

Furthermore, to increase relevance of information and credibility of the source, communication should occur between senders and receivers similarly situated. This approach can be achieved by following these steps:

1. Ownership of information centers by local organizations and institutions;
2. Network information centers, while retaining individual independence;
3. Promotion and support of independently owned and operated local media;
4. Deployment of electronic media to facilitate and support existing information sharing at local level; using and creating local contents.

This approach supports decentralization of the information power structure, to create independent information generation, storage, and retrieval. Subsequently, it facilitates, or provides conditions for, social change through local level, horizontal information sharing, complemented by true information provision. However, without an educated and aware population, such communication processes would hardly be able to sustain and facilitate the technology driven information flow to change the fate of an ignorant majority. It is hoped that these revelations will help improve the state of affairs in respective areas.

References

1. W. Schramm, 1964. Mass Media and National Development. Stanford, Calif.: Stanford University Press.
2. UNDP, 1998. Human Development Report 1998. New York: Oxford University Press.
3. World Bank, 1999. World Development Report: Knowledge for Development. New York: Oxford University Press.
4. Information and Communication Technologies: Visions and Realities by William H. Dutton. 467, Oxford University Press, 1996. Malcolm Peltu.
5. Knowledge Societies: Information Technology for Sustainable Development by Robin Mansell, Uta When.
6. ICT and Primary Science by Nick Easingwood, John Williams.
7. Using Communication Technology: Creating Knowledge Organisations by Bettina S.T Buchel
8. Technology and Resistance: Digital Communications and New Coalitions Around the World (ed. Ann De Vaney Stephen grace, Yan Ma, Peter Lang) 2000, pp. 182.
9. Information Technology and Development: A New Paradigm for Delivering the Internet to Rural areas in Developing Countries by Jeffrey James: Routledge.
10. Understanding New Technologies of the Mass Media by George E. Whitehouse
11. Nicholas Negroponte, Being Digital. New York: Knopf, 1995.
12. Joseph C. Pitt, Thinking About Technology: Foundations of the Philosophy of Technology. New York: Seven Bridges Press, 2000.
13. Jürgen Habermas, Toward a Rational Society, esp. "Technology and Science as Ideology", pp. 81-122
14. Patairiya, Manoj, Role of Corporate Sector in Science Communication, *NCSTC Communications,* 2007.

■

To our Readers

Indian Journal of Science Communication invites readers' views and critical comments on any of the aspects of the journal. Suggestions for further improvement in presentation of the journal and its contents are also welcome. Selected letters would be considered for publication under the column '*Letters to the Editor*'.

ARTICLE

Science and the comics

Mico Tatalovic
Large Animal Research Group, Department of Zoology, Christ's College
University of Cambridge, CB2 3BU, Cambridge, UK

Comics are generally underrated as an art form. The comic medium is most often associated with animated children stories. However, for many people comics are more than this. In *Reinventing the Comics* and *Understanding Comics* Scott McCloud argues for comics' ability to convey various messages in an artistic way. Appropriately, both these books are themselves comics. McCloud views comics as 'sequential art' supporting Will Eisner's theory, as outlined in his book, *Comics and Sequential Art*. The term "sequential art" refers to the juxtaposition of images that tell a story. According to this definition, comics can be traced far back in history. Some Egyptian wall paintings, as well as tapestries and column decorations qualify as comics.

The most famous comics are likely the superhero-type comics such as Superman, Spiderman, and Aquaman. Perhaps 'Scienceman' will be the next addition to the team of ever-admired superheroes! Already in existence, although admittedly not the most stereotypical of superheroes, is Profesor Baltazar.

McCloud proposes that the longevity, as well as the recent increase in popularity, of comics is largely as a result of the schematic representation of the main characters. This visual representation, he feels, allows readers to easily identify with those characters. Comics are therefore an intimate and personal experience for each reader. The reading experience is further individualized and enhanced by allowing the reader the freedom to use their imagination to fill in the gaps between the sequential frames. Although superhero comics are perhaps the largest genre of comics, other genres exist. In my opinion, one of the genres that comics have started to explore more efficiently with a lot of promise for future use is the non-fiction genre of science.

Comics have the power to convey complicated messages in a way that is both understandable and visually attractive to wide audiences. The popularity of political and social-based cartoons and comics, such as the ones published in newspapers, clearly illustrates the effectiveness of combining the attributes of accessibility and aesthetics. In addition to simply looking good, successful communication of science can benefit from the involvement of scientists in the process. A good example of this is Icon Books *Introducing...* (*Genetics, Darwin, Science,* etc.) or the *Horrible Science* series. These two series introduce scientific ideas in the form of a short book interspersed with funny yet relevant comics. These series of books use comics and cartoons to make scientific ideas more accessible to the non-specialist public.

A good example of a current compilation of comics that communicate science is *Science: sequential art annual 2006* produced by the Savannah College of Art and Design. This remarkable book is comprised of more than 40 comics drawn in various individualistic styles by students, faculty and alumni of the College. They explore, comment and criticize an extremely wide array of issues raised by science and technology of the 21st century. The topics range

from science and religion to genetic engineering and cancer, varying in mood and approach from funny and idealistic, to depressingly realistic and essentially sad. One could only wish for more science comics anthologies such as this one. In this way, comics can make science approachable to both children and adults who might not otherwise have the time, interest or courage to sit and read more serious scientific books or papers.

The most famous comics are likely the superhero-type comics such as Superman, Spiderman, and Aquaman. Perhaps 'Scienceman' will be the next addition to the team of ever-admired superheroes! Already in existence, although admittedly not the most stereotypical of superheroes, is *Profesor Baltazar*. In this classic Croatian cartoon the main character encounters a variety of problems in his hometown. The Professor goes to his study to think about a solution, which he then produces in his colourful chemistry lab, and applies to the problem. *The Science of Superheroes*, *The Physics of Superheroes*, and *The Science of Supervillains* all discuss comic superhero characters and their superpowers with a scientific eye. They explore whether or not it is possible for these superpowers to exist, given our current understanding of nature and the universe. Does the low-gravity of Superman's birth-planet, Krypton, explain his ability to fly? Could Spiderman's web really be used for swinging between buildings? Would Flash really be able to pick a bullet out of the air if he was running at the same speed as the bullet? Why couldn't Atom travel on electrons through phone lines? These are just some of the questions these books tackle. Interestingly, by taking a more biological approach, *The Science of Superheroes* does not always reach the same conclusion as the physics-based books when determining whether certain superpowers are possible.

Comics and cartoons as art forms have the potential to communicate scientific ideas. Comics can also provide a critique of research, or convey its funny side; which could also result in a better appreciation of the way that science is carried out. Comics have the ability to be the medium of scientific communication. They also aid science communication via other media such as books, which sometimes take their inspiration from existing comic characters (e.g. the superhero science). It is the readability of comics as a medium, comics' ability to combine pictures and words in short comic strips as well as longer comic books, while allowing the reader to identify with the story that makes it an excellent medium for communicating science.

■

Socio-economic philosophy of science: A message to public

Dr. C. Subbarao
Director, Avanthi Engineering Colleges, Visakhapatnam

Dr. C. Kavitha
Head, Department of Electronics, GITAM University, Visakhapatnam

Dr. Y. Somu Naidu
Department of Geophysics, Andhra University, Visakhapatnam

Introduction

Science is believed to be a mute servant of the society, catering to the needs, comforts and pleasures of human beings. It was thought that science, the material power, had nothing to contribute to the value system of life. 'Equality' of groups and sections of the people all over the world was the ideology of political or social reforms, and science had nothing to say either for or against. Scientific discoveries over millennium, however, reinforced the theory of 'equality of people' and a just order. Further, the technological production alone guaranteed the 'rights of all people' in a democratic society. The message of science was thus, proved to be 'egalitarian' in its essence. But at the end of every system created by science, there is a man, who in turn governs and dictates the fate of humanity and unfortunately science also here has a role to play!

Man's struggle with nature for survival developed 'science'. Science, over ages, had managed to acquire sufficient knowledge of the material world. Knowledge inspired 'action'. He progressed from 'knowing' things to 'doing' things. Metamorphosis of science into 'technology' began to modify his surroundings. More 'comforts' were created by scientific discovers. Instruments were designed to improve his pleasure systems. Further, technological production resulted in abundance of physical assets. The affluence thus created had to be distributed among more number of people through 'market systems', normally, determine the consciousness of human beings. Even a ruffian learns to be a Roman in Rome.

Scientific method

The dictionary meaning of the word 'egalitarian' is to believe in the 'equality of rights to all the people'. The word sounds political or social and apparently does not belong to scientific jargon. Learners of science are told that 'science is the accumulated knowledge of the physical world'. The definition at that stage implies that it has nothing to do with individual thinking, social habits, philosophical moorings, religious traditions, castes or classes.

