Manoj K. Patairiya | Maria I. Nogueira
Editors

Sharing Science

India - Brazil Dialogue on Public Communication of Science, Technology, Culture and Society

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242	Add the following text	This article is a reproduction of that published in: Estudos Avançados v.14, p.134, 2000.
330	Maria del Carmen H.M.	Carmem del Sol Ruiz
332	Prof. Ruiz	Remove
332	W.Allemandi	Remove, it is the same as Wilma Allemandi

This topics should be corrected in a new edition.

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India - Brazil Dialogue on Public Communication of Science, Technology, Culture and Society

Editors

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ज्ञान-विज्ञान विमुक्तये

प्रो० वेद प्रकाश

Prof. Ved Prakash
Chairman (I/c)

Preface

Science education and communication carry the inherent value and culture of science and its methods shaping the human thinking, behaviours and actions towards sustainable and inclusive development. It is not only knowledge that empowers people but also an attitude that was emphasized as scientific temper by our first Prime Minister Pandit Jawahar Lal Nehru, which is attributed to be curious, rational and analytical in all walks of our life.

The spirit behind "The Interdisciplinary Symposium on Public Communication of Science, Technology, Culture and Society for Building Brazil–India Knowledge Network" being organized at University of Sao Paulo, Brazil in October 2011, will reinforce the fact that the best combination of scientific knowledge and scientific attitude holds the key for a healthier, balanced, and more humane world order, especially in today's scenario of crises, conflicts and uncertainties.

India and Brazil are two fast growing economies and are attracting the attention of the whole world, developed or developing, east or west, modern or traditional. It is refreshing to note that these two great democracies are joining hands for cooperation in the area of Public Communication of Science & Technology, which I feel is a step forward towards making global scientific citizenship. It also underlines the will and concerns of both the nations to serve the mankind better with collective efforts and wisdom.

I hope that various academic and scientific institutions in both countries will come forward and will open up wholeheartedly to offer opportunities for scholars and experts to promote exchange, learning from each other, experience sharing, and working together in the area of science and technology education and research in general and public communication of science and technology in particular.

I am sure that the symposium will be immensely fruitful for researchers and practitioners of science communication and will pave the way for scholarly interactions in future for further advances in science–society areas.

I congratulate all the participants and organizers on this occasion and wish the symposium a great success.

(Ved Prakash)

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Forward

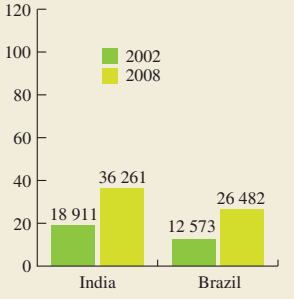
The Interdisciplinary Symposium 'Public Communication of Science, Technology, Culture and Society' is supported by the University of Sao Paulo and FAPESP from Brazil and the National Council for Science & Technology Communication, Department of Science & Technology from India. This is a great opportunity for scientists of the Institute of Biomedical Sciences and colleagues working in the same field in India to interact with each other and find areas of common interest. This is the first initiative to establish an academic and scientific way forward between both countries. Researchers in various fields of knowledge will be discussing partnerships, policies and strategies in research and development in Public Communication of Science & Technology and Culture & Society. I congratulate the organizing committees for the meeting and hope that colleagues will actively participate in the meeting to establish networking for research and collaboration involving the Institute of Biomedical Sciences, University of Sao Paulo and Indian Universities and institutions.

(Rui Curi)
Director, Institute of Biomedical Sciences
University of São Paulo

Editorial:
Diverse Perspectives in Public Appreciation of Science and Technology

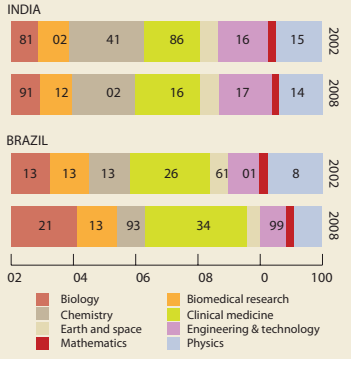
Public communication of scientific research and development is not the job of scientists only; it requires a common ground to be developed by experts from different fields to evolve it truly as an interdisciplinary area of knowledge. Equal participation and contribution of scientists, technologists, communicators, and specialists from socio-cultural sectors will ensure the overall and inclusive growth of the area to serve the mankind better. The field is growing so as the challenges and therefore the field of public communication of science and technology has to be examined and looked at from diverse perspective, i.e, scientific, technological, communication, cultural, and social. Science and technology have no territorial boundaries and similarly science communication is being benefitted largely by enhanced interaction and sharing of knowledge and experiences at global forums as well.