History of science tells us that it dates back to a few thousand years Before Christ (BC). Man's struggle with nature for his day to day survival began to reveal the secrets of material world, which were called 'discoveries'. Though modification of surroundings as result of these discoveries gained momentum after the 16th Century A.D., civilizations like Indus-Valley, Greek, Egyptian, and Chinese flourished with the then existing knowledge of material power from 3000 B.C. itself. Invention of metals, utensils, weapons, poisonous substances, handicrafts, colours, textiles, chemicals and medicines marked the growth of materialistic culture up to the beginning of renaissance period in 1500 A.D. in Europe

After 17th Century, Newtonian science, which

we call 'modern science' revolutionized ideas in physics, chemistry, biology and astronomy. The invention of gun-powder, mariner-compass, and electric lamp began the new order of industrial era. The scientific method, as described by Karl P. Popper and Thomas S. Kuhn, developed revolutionary theories in material-understanding, each improvising the earlier one, substantially modifying the former.

Revolution in science

Invention of steam engine by James Watt in 1736, electric lamp by Edison in 1793, the principle of vaccination by Louis Pasteur in 1822, Roentgen's X-Rays in 1896, aero plane by Wright Brothers in 1903, and penicillin by Alexander Fleming in 1929 gave momentum to the new scientific progress. The scientific 'age' dawned, providing a different way of life, shattering the existing 'faiths' and 'conceptions'. The doctrine of 'Old order Changeth giving place to new' was proved correct. The split of atom in 1940s was a giant whiplash on human civilization. The expansion of science by leaps and bounds, having started after First World War, exploded after Second World War. Technology and engineering were illuminated by the advent of computers, the new wonder of the scientific scenario, in the last quarter of 20th century.

'Science further provides intellectual pleasure, happiness and efficiency 'equally' by it's application to economic and social life and the persisting ideas of superior and inferior races, colour prejudices and other indignities inflicted on people are demolished. Science came to support this particular truth of unity of man and makes us more ethical than we happened to be before'.

Effect on human life

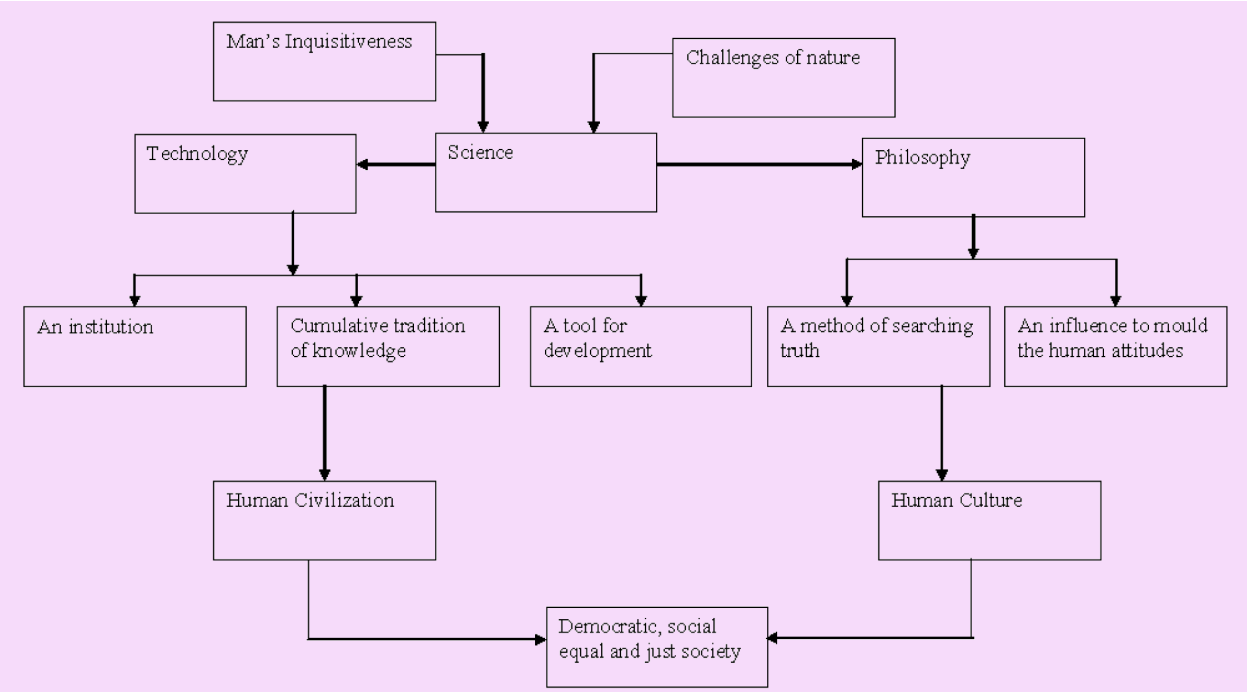
Modern science is not only capable of providing human comforts but an instrument of producing changes in human character, social-relations and his philosophical thinking. J.D. Bernal, a great science historian reported that science could be divided into five categories (a) an institution, (b) a cumulative tradition of knowledge, (c) a tool for development and material production, (d) a method of searching the truth, and (e) an influence to mould human attitudes.

People generally believe that science is all the a, b, c, d and not 'e'. They do not realize that scientific temperament and technological life influence the thinking of the people. They arrogate themselves to the point of view that human thinking is sacrosanct and cannot be altered by aberrations of science drama.

Science entered the phase of 'industrial revolution' in the 18th century when the technological production is bigger, sharper and faster, many times, than the primitive hand-made production. To cite an example, a hand-loom produces a saree in fifteen days and a power-loom makes hundreds of sarees in a day. A Bible copy could be prepared by hand-composure press in a month, while power-press could print a dozen copies in an hour. Same speed could be visualized in other sectors too. The speed of the horse-driven cart was no where near the car or train, not to talk of the aero plane.

The concept of equality

After the French revolution (1789), socio-political philosophy of the world underwent a drastic change. Liberty, equality and fraternity became the philosophical trio-of modern Europe. 'Egalitele' is a French word meaning 'Equality'. Karl Marx in the 19th Century further expanded the theory of equality into theory of communism, based on the politics of France, economics of England and philosophy of Germany, while socialism pleaded for equal opportunities for people according to their ability, Marxian communism prescribed each according to his 'need'. Marx foresaw that his theory of absolute



The sketch diagram showing the birth, growth and message of science.

equality will be realized by technological production. The capitalists, the owners of machine production, had to distribute the products to all sections of people for their own profits, resulting in equality of people not by 'consent' but as a 'consequence'. The capitalist cannot afford to discriminate on grounds of colour, caste, creed, race, gender, nation or notion.

Voice of science

Technology was welcomed as a natural agent for the emancipation of poor, weak and the disadvantage groups by leaders like Pundit Jawaharlal Nehru of India and promoted as part of egalitarian thinking. A Nehruvian intellectual, Bidhan Chandra Roy, the President of Indian Science Congress in 1957, proclaimed that 'science is an agent of change in the 20th Century that drew-millions of people into one common fabric of human society and social order. When a whole population uses a common railway platform, telegraph unit, telephone link, broadcasting system, omnibus, train, car, and a cinema then results a sense of equality 'identical' way of living without coercion or compulsion.

The unfulfilled 'dream of equality' contemplated by philosophers and politicians for centuries was thus realized by 'science' and its cousin 'technology'. An equal and just society can not be realized by poverty distribution but only by product distribution. It is the technology which created vast amounts of food, clothing, cement, bricks and cyberspace, catering to the needs of millions. Majority of poor people thus got qualified themselves into competition with rich and advantaged sections of the society. R.A Mashelkar (1999) in his Bose-Einstein lecture categorically said that "technology is not value neutral. Certain technical developments are more likely to serve open democratic processes than others which will have a profound impact on global economic and socio and economic political scenario".

The scientific world continued to emerge as follows

a. The poor old man in an 'untouchable colony' is saved by a kind of doctor and his anti-biotic drugs.
b. Infectious diseases are contained by detergents, deodorants, vaccines and inoculations.
c. Surgery was facilitated by anesthesia, air-conditioning and electronic gadgets.
d. Proteins, vitamins and nutritious diet supply

were possible by medical assistance to all the sick and needy.

e. The genetics and DNA studies confirmed that social inequalities are not ratified by scientific discoveries. The blood-groups A, B, AB and O are physiological divisions and have nothing to do with social determinants like caste, creed or colour.

f. The Environmental science born in the last leg of 20th century further advanced the argument of equality of all species, humans, animals, plants and microorganisms as a vital need for ecological balance and sustainability of biodiversity. The science of environment prohibits all dubious discriminations as harmful and hazardous to 'sustainability' of life on the planet. The essence of environmental science transcends all inequalities, propounded by political and philosophical texts and declares as null and void.

Conclusion

The rights of people in the scientific age are guaranteed by material production and not by ideological prediction. T.R. Seshadri, an Indian chemist and a Fellow of Royal Society categorically stated that 'science further provides intellectual pleasure, happiness and efficiency 'equally' by it's application to economic and social life and the persisting ideas of superior and inferior races, colour prejudices and other indignities inflicted on people are demolished. Science came to support this particular truth of unity of man and makes us more ethical than we happened to be before'. So said TRS in his convocation address to Andhra University in 1963, thus summarizing the burden of our discussion. The essence of the paper is represented in the sketch diagram given above.

References and further reading

1. Bernal, J.D., *Science in History*, Vol I to Vol VI., The M.I.T Press, Massachusetts, 1971.
2. Bertrand Russell., The impact of Science on society. Blackie and Son Ltd., Bombay, 1966.
3. Chalam, K.S. and Subbarao C., Science and Civilization., Andhra University, Visakhapatnam, 1997.
4. Chatopadhyaya., D.P. Science and Society in Ancient in India., Research Indian Publication., Calcutta, 1979.
5. Jawaharlal Nehru, On Science and Society, Ed. Baldev Singh., Nehru Museum and Library, 1976.
6. Karl Marx., Thesis on Feurbach, Collected works., Moscow, 1976.
7. Kuhn T.S., The structure of Scientific Revolutions, University of Chicago Press, 1962.
8. Popper, K.P., The logic of Scientific Research, Harper and Row, New York, 1974.
9. Mashelkar, R.A., Science, Technology, Innovation: Their impact on Economic and Political Power, Bose-Einstein Lecture delivered at India International Center, New Delhi, 1999.

■

Excerpts of dialogues with Nobel Laureates, Young Researchers, Policymakers, and Science Communicators

Convergence: The key to creativity in science and communication

Dr. Manoj Kumar Patairiya
Editor, Indian Journal of Science Communication, Technology Bhavan, New Delhi-110016

Lindau Lighthouse at night

Lindau is a small island town in Germany connected by a small passage with the mainland adjoining the beautiful Lake Constance touching the boundaries of 3 European nations – Germany, Switzerland and Austria. Since 1951, this small peaceful town becomes the home of hundreds of young researchers from across the world and dozens of Nobel Laureates for a week every year during summer. The historical Inselhalle, the meeting place, becomes the epicenter of weeklong novel scientific discourses spread over different city-halls, museums, theaters, islands, heritage buildings, grounds, and even hospitals and hotels in and around Lindau.

The Lindau Nobel Laureates' Meetings provide a broad range of programmes and activities that attract not only the international guests but also engage Bavarian populace in a big way. Hotels, restaurants, streets, and markets, all are full of chatty and curious young researchers, who may be speaking different language, wearing different clothing or belonging to different ethnic groups, but one thing is common in them – they have a spark to pursue novel

scientific research in frontier areas of their studies. One can easily identify them from a colourful meeting bag on their shoulders especially designed for the occasion. Every year the meeting is focused on a specific area of science.

The 63rd Lindau Nobel Laureate Meeting was organized during June 30 – July 05, 2013, the focus was on chemistry. Over 600 young researchers from 80 countries and 35 Nobel Laureates attended the meeting. The *Indian Journal of Science Communication* (IJSC) had a chance to have interaction, dialogue and discussion with Nobel Laureates, Young Researchers, Policymakers and Science Communicators. IJSC is able to capture some of the moments, ideas, concepts and excitements from these Noble minds participated in the Lindau meeting; here are some excerpts:

Also publish experiments that you tried and failed!

-Prof. Werner Arber, Nobel Laureate

Prof. Werner Arber talking to Dr. Manoj Kumar Patairiya

Prof. Arber is known for his work in biotechnology as well as he is an authority on "cultural values of scientific knowledge". How do you see the dilemma, on one hand biotechnology is helping in agriculture, and there is a strong conflict over GM crops on the other hand, how do you suggest it can be tackled? Prof. Arber replied: The acquisition of knowledge largely depends on the availability of appropriate research approaches and methodologies. Novel scientific knowledge represents cultural values. On one hand it enriches our world view with impacts on our orientational knowledge. On the other hand, basic scientific knowledge can lead to technological innovations to the benefit of mankind. DNA was discovered as the carrier of genetic information, the double helical nature of DNA molecules was described, the very long DNA molecules became dissected into specific fragments, and such fragments then were spliced into natural gene vectors, which enabled the researchers to obtain sufficient material for structural and functional studies. Biotechnology, including agricultural practices, no longer depends on chance findings in the natural biodiversity.

As a scientist you are playing with organisms, genes, and DNA fragments in the field of biotechnology; how do you think it can help solve the food security problems in the context of developing countries? Prof. Arber said: As we know nature is very complex, what nature occasionally does that's not rule but it contributes to the evolution, genes go on the mutation and that can be within the genetic information of that organism but it can be small piece of genetic information which can come and transferred from one type to another type of organism and just the same strategy is the basis of genetic engineering. You cannot combine half genome of one organism with half genome of other organism, which will never be functional as it cannot give a functional harmony. So any genetically refracted genetic engineering over genetic information will naturally be submitted to natural selection according to Charles Darwin. If the harmony is there it'll grow for long period of time, if the harmony is not sure that organism will not continue to live.

Can this harmony be established with the latest science and technology research approaches? Prof. Arber said: Of course you have to find out whether it works! And I know people were active in this field and they did not get what they expected…and the problem with scientific investigations you usually publish only the positive results…so you forget about the other things. May be some years later some other people may have the same idea and again it may not function but it is not published. So in a way, it might be more appropriate if you can also publish experiments which you tried and get negative results or failed.

That is very important in the present context when we are coming across various issues which

have conflicting dilemmas within scientists and consumers, like GMOs, Genetically Modified (GM) food and people feel there is lot of risk if they are exposed to such products at large, what is your opinion how to tackle and handle these issues? Prof. Arber replies: Often it is based on misunderstanding between the laws of nature and what is really possible to do. Many people think that genetic engineers are like any other engineers who can just construct whatever comes to their mind; this is not true in genetic engineering because as I said the functional harmony of that hybrid organism must be functional to survive!

You have been talking about cultural values and scientific knowledge and there is general perception that the cultural values impact the scientific values as well, and at the same time the scientific values also impact the cultural values, what is your opinion and how you put them together? Prof. Arber says: Well, it is a long kind of basic observation that human beings are curious; they wonder how did I come about here to this beautiful world, what is the basis of my life , how did the habitat come about, it also goes back to the origin of our planet earth, origin of sun, the universe but also origin of life, to which we have some theoretical ideas but not yet have really very solid explanation, so we have to be aware and as a scientist I am in fact quite glad that I see the complexity which I cannot fully explain by all rational thinking, so that gives possibility for future generations of science and I expect that there'll be more insights into the laws of the nature and one can better understand all our environments and that's important to know how do we handle environment which should not destroy it.

Professor Arber you have rightly said that science is rational and at the same time there are interests of many and interests of few, but interests of few take over the interests of many, how do you think science and rational attitude can help solve these issues? Prof. Arber observes: Hope so, yes (laughs)! It's difficult to explain but ok it'll take often some time. Because you know the perception of human beings contributes to understand science but of course some aspects cannot be easily understood by just normal perception. And it means that education is an important part and of course we have to find ways once solidly established knowledge is showing us novel things that usually takes a few generations or let's say a few decades until large part of our population receives it by schools and later on by research cycling and so on!

What do you think about science culture all about and how it can be propagated further? Prof. Arber says: We try to do our best; one can cooperate with politicians, with other… I also think cooperate with belief systems, like religious beliefs and other types of beliefs to influence them and if one is lucky they do accept and well established laws of nature that you can always do if these laws of nature are well proven to them that they are important, the job is done!

Prof. Werner do you think science communication or taking science to masses is important and how do you suggest a scientist should go about it? Answer: Very much so, as I said, of course there is another route once you have scientific knowledge you can think about useful beneficial applications which is a way to shape our future and to shape the future of planet earth, we cannot yet shape and I think we may not be able to shape the future of the whole universe (laughing), but certainly we can shape the future of the earth and therefore I think it needs the co-responsibility of the general public to go in a direction or not to go in a particular direction!

You have well said about the future and scientists are here for shaping the future and lot many young researchers from all across the world are participating in this meeting of Nobel Laureates, what are your expectations from them in the present context? Prof. Arber said: I find it absolutely fantastic to have people from all over the world from all continents here, I expect and I am very sure they'll do so taking some of the messages back home and may amplify it there.

Sometime serendipity has played major role in the growth of science and you have talked about culture and religion, how you combine both of them and what is your opinion about it? Prof. Arber said: Serendipity certainly is an important thing and also certainly in how nature advances, you know I studied molecular mechanism of biological evolution how in the course of long period of time species adapts to changing to living conditions because we have to be aware to not only living organisms evolve but also the living conditions. And it is important to see that it is going hand in hand and actu-

ally one talks nowadays systems biology and I see the life not only one species like human beings but life within big biodiversity as a big system in a big diversity of habitats and the evolution of that steadily proceeding sub-system and it helps us maintain a big biodiversity, may lose some organisms but new more organisms may come up.

What are the new areas of research that you are looking forward the new generation scientists can take up? Prof. Arber says: Well, this is a meeting here in chemistry and I have little bit the ideas that one can also play to increase the attention to rare processes. Rare processes can be new to various barriers in nature that something gets changed and nature I think has fine tune search for life, nature of life, fine tune search that those living beings are among us who have a rarely stable genetic information not on too many mutations but if there would not be any mutation in the genetic information, there would not be any evolution of life. So we have a kind of different feeling, the steps of evolution are slow and we usually think in terms of our children, our grand children and perhaps great grand children, but not further on! I have been told by astrophysicists probably our sun gives us for many millions of years its energy and I hope that in this very huge span of time, a very big biodiversity will be present. I am not sure whether human beings, but if not, other intelligent organisms may or may not come up!