Fig. 1. Scientific Publications in India and Brazil, 2002 and 2008



Brazil and India two fast emerging economies of the world are on move. Science and technology interventions are instruments of accelerating the pace of growth and if it deeper percolates into the society can get more edges to strengthen and build capacities amongst citizens to be able to contribute to the mainstream of development. The plurality and commonality of their needs, concerns and challenges offer opportunities for both the giants to joining hands and synergizing efforts in the area of public communication of science and technology to benefit the people at large. Science communication in both the nations is developing fast may be because of the fact that it keeps pace with the developments taking place in different sectors, such as research and development in leading edge science and technology, agriculture, environment, industry, computers, education, social welfare, mass media, service sectors, and

Fig. 2. Publications by Major Fields of Science in Brazil and India 2002 and 2008 (%)

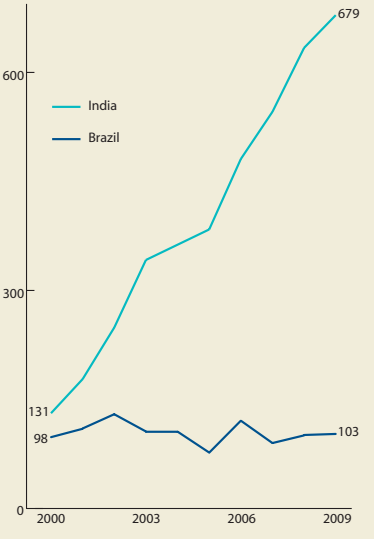


so on. Brazil and India have remained the centres for science and its propagation for a long time in modern world as well. The urge for scientific explorations as well as sharing its excitement with the public has been very common throughout. Similarly, a combination of creativity driven science and media has been able to lay down the foundations of rich science communication culture.

India and Brazil are poised with many challenges, that offer opportunities and possibilities in S&T communication.

A comparative account suggests that Brazil is following the western model of public communication by and large involving "the science museums, planetariums, exhibitions, lectures, audio-video media and high-end technological application" approach. Whereas, in India, "folk forms, Vigyan Jatha, print and visual media, road-shows, and people's involvement" approach proves to be cost effective and fits into social milieu of the country.

Fig. 3. USPTO Patents for Brazilian and Indian Inventors, 2000 and 2009



Another observation has revealed a strong research base and shows very encouraging trends for undertaking innovative research projects in varied areas of public communication by scholars and researchers, as evident from the papers submitted for publication in the present book.

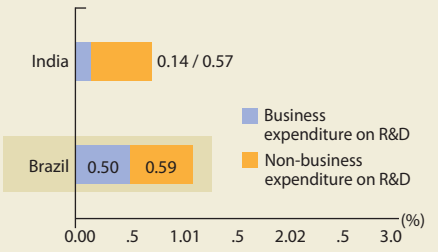
Table 1. Scientific Publications in India 1999-2008

	1999–2003		2004–2008	
	Count	Word share (%)	Count	Word share (%)
Chemistry	21 206	4.42	33 504	5.71
Agricultural sciences	4 303	5.91	5 634	5.65
Materials science	6 960	4.08	11 126	4.81
Pharmacology & toxicology	2 034	2.80	3 866	4.25
Plant & animal science	8 132	3.58	10 190	3.77
Physics	11 700	3.00	17 295	3.7
Engineering	8 101	2.69	14 103	3.57
Geosciences	2 839	2.64	4 266	3.13
Space science	1 322	2.44	1 665	2.79
Microbiology	1 078	1.62	2 273	2.79
Total for the top 10 fields	67 675		103 922	

The PCST conferences offer fabulous opportunity for scholars to learn and share, amongst others, the innovative ideas and best practices from experts from different parts of the world. The 11th PCST-2010 was organized in India last year and the 13th PCST-2014 is scheduled to be organized in Brazil, which is yet another encouraging development.

Moreover, if scientific literacy implies disseminating knowledge of science, its wonders, its scope, its application, etc., then perhaps in Indian and Brazilian context scientific and technological temper has more meaning and relevance. What we would like to see is that our populations at large, develop a scientific outlook rather than being told about facets of science alone that allows informed and logical application of S&T and elimination of superstitions and ignorance. Therefore, more organic approach has taken shape and making inroads.