There is no general recipe to become successful, that depends very much on the daily life of the scientists and on the difficulty of the problem in which you work.

Prof. Arber's message to young researchers: O' yes, some time they ask me, but there is no general recipe to become successful, that depends very much on the daily life of the scientists and on the difficulty of the problem in which you work. So it is clear that all scientists may not receive the Nobel Prize but often they contribute same ways to building up as all of us who had the chance to receive the Nobel Prize. Thanks to the past generation of scientists who have furnished the knowledge and build up that knowledge and you go a step further and you make a new insight into how nature works!

Change your mentor if not good!

- *Prof. Richard R. Ernst*, Nobel Laureate

Prof. Richard R. Ernst is known for his work in nuclear magnetic resonance spectroscopy and is deeply interested in Buddhist Arts. He had been to India on several occasions, i.e., more recently for a public lecture on Science for Society at Nehru Science Centre, Mumbai and 99th Indian Science Congress, 2012, KIIT, Bhuvneshwar. Is it convergence in divergence of disciplines that leads to excellence in science or society? Prof. Ernst says: Some observers might think that fierce scientific competition borders on a rat race. The Wikipedia defines: "the rat race is an endless, self-defeating or pointless pursuit; it conjures up the image of the futile efforts of a lab rat trying to escape while running around a maze or in a wheel". Surely this analogy gives a strongly distorted view of research, where both convergence and divergence have value.

How a scientist can develop passion and reach out to public? Prof. Ernst suggests: Nevertheless, we scientists and science educators must ensure that not the slightest pretence of a rat race remains in the image of competitive science. In other words, all human values that are associated with curiosity, wisdom, and creativity shall be preserved and enhanced by research. One of the best means is to

encourage the development of passions in fields as remote to the research subject as ever conceivable. Such project helps balance one's own endeavours and prevents one-sidedness.

How do you combine nuclear magnetic resonance with agriculture, food security, and arts in the context of emerging worldview? Prof. Ernst responds: In my personal case it is nuclear magnetic resonance with its fascinating applications in chemistry, biology, and medicine, contrasted to the mysterious world of Bhddhist paintings that establishes the necessary balance and provides reveling insights into philosophy, psychology, and religion expressed

The rat race is an endless, self-defeating or pointless pursuit; it conjures up the image of the futile efforts of a lab rat trying to escape while running around a maze or in a wheel.

by the beauty of the superb artwork, in both fields, symbolic and metaphoric languages have been developed to describe features that are difficult to express in mathematical formula or in words.

How science of art making and art of science making are similar or different and what has been your experience to them? Prof. Ernst gives own example: It was a surprise to me that science is useful, after all, also for the analysis of the chemical pigments used for painting by methods such as Raman spectroscopy. Pigments contain rich information on painting history and also on the geographical provenience of paintings. It is gratifying to experience how the two ends of the thread match, indeed science and art have much in common.

Your expectations from young researchers? Widen your scope of acceptability by taking up extracurricular activities. Be prepared to change your mentor if not good, as sometime they tend to start competing and creating obstacles rather than supporting! Generally, the crowed goes with mainstream, so do not follow the crowed, find a newer area and pursue it with dedication; and also keep in mind who knows one day big guys will get there too before you reach! Benchmark your work and raise the bar to make a new benchmark and carry on it further to go ahead!

Not only tell what scientist did but also tell the risk involved!

- *Prof. Mario Molina,* Nobel Laureate, Mexico

Prof. Mario Molina is a scientist turned policymaker and politician. Climate change and global warming are the burning issues in today's context; your effort as a scientist to help solve these emerging problems? Prof. Molina says: Climate change represents one of the most serious challenges that society is facing in this century. It is important for humanity to limit its interference with the climate system by profoundly modifying activities such as burning fossil fuels, deforestation, and a change that amounts to having a second industrial revolution. For this purpose it is necessary to communicate to the public and to decision makers in the governments, with clarity and objectivity, the causes, consequences, and solutions to climate change, so that the society implements without much delay the necessary actions to confront the challenge.

Climate change and sustainable development go hand in hand, who pays the cost in case there is a conflict? Prof. Molina explains: Although there remains uncertainties, in our understanding of the science of climate change, such as those connected with the feedback effects of clouds and aerosols, the scientific foundation of problem is very well established, and is based to a large extent on laws of physics and chemistry discovered at the beginning of the 20th century. The average temperature

of earth's surface has increased so far by about 0.8^0 Celsius, and there is a very clear consensus among experts that this increment is a consequence of human activities. Furthermore, it is clear that the risk of causing changes in the climate system with potentially catastrophic consequences increases rapidly if the average surface temperature of the planet increases over 3^0 Celsius.

In the context of extreme weather events, how do you asses or consider the recent Himalayan floods devastating over 0.1 million people in Uttarakhand, a north Indian hill state, would have occurred? Prof. Molina analyzes: Extreme weather events such as heat waves, floods, and droughts have occurred with increased frequency in recent years. An important question is whether there is any connection between such events and climate change. Until few years ago the scientific community stated that there was no statistical evidence to give a positive answer to the question. However, more recently, scientists have published a series of papers indicating that there is indeed a connection. The confusion was due in good measure to the way the question was asked, there is indeed little, if any direct evidence that specific extreme events are caused by climate change; on the other hand, evidence is accumulating that the intensity of many such events has increased recently, and that the probability that this increment is a consequence of climate change is indeed significant. For example, a recent report based on satellite measurements of surface temperature in the northern hemisphere indicate that the probability of occurrence of heat waves, defined as those with temperature departures from the 1950s mean reaching the standard deviation, has increased tens of times in the last 60 years or so; the report attributes the increment to the change in composition of the atmosphere, which is in turn caused by human activity.

What should be the public response towards climate change communications? Prof. Molina points out:

Yet another paper that appeared in the literature recently examined six extreme events that took place in 2011, including the Texas and northern Mexico drought that had sizeable economic consequences, the conclusion being that five of the six events were connected with climate change; the exception, namely flood in Thailand that also had important economic consequences, was not connected with climate change, as the amount of rain in the affected area was not really unusual; the problem was caused by changes in the river basins carried out by society, again a local manmade disturbance! Yet another example of an extreme weather event was Hurricane Sandy, which had devastating consequences in the East coast of United States in 2012. Here again, experts did not try to establish that the hurricane was caused by climate change, but rather investigated if the intensity and other characteristics of the storm were affected by climate change , and concluded that there was indeed a very likely connection. Among other factors, the surface temperature of the oceans affects quite substantially the power of hurricane. The overall conclusion is that climate change poses a threat not only to future generations, but also to our children and to our own generation.

Your advice to climate change communication to scientists, communicators, and policy makers? He suggests: Experts agree as well that a solution to the climate change challenge is indeed feasible, although by no means easy, and it requires implementing many actions simultaneously. These include using energy much more efficiently in the transportation, construction and industrial sectors, as well as reducing emissions of carbon dioxide caused by burning fossil fuels both by utilizing renewable energy sources, such as wind, geothermal and biomass and possible also by developing and using safer nuclear energy power plants. A number of leading environmental economists estimate the cost of such measure as something between 1-3% of global GDP, the most likely number being between 1-2% per year. It is clear that the cost of not taking the necessary measures is larger, considering damage caused by drought, floods, forest fire, intense hurricane, snow avalanches, etc. In addition, it appears that the countries that will be most affected are those with least resources, which makes it imperative for the entire planet to seek an equitable solution to the problem.

Your experiences while being in active research, and being in policy and politics, how you see the future of climate change science? Prof. Molina says: Furthermore, given the uncertainties in an understanding of climate change science and likely future emissions of greenhouse gases, one cannot rule out temperature increments of more than $4\text{-}5^0$ Celsius towards the end of the current century. The

associated risk is unacceptable for society. It is important to clarify, though, that science itself does not tell us what to do; it can only inform us what is likely to happen as a consequence of our activities. It is thus an ethical responsibility for us and for society as a whole to respond to the messages conveyed by climate change science, in order to ensure that the human population can enjoy now and in the future the quality of life at least as good as the one many of us have today.

Science has its own value system that keeps changing!

- *Prof. Dan Shechtman,* Nobel Laureate

Prof. Shechtman has been devoted to crystallography research that has been one of the mature sciences. Prof. Dan Shechtman has been kind enough to have discussion onboard the boat trip from Lindau to Mainau. On a question of the influence of cultural system on the progress of science and whether science research should be for new exploration of nature or finding solutions, and how you see it from cultural perspective, Prof. Shechtman said: Over the years the modern science of crystallography that started by experimenting with x-ray diffraction from crystals and has developed a major paradigm – which all crystals are ordered and periodic, this was the basis for the definition of crystal. A vast number of experimental data, constantly improving research tools and deepening theoretical understanding of the structure of crystalline materials widen our understanding of the atomic order of solids. While believers and nonbelievers were debating a large volume of experiments results of a relentless effort of many groups around the world was seen promising.