Fig. 4. GERD/ GDP Ratio in Brazil and India, 2008 (%)

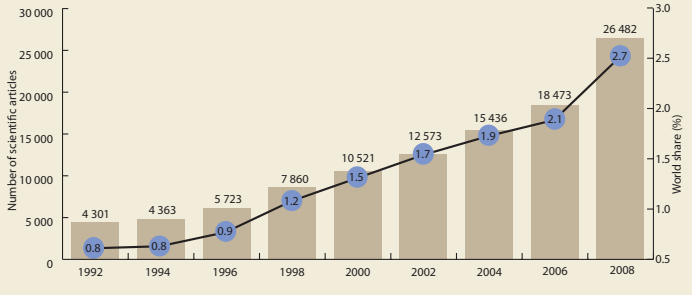


While technology shapes the future, it is people who shape technology and decide what it can and should be used for (Kofi Annan). Curiosity is a little worm that scratches our brain (Rubem Alves). Sometimes we feel that what we do is not more than a drop of water in the ocean, but the ocean would be lower if it" miss a drop of water" (Mother Teresa)

On behalf of the Indian and Brazilian committees and all Brazilian and Indian supporting agencies, we extend our warm welcome to the participants of the symposium at University of Sao Paulo, building knowledge networks through collective declarations, messages and articles in science, technology and culture for public understanding of both countries.

From historical perspective, we wish to say that this initiative of symposium and workshop which comprises the efforts for shaping this collection, was conceived in 2009 at Ahmedabad (Gujarat-India) during a music show projection at the arena of a planetarium, at the down, a sky with plenty of stars, the same

Fig. 5. Scientific Articles by Authors from Brazilian Institutions, 1992 – 2008



sky is widespread all around the world. The inspiration of a path to join and work together became strong at the touching visit to the house where Gandhi was born.

The wheel he used to produce his fabrics still runs in our minds showing paths to integration, keeping identity.

It is auspicious that this unique initiative is beginning in October, the month of Gandhi´s birthday (Mohandas Karamchand Gandhi, 2 October 1869 – 30 January 1948) also named Mahatma, "Great Soul," an honorific first applied to him by Rabindranath Tagore. In synchrony, the Faculty of Human Sciences at USP is working on a Tagore´s Cathedra for this year. Yet, Butantan, the neighborhood where the University of Sao Paulo is located just received the subway yellow line, considered an integrative line in the city, that meets the green line at Paulista Avenue, considered to be the most charming, technological and cultural avenue of Sao Paulo.

Here, we invite all those who are willing for a better and fair world to produce Satyagraha to overcome ignorance by joining this movement of construction of knowledge networks, by involving people through hands, minds, hearts and souls in the direction of sustainability and sovereignty.

The proposed book is a compilation of papers, views and expressions to be presented at the Brazil-India Symposium and Workshop on Public Communication of Science, Technology, Culture and Society being organized at University of Sao Paulo during October 17-24, 2011 marking the beginning of cooperation for sharing science in society. The book is going to be immensely useful for researchers and practitioners of science communication and will pave the way for scholarly discourses and will help bring further advancements in the science – society issues.

We are thankful to the authors who have contributed articles/ papers/ chapters of a varied nature, i.e. research, opinion, review, new ideas, etc., in the area of public communication of science, technology, culture and society and have enriched the publication. We gratefully acknowledge encouraging support and cooperation form the Department of Science & Technology, Govt. of India and University of Sao Paulo or making it happen. On behalf of the Organizing Committees, we welcome all the delegates and wish a comfortable stay to all of them and hope to have thought provoking and fruitful deliberations.

Maria Inês Nogueira
President/ Coordinator,
Organizing Committee, Brazil

Manoj K. Patairiya
President/ Coordinator,
Organizing Committee, India

Source: UNESCO Science Report 2010

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Chapter 1

Powerful Science Communication is an Asset to the Transformation of Societies: Science Leads to Borderless World

A.P.J. Abdulkalam

Purpose of Science

The purpose of science is to understand the nature where we live and continuously we have to give more than what we take from the earth and above all science is intended to improve the quality of life of the people. As it is known, science is linked to technology through applications. Technology is linked to economy and environment. Economy and environment are linked to technology, which promotes prosperity to the society.