There has been a visible impact of science and technology on cultural values, which have changed the cultural systems; can there be a meeting point of scientific values and cultural values, and how will you define it? He says: 20-30% Americans believe in astrology, while science based on honesty has values, universal values, and ethical values too. The nature of science is changing in the light of new evidence. Therefore, science has its own value system that keeps changing from time to time and a scientist has to sense the pace of these changes which many a time remains unnoticed!

On a question of illogical logic, Prof. Shechtman said that science too sometime displays reverse laws when everything is alright but the desired results do not come! As a contrast, sometime you must have seen that serendipity works – you do not expect, but something different appears all of a sudden! So if the nature's behaviors are unpredictable sometime, the man's behaviours also deserve to be illogically logical or logically illogical sometime, as human beings are also part of the same nature that the scientists are trying to understand! Let's hope that the future research would unfold the mystery of these stray and hidden behaviours of nature.

Small communications - big impact!

- *Prof. Rudiger Tiemann,* Head, Empirical Analysis of Teaching-Learning, Humboldt University, Berlin

Prof. Tiemann discussed the empirical analysis involved in teaching and learning process especially in chemistry. Besides his research in chemistry, Prof. Tieman is interested in promotion of research in chemistry education and communication. "We are assessing our pupils for their retention of studies in chemistry classes", says Prof. Tiemann. Such empirical studies are carried out by his group at inter-class as well as intra-class levels amongst the university students.

He believes in small communications – to the point, crisp and brief. "There is a growing tendency amongst researchers to write large papers, bring out big publications and prepare huge theses, but the actual work can be communicated only in a few paragraphs or pages!" Prof. Tiemann then gives example of *"Science Education Review Letters"* that his group has just started. "To avoid the mis-perception of a big journal, we have kept the word – *Letters* – which itself conveys for - small". *Science Education Review Letters* is a peer reviewed electronic journal published by the Humboldt University.

On a question of the current scenario of science education research, Prof. Tiemann told: Over the past decade the field of science education research has matured as the result of numerous researchers investigating many topics, such as, nature of science, teachers' professional knowledge, and students' conceptual understanding. The research has helped foster much theoretical and applied advancement in the field of science education.

How you judge the new research findings for their relevance? Prof. Tiemann replies: The findings are judged according to existing theories and these existing theories are often revised based on new findings, and it marks the progress!

How do you think the short communications can be useful? He answers: Often the majority of today's discussions seemingly limited to conferences, colloquia, and e-mails. Putting them into public domain is important because generally all the good stuff that was discussed and the new ideas emerged out of these valuable interactions are going to be evaporated in due course if not recorded, even a summary or salient points are good enough to recall full discussions.

He further adds: Open discussions are of the utmost importance in research that are particularly concerning to – i) different theoretical approaches, and ii) contradicting results obtained from empirical studies. The goal is to facilitate productive scientific discussions among researchers for the growth of science, and small communication can make big impact!

Focus on scientists to get them comfortable in communication!

- Beatrice Luggar, Joint Scientific Director, National Institute of Science Communication, Germany

Beatrice Lugger's degree in chemistry with a focus on ecological chemistry, curiosity and the joy of communicating knowledge, made it into a science journalist. She completed internships at Süddeutsche *Zeitung* and *Nature*, volunteered in *Political Ecology* and stayed there for a few years as an editor. Since then she has been a freelance science journalist and writes for various German media. She was involved in creating the *netdoktor.de*, and the *ScienceBlogs.de* as Managing Editor and Social Media Manager respectively, and is associated with Lindau Nobel Laureate Meetings for couple of years.

What kind of activities you have undertaken in public communication of science? Beatrice Lugger says: I tried to find that what Germany is doing in the area of science and technology communication. Well, what we are offering since last October to scientists to help them to communicate to public better and more. These courses are meant for writing skills, giving an interview, and preparing them for

talking to the journalists.

Do you have a programme for the journalists also? Beatrice Lugger responds: We are not offering such programme for journalists. Our focus is mainly on the scientists to get them comfortable in communication. We encourage scientists to enter into dialogue to communicate science in the new forms of media.

Generally, the scientists and the journalists feel that it is not their job to communicate science to public and there remains a dilemma over whose cup of tea is it anyway? Beatrice Lugger explores: As I know from my experience, as I have been working as science journalist for 20 years from now, and that is the point why I was interested to work with this institute, and as exactly you say, very often scientists are not prepared to communicate and consider it is the job and business of a journalist to translate what they (scientists) are doing. But that is not the job of the journalist too. The job of the journalist is to investigate, to look behind the scene, to get other opinions, and to combine all of them together.

In case a journalist tries to look behind the scene the scientist can be angry, how will you deal with it? Beatrice Lugger explains: Might be angry, but therefore it is necessary to be well prepared to know that you want exactly to be said, what are your main messages. If you have that focus before you meet someone then you really know as how to interact with a journalist! Then you are saying you are the stakeholder, you must be knowing what should to be transmitted to the public.

We think that there is a need for science communication amongst kids and children, so how you are harnessing this area for science communication in your country? Beatrice Lugger says: Well, that is really a huge topic and we really noticed that the youth are getting it indirectly, the youth are really sitting on Face-book and Twitter, they do not actively or pro-actively use media anymore and so we really have to focus on how we can catch them with pictures, with video, with interactive approaches, and so on!

In the lines of international collaboration in the area of science and technology, do you have any initiative for international collaboration in science communication? Beatrice Lugger informs: Yes, this would be the second step, as I told you we have just started last year, we'll try our level best, though we have so many requests for outside and recently we had been working with the Netherlands and definitely we have to take care for that with other countries as well, so there is huge interest all around and it really makes sense to collaborate with each other.

Beatrice, would you like to highlight any novel science communication activity that you have undertaken recently? Beatrice Lugger says: O' yes, we have a science boat which is actually started in my home place and it is very nice to have some kind of science museum to go from one point to another onboard, it is really good for public.

Science is a social entrepreneurship!

- *Simon Engelke,* Inventor and Entrepreneur

The author with Simon Engelke

Simon Engelke is a student, science communicator and entrepreneur participated in Lindau meeting. Science communication is important, how it is going to help scientists and journalists and how the students can take advantage from both of them? Simon Engelke says: Definitely it is important to communicate and at different levels you need to communicate. At one hand you are communicating to your peers like a scientific discipline you are working in and with other scientists. On other hand you can talk to other partners like the politicians and you may like to talk to people from business, and of course you can talk to the public, especially if you have achieved something great for mankind you need to share it with lot of people the field you are working

in. I think it is important for the collaborations between students and young people who inspire you and you can inspire them, so such partnerships are important and I feel communication is really good thing to achieve that.

We learnt that you are an entrepreneur and a student, so an entrepreneur has to look for profit and society has to look for public interest, so how you cope up with both of them and bring a balance especially in the context the lobby groups and other pressure groups? Simon Engelke replies: I think, for me as everything I do for example is the social business, so everything I do has to have some value out of the money we invest in it because I think that is the key thing that I have fun enough and great enough to have this in what I am working in. I really do not like to make lot of profit for myself. I would like to bring profit for the people I am working with. I feel, yes we need to find a balance there. Of course you need money to do great things, you need lots of investment to create new technology that is really time consuming and money consuming process so there has to be income. On the other hand you have to look for creating something great and also if you want to make profit you need to find the base to paying respect to the people who may like to know the reason where you make the profit, so this is really I try to be very conscious about everything I do and I really bring benefit to the people. So this is my philosophy the science is a social entrepreneurship.

How to do that as far as the social responsibility of corporate is concerned? Simon Engelke suggests: O' Yes, I am quite concerned since beginning and when I was quite young around 15, I started my first publishing house! So already I wanted to share with the artist what I was writing for publication, and now we are collaborating with authors, artists sitting in Berlin and other cities, and the idea is to work together, people work together and become greater, and helping each other, by collaborating, and creating great things together. And more satisfying is that the money issue is not present here. I am also involved in consulting that looks more like going towards money direction, but here also the idea is to invest our efforts with high school students and university students and there also money goes back. So in fact I am not really looking for profit myself and maybe I want to go to science direction because basically I am a scientist, so I have this opinion to become great and do great things.

How the Lindau meeting is going to help you in your endeavours in future? Simon Engelke looks into future: It'll help me a lot because there are so many amazing people and I am meeting many people here every day, it could be a Nobel Laureate, all of them are so open that we see something very special here and I feel they are ready to sharing information, sharing knowledge, so anybody you can approach and nobody was going to say no, I do not want to talk to you! Everyone likes to share his or her story, like this something arouse me a lot, and I can see a lot of interesting people and make lot of connections, so in future we can find lot of new things, new discoveries of each other may be in media, may be in science, it is all about sharing, connecting, it is all about inspiring and this meeting fulfilled everything.

What are your future plans in science and technology communication? Simon Engelke tells: Sure, my next step is, earlier I was in the Netherlands for my studies, now I'll go to California in USA to do research on batteries. At the same time I also want to work to find other people to converge technologies, we try to get players from all of the science, all of the business, and all of the politics, together to tackle this problem, because I think if you want to do something in this direction you have to bring all the players together and this is not just science here, subsidies may be there, you need to know the companies to general market, so this is now I'll keep things up and I'll publish things there, and I think I also work with lot of fun projects and also to inspire young people to join this field, because I feel these are the big challenges for the next step.