Science is very pure in its aims, and science does not know any borders, of either geography, political, linguistic or religious. But, science, has one disadvantage as well ? in division of people between those who know science and those who do not; those who use it and those who do not. The divide, manifests itself in many names, such as, developed and developing nations; economically advanced and economically backwards; and the latest phrase used is; digital divide. This divide caused by imbalances in scientific knowledge has been one of the key factors leading to disharmony across the world including religious or political conflicts, terrorism and civil disobedience.

Fortunately, science also has the potential to remove these imbalances and bring happy and prosperous order in the nations and societies across the world.

One of the recent contributions has been in the field of communication. Communication has advanced so much that we could transfer knowledge from the experts to the least empowered citizen without the concern of distance and time taken. So time is most apt today for the usage of giga-bandwidth and eloquent capabilities of scientist to explain complex concepts with absolute ease to the common man. Today, the communication through print media, electronic media, particularly internet, is almost real time, and presented in various form on the subjects sports, natural disasters, political upheavals. I wonder, why not dais members and the friends who are in front of me, pave the way for real time success stories of science and technology through the fast mechanism available.

The role of science communication is no longer limited by communication bandwidth but the imagination bandwidth of scientists. I have three important tasks for the experts engaged in science communication:

1. To make all citizens, particularly those in remote and rural areas (e.g. India has 700 million rural population) to feel excitement about science.
2. To make all the citizens to know about the advances of science and their role in the society in economic and health development and to bring more and more of fruits of science within the reach of their daily lives while being sensitive to the sustainability of our planet and our responsibility towards it.
3. To motivate the students and entice them to embrace science as a profession.
4. There are many young inventors and imaginative citizens (including from remote rural areas), some times without a formal training, who can be brought to public attention and encouraged.

Science communication profile

Friends, I thought of sharing some experiences with all of you. So far, I have met about eleven million youth below 20 years from various parts of India and abroad. Youth have their dreams, youth have their pain and above all youth have the immense power. I have come across thousands and thousands of questions. Most of the youth are concerned, about what type of India they are going to meet in a decade times. They have questions like "Will I have opportunity to study what I like?" But one thing I noticed, the youth of India?s are excited to know more about vision for the nation and the nation?s standing with reference to other developed world. The youth compares India standing with other countries and draw inspiration when India is very close race to the developed world.

When the visionary Prof. Vikram Sarabhai unfurled the space programme in 1970s, the nation was closely following how the space programme was cheering the hearts of young and experienced. Similarly, atomic energy programme brought proud smiles to millions of Indians. When India achieved its first green revolution and achieved the 230 million tonnes of food grains, the people of the nation gave the ovation to the both farmers and scientists. Of course, the young entrepreneurs entered into IT and communication field which progressed well and brought cheers to the youth of the nation. The science and technology communicators have contributed in a big way for such a happy scene of the nation. I have seen in many children science congresses and conferences, how one of our greatest science communicators, Prof. Yashpal, has been inspiring the youth.

The working in science itself is the greatest award a scientist can dream

Particularly between the age 14 and 17 of students, it is very important to inject the beauty of science, challenge of science and bliss of science when one achieves. As per one of our renowned scientist says "The working in science itself is the

greatest award a scientist can dream", I would like to recall one of the important questions answered by Prof. Yash Pal, which reflects this thought. In his book on "Discovered Questions", I found an interesting answer giving hope to the young for the question "What does it take to be the Nobel prize winner?". He says, "Nobel prize winners are not demi-Gods. But usually they are rather creative people. They are also those who have dared to think thoughts that were not very conventional or fashionable and they are astonishingly hardworking. Work for most of them is not arduous or unpleasant. It is something they just cannot help doing. They often are prisoners of great passion. Though some lobbying might help, usually it is superfluous, even counter productive. Your work must be exposed to the scrutiny of your peers. You cannot get a Nobel prize for doing something great and not telling anyone about it." - What a great message for the young scientist of India and other countries. This message will definitely give the confidence to the Indian scientist that "they can do it". There is also a clear message on the importance of science communication

Experience of mobile science labs in rural schools

I am part of Viksit Bharat Foundation. Let me share an experience. The Viksit Bharat Foundation, Bihar Branch had successfully operated for nearly three months the Mobile Science Lab given by Agastya International Foundation (AIF), Bangalore along with Science Instructors during April-July this year. During this campaign, the mobile lab visited 14 High Schools and 28 middle schools in the flood affected the rural areas of Bihar. This included six Kasturba Gandhi Girl?s middle schools and Project High schools, run by the state government. With the help of this mobile science lab, the scientific knowledge could be made accessible to nearly fifteen thousand students in these schools.