Congratulations for starting your business at 15! You must have faced many hurdles and how were you able to cope up with them? Simon Engelke recalls: Yes, you see lot of things that do not work out, but if you keep experimenting, if you see everything you achieve that'll be really great that inspires to keep going that is the right way to go so you must look for new things that work out, if some of the things do not work in the beginning, just be patient things will work out later on, let us always look for opportunities and I think that is the good way to go. I think a Nobel Prize should be a surprise and we shouldn't be working for it! You should do just you love to do and then one day if you do the discovery

it's luck and it's great but I just keep things going.

Seeing their passion you also feel passionate!

- Garima, Young Researcher, India

Are you excited with this very unique kind of conglomerate of scientific events and how it goes here? Garima says: Yes, I am very excited because it's for the first time I am out of my country and to meet so many people from so many different countries who are experts in the field which is a unique opportunity and I simply love it. I have come here to attend the Lindau meeting in chemistry and meeting Nobel laureates and young researchers in my field and till now its great experience.

How do you think you can harness this excitement for your research? Garima replies: So, yes, when you get to meet so many other people and people who are Nobel Laureates, it's not about only the science, it's about how they have come through and their passion because science you can learn from anywhere for example you can just Google and you will know what they are doing. But it is more about passion obviously when you get to know how they work and how they strive in their field you get motivated and seeing their passion you also feel passionate. When you talk to many other people you feel confident that you are working in the right direction and something good for the whole society.

What is your plan to do after going back to India? Garima tells: My plans like I am doing my Ph.D. right now and my immediate plan is to complete my Ph.D. and submit my thesis. Subsequently, I would like to go for postdoctoral research outside India and that is because I want to see how it is outside India because I have been working in India so far. After doing my postdoctoral research I am definitely coming back to India. And then merge all the things that I have learned in my Ph.D. and what I learn in my postdoctoral work and then probably join my own university and would improve what is lacking there, that is my main goal.

What you learnt here in Lindau? Garima reveals: In Lindau, I got to meet so many people and I came to know that there are other areas of research as well. There are many things to be addressed like we had discussion about climate change and it is so important because in India and other developing countries there are issues which are more important you know, rather than the technology and the environment, there are other things which are given more priority there. So, here I came to know that it is not about that but other issues are important, and scientists have their responsibility and we need to tackle these issues. Like there is lot of discussion going on green chemistry, catalysis, climate change, so it is important that we in developing countries also start taking up such issues and start working on them because I think there is lot of research needs to be done in developing countries also. Because it forms a larger chuck of the world and solving problems in the U.S.A. and Europe would not help, it is important that in developing countries also we step forward and do research in these areas which are very important now.

Here we learn dreaming big science!

- Shibdas Banerjee, Young Researcher, India

How did you find your way to attend this meeting? Shibdas says: I came to know about this meeting from an advertisement in DST website and then I applied for it and got this opportunity. Similarly, some 22 young researchers are selected from India and are participating in this meeting.

What is your area of interest and what you want to pursue? Shibdas tells: I work in bio-molecules and enzyme catalysis, as it is going to help in Indian situation as far as crops and food grains are concerned. Actually, I am working in the structural functions relationship of proteins and proteins are the mastermind molecules, so it does everything in our body starting from physiological function to body movements and different mechanisms of our body. I am trying to develop the understanding as how the protein structure is related to its function.

What do you think you'll do after going back to India? Shibdas thinks: On going back to India I am just on the finishing line of my Ph.D. and I submit my thesis and shall go for my postdoctoral research to abroad.

How your work is distinguishable from your fellow students in your university and whether they are going to be benefitted from your Lindau experience on your return? Shibdas explains: I feel the work I am doing on structure-function relationship of proteins is going to help society and the unique work being carried out by my fellows will also contribute to the society. As a matter of fact, everything has a scope for further improvement; this meeting is going on very well.

So what do you feel, you are going to be benefitted from this meeting? Shibdas suggests: So what we are learning here how to dream because we are surrounded with successful dreams once solved the problems of the mankind. So here we are learning to dream big, dream science and develop passion for science and do good science as well.

After this meeting do you have plan to visit some research institutions in Germany? Yes, DST is supporting our visit to other German universities including Max Plank institute, Heidelberg University, Bonn University, Humboldt University, and different other institutions as well; definitely this experience is going to help us in a big way.

Understanding science of risks, crises, and uncertainties!

- *Syed Khalid Yousuf,* Young Researcher, India

As a student, what are your expectations from scientists, media, or policy makers, in the context of science communication? Yousuf says: I think there is a need of synchronizing efforts to popularize science of risks, crises and uncertainties, especially in the remote and border regions prone to such disturbances. The scientists, the media, and the policymakers need to converge in a way so that the appropriate knowledge reaches the common man whosoever is in its need.

What did you learn from this opportunity? Yousuf recounts: It is an eye opener experience for a person like me who belongs to remote part of Jammu & Kashmir and had struggled a lot for even his smallest wish to fulfill. It suggests the quantum, variety, and quality of pure and applied research being done in German institutions; though we are making progress in world class research, yet we have many miles to go and I hope I'll be able to contribute to my bit.

What'll be your contribution to achieve that? Yousuf tells: My efforts are going to be centered on improving the quality of research and education in science after going back. I'll try to transfer my excitement and motivation to fellow researchers in my lab and would work out strategy for Nobel research in the years to come!

Meeting Laureates gives a thrill leading to excellence!

- *Tripti Aggarwal,* Young Researcher, India

How do you feel after getting here amongst "Special 22" and "Special 600"? Tripti says: The DST has provided an opportunity for us to attend this important event and we are able to share our research with rest of the world here and can tell them what we are doing in India. As we are from developing country, it is very good opportunity for all of us to share our knowledge and to share our research with other groups.

So what did you find and how it is going to help you shape your ambition? Tripti thinks: We are still growing and India is doing good research but in European countries the research is very good and they are doing more research than us, so we learn here how we can improve our own research and make it better so that we can reach that level.

Do you think you'll find any clue for our larger problems such as un-potable drinking water, food insecurity, and energy crisis, etc.? Tripti suggests: I attended a discussion that was on energy, today I'll be attending another discussion on communication, and tomorrow we have a discussion on green chemistry, so that we are able to find some answers to our problems of drinking water, energy and so on through green chemistry. It is exciting to meet Nobel laureates and to get knowledge from them.

What are your expectations from this meeting and how far these are being fulfilled? Tripti remembers: I have lot of expectations and wanted to meet so many Nobel Laureates, because I am working on synthesis, and I use many catalysts, so first time I met the Nobel Laureates who gave the names of these catalysts, so I am very happy to be able to meet them and have interaction with them. They also helped me shape my research and pursue my research in right direction.

What is the topic of your research and how it could impact the life a common man? Tripti narrates: The area of my research is synthesizing the poly-heterocyclic molecules, basically the quinoline molecule I am synthesizing. The research would be helpful for drug development for effective cure of malaria.

If we want to communicate your work to a common man, how would you explain? Tripti simplifies: I am basically working on drugs development for treatment of malaria. I am not particularly focusing on those drugs but synthesizing the analogs for those malarial drugs that would eventually help develop the desired drug.

Clear mind and positive attitude pursue good science!

- *Mohammed Afzal,* Researcher, Aligarh Muslim University, India

Afzal what is your area of interest? Afzal says: Well, I am working in the field of metal based drugs for cancer especially platinum and copper based drugs so that we can replace the existing drugs with more effective ones. It's a really very challenging field for the new era.

How did you find the way to join this extremely interesting programme and who supports your visit? Afzal replies: Robert Bosh and AMU helped me join this programme and I am thankful to them. It is very nice platform for exchanging knowledge between brilliant minds and interacting with them. We can have lot many exchange programmes between India and other countries as well.

What do you think in India the students are facing challenges and how your visit is going to help you cope up with these challenges? Afzal feels: They are exploring nature in a natural way. Which is fantastic and definitely it's a great learning from this meeting of minds. They offer lot many newer ideas in the area of green chemistry and blue chemistry; it's an era of blue chemistry from green chemistry, which is very exciting.

Do you think it is important for scientists to communicate to the public? Afzal responds: Of course, it's important as science communication is a must for social diffusion of science and its outreach helps develop a better society. The financial support is the main issue for promoting scientific research in India as it takes longer to get funding and many a times its not available or minimal.

You have raised a very important issue, but it is believed that money can do many things but money alone cannot do everything, rather it is the idea and attitude that make a difference, what is your opinion? Afzal agrees: O' yes, money alone is not sufficient; you need to have right kind of aptitude, inclination and innovative ideas too. If anyone works in clear mind, focus, without jealousy can pursue good science.

Money can do many things but money alone cannot do everything, rather it is the idea and attitude that make a difference.

What is your future ambition in the area of science and technology? After I go back to India and submit my thesis, I'll look for postdoctoral work in Germany or USA. As I am in the field of metal based drug research I'll try to develop new drugs to replace the existing ones, which have some drawbacks.

What are these drawbacks and how you are going to remove them? Afzal proposes: There are many drawbacks of platinum derivative based drugs such as drug resistance and failure of many organs, like kidney and liver, body system. The existing drug can cure at initial stage but carry many inherent problems of toxicity. We are looking into copper and zinc transition metal based drugs.

So, is this meeting going to widen your horizon of understanding and going to give you deeper insights to pursue your research? Indeed, I am grateful to the meeting and cannot express my gratitude in terms of the advantages that I have got by attending it!

We are like a facilitator to bring scientists together!

- *Dr. Torsten Fischer,* Director, German Research Foundation (DFG), India

Dr. Torsten Fischer in conversation with Dr. Manoj Kumar Patairiya

Dr. Torsten Fischer, Director, DFG India is a historian and deeply involved in bringing Indian and German scientists together to contribute to collaborative scientific research areas, not only in Germany but also in India. How DFG works in this direction? Dr. Fisher says: The German Research Foundation has noticed the potential of the Indo-German scientific relationship. We are like a facilitator to bring scientists together. Bringing them together on a product level, helping them to cooperate on a concrete product for couple of years together is what we want to achieve. We want to motivate Germans to come to India, which is an important task, as you need to explain to the German scientific community what can be done. Several initiatives are already underway, if you look at the scientific community in India, there are already many projects going on at interdisciplinary level.

How do you think this togetherness will continue in future to help promote scientific research? Dr. Fisher tells: The young people working together either in Hyderabad or in Berlin will be able to meet each other again and again in the upcoming years.

They will bring together the scientific community in India as well as in Germany. This is one reason why the scientific relationship is so important. It is a win-win situation, the scientists from India and Germany would benefit from this cooperation and the overall population can benefit from this. Here we try to intensify the cooperation coming from the tradition that people of both countries have created. It is important to take into account what politically happens and equally important is what the scientists do. That will help bring the overall relationship forward for the larger mutual interests of people of both countries at large. It is not only scientists and professors are coming to Germany; we want to see Germans also come to India.

How does the DFG framework help cooperation at global and national levels? Dr. Fisher describes: In order to run its day-to-day operations, the DFG maintains a Head Office, which is led by the organisation's Secretary General. The DFG's Head Office, which is headquartered in Bonn, is divided into three departments and an Executive Board. It has its offices in 6 regions/ countries – India, China, Japan, North America, Russia, and Latin America. These offices have branch offices, like we have one in Hyderabad, in addition to headquarter in New Delhi. These offices are governed by the Headquarters in Bonn, Germany; however, the meeting of all 6 leaders also takes place from time to time on policy and functional issues.

What are the major areas of collaboration and cooperation?: Dr. Fisher explains: Innovation, transfer of knowledge, basic research application to industry, basic research project database, newsletter, industrial and technical innovation, etc., are the major areas where we are working with Indian institutions and scientists involving something like 6000 projects in hands. The German House for Research and Innovation is a single window service to all facilities for Indian students to know about education and research prospects in Germany. Some European Union based projects are also there.

Whether any evaluation of the activities was done and what are the important milestones you have come across over the period? Dr. Fisher recounts: The CSIR-National Institute of Science Technology and Development Studies (NISTADS) conducted a study and have brought out a report on Analysis of the Publication Output that gives an increasing trend of Indo-German research publications. Apart from that, joint training programmes for 10+10 Indian and German scientists are also organized from time to time in India and in Germany for mutual understanding of emerging scientific fields.

What kind of projects you are undertaking? Dr. Fisher informs: Interdisciplinary projects are encouraged. IITs and R&D centres are involved in collaborative research with CRCs, and India-Max Plank Group – under basic science exploration globally mural structural bilateral programme - long term and short term. The other activities included are - professional S&T management, curriculum development, funds for public side, SPEYER, mutual benefit- small/ large - India-German core sustainable research. Indo-German Programmes were organized in 6 cities, and India Year was celebrated in Germany in 2013. The German House of Research and Innovation hosted a training group - 15 experts and students, who learnt a lot from Indian faculty, have intercultural exchange, interaction with Indian scientists, undergone a peer review during last week; a joint panel on Glyco-science, and promoting two generation international research. The FHG Society, Bangalore is working on Public-Private-Partnership (PPP) mode.

How you think this cooperation framework is going to help the young researchers to pursue frontline research? Dr. Fisher replies: The scope and significance of the cooperation between German and Indian researchers has increased substantially in the past years. To keep pace with the growing trend it is necessary to increase the awareness of the research environment in the partner countries. The mutual exchange of information on universities, research institutions and funding opportunities will further intensify Indo-German academic and research cooperation.

What is the role of institutional and official cooperation in achieving the objectives of good science? Dr. Fisher says: The DFG Delhi Office, along with its branch in Hyderabad, is striving to achieve this. Apart from coordinating and supporting existing projects, the DFG brings together eminent researchers from both countries with each side complementing each other and thereby creating synergy. The DFG Delhi Office is undertaking these tasks jointly with the Indian partner institutions - the Department of Science and Technology (DST), Indian

National Science Academy (INSA), Department of Biotechnology (DBT), Indian Council for Historical Research (ICHR), and Indian Council for Social Science Research (ICSSR). In addition to its own tasks, the DFG India Office acts as the consortium leader and coordinates the activities of the German House for Research and Innovation.

Do you see newer areas of cooperation for science promotion? Dr. Fisher comes forward: I feel there is a pressing need to develop cooperation in support areas of science research, such as innovation management, science promotion, information processing, and history of emerging aspects of science, etc. I think rather than attempting to creating parallel initiatives, we must focus on complementing each other and synergizing concrete efforts.

Science coming directly from researchers to the people!

- Dr. Monika Sharma**,** Senior Programme Officer, DFG Hyderabad Office

Dr. Monika Sharma is a doctorate from Jawaharlal Nehru University, New Delhi; she served as the Coordinator from German side for the Indian Group of Yong Researchers to Lindau, Germany. What has been your experience while accompanying the group? I found the members of the group are mature enough to take care of themselves, as well as all of them are promising leaders of their area of research and keen to excel in their respective fields. I am happy to see that DST and DFG are nurturing their imaginations and helping them take a step ahead to explore the infinite world of science!

Whether DFG Hyderabad Branch has any specific role to play as compared to its counterpart in New Delhi? Dr. Monika explains: The DFG Hyderabad Office was launched simultaneous to the DFG Delhi Office in November 2006. One of the major tasks of DFG Hyderabad Office is to enhance and intensify Indo-German research activities in the southern region of the country.

How Hyderabad Office promotes scientific activities in the region? Dr. Monika narrates: In the last five years, Hyderabad has seen two International Research Training Groups that have been able to link up universities and institutions from India and Germany. The city has a large German alumni presence in terms of Alexander von Humboldt, DAAD and Max Planck Fellows along with other Germany returnees. To achieve and promote its objective DFG Hyderabad Office works in collaboration with the Goethe-Zentrum Hyderabad which was launched in 2004 and is affiliated to the Goethe-Institute/ Max Muller Bhavan, which promotes German language courses and cultural activities.

Whether you have any plan or activity in the area of communicating science and research to common masses? Dr. Monika tells: We did an interesting experiment. Researchers working on ten extraordinary research projects from a wide variety of disciplines spent three months presenting their work in three-minute shorts. The special thing about these films is that the scientists were also the cameramen, resulting in films that are genuine research diaries. Week by week they tell us about the progress of their work, relate anecdotes about the problems and success stories they encountered and report what they plan to do next. The production of these shorts by the scientists gives a very personal insight into their individual approaches and ways of working. The research work they were doing was on land and under water, for instance in Germany, Ecuador and Cambodia. The cameras that accompanied them give us a first-hand impression of the world of research and the methods used. A window on science! Something new every week! How can you make concrete light? Can a robot learn from humans? And what will life be like in the future in megacities such as Delhi and Dhaka? These shorts present answers to these questions and more on Internet TV.

It seems extremely interesting; how you are able to systematize it as an attractive endeavour? Dr. Monika overwhelmingly says: Each week there was

The collective wisdom of novel researchers goes into action to change the world!

one new episode about each of the research projects, meaning that the shorts also form part of an ongoing story over the course of twelve weeks – keeping you tuned-in to Science TV. On the project page you, the viewer, can also follow the origins and progress of the research work as it develops, to see if there are any new findings, or the different research methods the scientists employ. Week by week the three-minute shorts formed a series, gradually coming together to form a research diary, and anyone interested in finding out more in-depth information about the researchers' day-to-day lives and their work on the projects can do so on the project websites. Do you see it as an effective mode of direct science coming from researchers to the people at large? Dr. Monika smiles: O' yes, the future digital television has taken off. Videos and television content are becoming increasingly popular on the Internet. This offers new ways and opportunities to present complex subjects simply and graphically. In this sense, the first series was a pilot project that picked up on current developments and aimed to use them to enable new and personal insights into the world of science and research. The next series sees an incremental development. We have been at the forefront of a wide array of activities from research and governance to public outreach and social good!