The Mobile Science Laboratory and the team of Science Instructors sent along with it, have become very popular among the school children in rural Bihar. The Mobile Lab van visited schools in remote areas, drawing large attendance in schools. The students of class VII to class X were given instructions with practical lessons in science subjects and taught with the help of models and experiments which made learning exciting. The response from the students was overwhelming. Their attendance in class went up.

Due to physical constraint of class room space in schools, the number of students had to be limited on average to 75. In order to reach the students of lower classes and in larger numbers, science exhibitions were conducted by Science Instructors with participation of a few selected senior class students as trainee instructors on weekend days at some of the schools. The Mobile Science Lab has covered schools in flood prone blocks of Ghanshyampur, Kiratpur and Gora Bauram, Biroul and Benipur in Darbhanga and Madhepur and Tardih Blocks in Madhubani district before onset of monsoon. It has drawn wide coverage in Press as well as appreciation of the local people in Bihar. Already Viksit Bharat

Foundation is progressing to establish a full time mobile science laboratory in the rural areas of Bihar with also the help of Bihar Government.

I would like to inform the science communicators that there are 40 mobile science laboratories established by Agastya International Foundation, Bangalore, are in operation in these two states covering over a lakh of students. The lesson we derive out of this experience is that innovative and student friendly solutions are needed to enable scientific learning in the youth, especially those in rural and remote regions of the nations of the world. Whenever possible, scientific education has to reach to the remotely placed youth and excite them about science.

Missions for science communication

When I am with you, I would like to suggest the following missions for discussion in this Conference.

1. Bringing out a document and may be a website, on the number of science communicators available different regions, nations and states and in different languages. Based on this data, efforts should be made to treble the available science communicators across the length and breadth of the country in multiple languages within the next three years.
2. Like the discovery channel, there is a need to establish science channel through innovative communication methodology. It would cover a vast array of innovations, researches and interesting scientific facts.
3. Promoting systems science education among the youth and experienced for enabling informed debate on public policy leading to development oriented decision making.
4. Generating the content for primary and secondary level science education and putting it up on an open source web based media, which can be available in multiple languages
5. Bringing out at least ten volumes on researched biographical information of scientists from different parts of the world within the next three years. These biographies must pay particular attention to describe the interest and enthusiasm shown by the young scientist in learning and applying science. These stories will motivate the younger generation to take up science as a carrier.
6. Bringing out “Science & Technology Daily” newspaper which can internet based, open source and contributed by the best of the scientific community and written in user friend language.
7. Publishing case studies from experiences like Agasthya International, as to how exposure to imaginative simple experiments increase the broad base of scientific education in the country.

Conclusion

Friends, throughout the world, many advances in S&T are taking place in hundreds. The experts in Science Communication and the experienced scientists who have assembled here, can you collectively ensure that in real time, these great advances find place in print, electronic and internet which can motivate more and more youth to align themselves with such missions. Communication system of the modern age should be a tool to communicate great scientific lives of triumph of scientific minds in the midst of difficult times and overcome the impossible problems.

As you are setting your goals for creating a system of science communication to inspire the younger generation and experienced, I would like to share with you an inspiring message from Maharishi Patanjali in Yoga Sutra an ancient Indian literature:

"When you are inspired by some great purpose, some extraordinary project, all your thoughts break their bounds, your mind transcends limitations, your consciousness expands in every direction, you will find yourself in a new great and wonderful world. Dormant forces, faculties and talents become alive and you discover yourself to be a greater person by far than you ever dreamed yourself to be."

Source: www.abdulkalam.com (Inaugural address at the 11th International Conference on Public Communication of Science and Technology, New Delhi , December 7, 2010).