The Lindau meeting is the biggest assemblage of scientific elite of the world. It is an opportunity for the young researchers from across the world to interact with Nobel Laureates without any hesitation or seeking an appointment with them. One can rub shoulders with them and talk to them freely during the Lindau Nobel Laureate Meeting. With support from the Department of Science & Technology, Govt. of India and German Research Foundation, a team of 22 young researchers from India also took part in the meeting from various scientific disciplines, especially from chemistry. The Indian group of young researchers also visited different universities and research institutions in Germany for a week after the Lindau meeting and learnt a variety of things. Like researchers, some academicians and corporates can also participate in the meeting, besides introducing a forum for science-academia-industry as well! The IJSC is grateful for all those young and experienced who could spare their time and joined interesting and illuminating discussions for this interview feature. The dialogue with these Nobel visionaries brings out a wide range of unique and novel insights that would definitely go a long way. The Lindau exposition helps create new generation visionaries; it is not only valuable for the future science and scientists, but also immensely rewarding for current generation science and scientists who look for carving a better world! ■

Indian Journal of Science Communication

An International Half-yearly Research Journal in Science & Technology Communication

A Joint Publication of

National Council for Science & Technology Communication, New Delhi

and Indian Science Communication Society, Lucknow

SUBSCRIPTION FORM

To
The Coordinator
Indian Journal of Science Communication (IJSC)
Indian Science Communication Society (ISCOS)
Chandrika Bhawan, 577-D, Near Dandahiya Masjid
Lucknow - 226 022, India
Email : info@iscos.org, mkp@nic.in

Please enroll me as a subscriber of Indian Journal of Science Communication. I am enclosing herewith a demand draft / cheque No. ..... dated ..... issued in favour of Indian Science Communication Society, payable at Lucknow, India, towards subscription fee as indicated below :

Name.....

Mailing Address .....

.....

.....

Date : ..... Signature : .....

SUBSCRIPTION FEE*

Period	Institutional Indian (₹)	Individual Indian (₹)	Institutional Overseas (US $)	Individual Overseas (US $)
One year	1000	500	50	25
Two years	1500	750	90	45
Three years	2500	1250	140	70
Five years	4000	2000	200	100

* Please indicate : Your category ..... Subscription period .....

* Overseas subscribers can send subscription through Bank Transfer (SWIFT Code SBTRINBBFED payable to "INDIAN SCIENCE COMMUNICATION SOCIETY, Account No. 57023117240" State Bank of Travancore, India) or through International Money Order to ISCOS at the address given above.

Indian Journal of Science Communication

Instructions to Contributors

- The scope of the IJSC encompasses all aspects of Science Communication and Popularisation (SCP); including Public Understanding and Engagement of Science (PUES); Public Communication of Science and Technology (PCST); and Science Technology and Society studies (STS). The communication of 'science' incorporates all its forms, i.e. Science, Technology, Research and Innovation (STRI), including Method of Science, Scientific Temper, and Scientific Culture. The communication of 'science' is inclusive of all basic, applied, and derivative sciences consisting of physical, chemical, biological, health and medical, animal husbandry and agricultural, environmental, space, nuclear, defence, and earth sciences, etc. It excludes contributions on basic and applied sciences and anything bracketed as popular science writing or science education. It also excludes technology development but includes its social and cultural implications and such studies.
- The IJSC invites original research papers, review papers, case studies and other contributions in any aspect of 'science communication' in the form of articles, assessment studies, book and programme reviews, survey reports, guidance and science dissemination project analyses from scientists, scholars, researchers, communicators and authors. Write-ups on science communication skills, innovative ideas to communicate science, cartoons (scientoons), etc., are also welcome. Science software materials, such as books, monographs, copies of TV and radio programmes, science kits and toys, etc., are considered for review, for which two copies may be submitted. News, views, opinions, debates, letters to the editor and suggestions are solicited for inclusion.
- Manuscripts should be submitted in hard copy and electronic form. Good quality printouts (two copies) in the Times New Roman font size 11 point are required. The pages should be numbered. The corresponding author should be identified by an asterix (include E-mail address). Electronic form of the manuscript should be submitted via E-mail and/ or in a CD/ DVD. Text should be entered using word processing software MS Word without any commands, formatting or designing.
- For illustrations, Corel Draw, Harward Graphics or any compatible format software (BMP, GIF, JPG, PCX, TIF) may be used. Label the CD/ DVD with the author(s) name(s), the word processing package used, software for illustrations and the type of computer. The illustrations should preferably be in camera ready form on white drawing paper suitable for reproduction without retouching and about twice the printable size to facilitate reduction. The photographs, charts, graphics and diagrams to be referred as figures(s), should be numbered and the captions be provided on a separate sheet. The figure numbers should be marked on the back of figure with the author's name. In case of photographs, only originals should be provided.
- The authors' photographs along with names and E-mail addresses may be provided for publication.
- The papers should be arranged in the order of - Title, Name(s) of author(s), Affiliation(s), Abstract, Keywords, Main text, Acknowledgements, Appendices, References, and then Footnotes/ Endnotes.
- Each table should be given on a separate sheet of paper and not to be adjusted into main text. Tables should be numbered consecutively and given suitable titles.
- Normally, the abstracts should not exceed 250 and the papers should not exceed 2500 words.
- The number of keywords should be around 5 and be placed in alphabetical order.
- The acknowledgements, if necessary, may include only special nature of assistance; no routine 'permissions' or 'thanks' to be mentioned.
- The references for sources cited in the text should be given at the end of text, numbered consecutively. In the text, the reference should be indicated by a number placed above the line (superscript). If done so, the reference should be listed in that order. If a reference contains more than one author, the names of all the authors should be given. References should be given in the following form:

  1. Patairiya M.K., Nogueira M.I. (ed.), Sharing Science, NCSTC, New Delhi and USP, Sao Paulo, 2011.
  2. Sharma R.D., Communication of science and technology in ancient India, *Indian Journal of Science Communication*, 1(1), pp 3-7, 2002.

  The sources such as unpublished papers and personal communications should also be included in the references in the following form:

  3. Menon P.K.B., Personal communication, 2000.
  4. Das Anamika, Unpublished work, 2002.

- The use of SI units in papers is mandatory. Commonly used units may also be given in parentheses following SI units.
- The national currencies may be converted into US $; the equivalent national currencies be given in parentheses following US $.
- No fee is charged from authors for their contributions for publication in the journal, similarly no remuneration is paid to them for their contributions.
- The IJSC follows zero tolerance policy for research misconduct or unethical practices. It is urged to refrain from plagiarism, copying, or using any material, information, text, visuals or data for your contributions for IJSC without proper permissions and citing references to avoid eventual consequences.
- The lead author or corresponding author is required to put his original signature on the manuscripts and give a certificate, along with the contribution, duly signed stating that: i) The contribution is the original work of the author(s), ii) The contribution has no infringement of the copyright and the necessary permission, if any, has been taken; and ii) The contribution is unpublished and is neither submitted earlier nor will be submitted later for publication elsewhere.
- Since the periodicity of the IJSC is 6 months and even if your contribution is scheduled for the next issue, it may take at least one year for publication!
- The contribution once submitted to IJSC normally cannot be withdrawn.
- Contributions submitted for publication should necessarily conform to these guidelines and while submitting manuscripts, the guidelines become acceptable to the authors.
- All contributions may be sent to:

The Editor
Indian Journal of Science Communication
National Council for Science and Technology Communication (NCSTC)
Department of Science and Technology (DST), Govt. of India
Technology Bhawan, New Mehrauli Road, New Delhi-110 016, India
Phone: +91-11-26537976, Fax: +91-11-26590238
E-mail: mkp@nic.in; editorijsc@gmail.com; Website: www.dst.gov.in

Volume 13 Number 1 January – June 2014 ISSN 0972-429X

SCIENTOON

APRONS

Clothes worn in the Laboratory should offer protection from splashes and spills. Don't wear loose clothes, shorts or mini skirts. Nonflammable and nonporous aprons provide the most satisfactory and the least expensive protection. In Lab, **shoes** should be worn. But not high heeled shoes, open toed shoes.

Bare footed or wearing a sandal in Lab should not be allowed. **Never bring lab aprons in the area where food is consumed.**

"No, No! I am not against the fashion, but this is lab, please don't wear sleeveless apron here"

Carbon Mono Oxide (CO) is a gas produced by the vehicles when complete combustion of petrol does not take place. CO is also responsible for causing accidents on the roads as more concentration of CO in the atmosphere affects our alertness and applying brakes is delayed by a fraction of seconds resulting into an accident.

Encroachment on the roads is also responsible for slowing the vehicles and thus causing more pollution. Therefore, there is a need to educate the people about proper driving and road manners.

"Oh No! Earlier only living things used to come to heaven, but now they all start coming in their vehicles. What will happen here?"

Published and printed by Dr. Manoj Kumar Patairiya for and on behalf of ISCOS, NCSTC, DST, Technology Bhavan, New Delhi-110016, India. Printed at Sonu Printing Press, S-217, Munirka, New Delhi-110067