Chapter 2

Open Access: Major Issues and Global Initiatives

Krishan Lal

Abstract Free availability of scientific data, information and knowledge has played a key role in the phenomenal developments in science. At present, high and ever increasing cost of scientific literature is a major barrier to access to knowledge, particularly in the developing world. A number of initiatives like the Budapest Open Access Initiative, ECHO Charter, Bethesda Statement on Open Access Publishing and Berlin Declaration have emphasized on open access. Studies by the Wellcome Trust have concluded that it should be viable to move towards another system and that system should be more efficient and less expensive. Dissemination of scientific results through Internet and associated digital technologies is cost effective, efficient and beneficial to producers and users of knowledge. CODATA has been actively engaged in propagating open access. Some of its recommendations found place in the Declaration of Principles and Agenda for Action of the World Summit on Information Society (WSIS). In the second and final phase of the Summit at Tunis (November 2005) CODATA presented the viewpoint of scientific stakeholders and a new proposal on Global Information Commons for Science (GICSI). CODATA recommendations were evolved after in-depth deliberations involving scientists and technologists, legal experts and noted economists and with the active participation of organizations like ICSU, UNESCO, ICSTI, INASP, IAP, TWAS and US NAS and collaboration of OECD. Recently, CODATA at the request of GEOSS successfully led the task concerning with practical applications of agreed GEOSS Data Sharing Principles (GEOSS Task DA-06-01)

Keywords *Open access, scientific knowledge, Berlin declaration, ECHO charter,*

Introduction

The phenomenal advancements in all scientific fields in the recent past have transformed the human society. One of the key enabling factors in these amazing

achievements has been the free availability of scientific data and information. In the pre-digital revolution era, the exchange of scientific and technological data, information and knowledge had been exclusively through published literature. The private enterprises with the collaboration of scientific and technical community have played an important role in efficient distribution of latest developments among scientists at global level. However, the costs of the publications have been rising at a very high rate, making access to scientific results restrictive. The developing world is the worst sufferer. At present, even the developed economies are finding it hard to cope with this situation. As a reaction, in many countries due to public pressure scientific results generated through projects funded by public money are coming in open domain. On the other hand the fast rate of developments in the Internet and communication technologies have opened up new efficient and low cost options. The use of world wide web and the associated digital technologies offer opportunities, which have potential to provide low cost efficient options. Already, a huge volume of scientific information is available freely on the web. However, the information and knowledge that has not gone through the proper peer review process is quite injurious to the growth of science and in spreading awareness about science among common people.

Several studies have been carried out to understand the basic issues and possible solutions. Also, several initiatives have been taken at global level to find widely acceptable solutions. There has been a UN Summit on Information Society (2003 and 2005) in which CODATA had presented the views of the scientific community. A new concept evolved by CODATA and several important organizations like UNESCO, ICSU, IAP, TWAS, ICSTI, INASP in the form of Global Information Commons Science Initiative (GICSI) was presented at the Summit Plenary Session in November 2005. This paper reviews these developments.

High cost of published scientific literature and barriers to access scientific knowledge

At present most of the research and development work is carried out in universities, national laboratories or in research establishments of industries or other private organizations. The research papers are prepared by scientists and submitted for publication in appropriate journals. These are subjected to peer review, an exercise carried out by scientists who are experts in that field. These are finally published in the journals. Figure 1 shows the publication cycle. The journals are accessible to researchers and others through libraries, which pay ever-increasing subscriptions to acquire the same. Two groups are involved in the whole process. These are:

Group I comprising of Funding Agencies; R&D laboratories; active scientists, who conduct research, produce scientific literature, are involved in the refereeing process and proof reading; and Libraries; and

Group II Comprising of Publishers and Marketing agencies.

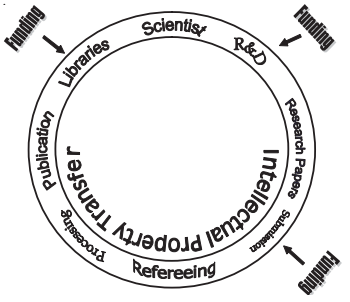

Fig. 1. A schematic diagram depicting the publication of scientific research papers in journals.

It is obvious that there is a one-way transfer of funds from Group I to Group II. The laboratories fund the R&D and scientists create scientific literature by following steps mentioned above and finally their laboratories pay for the final product, in whose production they had played a vital role. The publishers have a legitimate right to recover their costs and make reasonable profit. However, the prohibitive costs of books and journals are raising questions about the level of profits and the technologies of production. Also, the possibilities of new digital technologies for dissemination of scientific literature are being tried globally. Among others the Data Science Journal of CODATA is one such example. The Proceedings of Indian National Science Academy is available on the web and is also available as a hard copy.

In view of the high cost of publication of the scientific literature, in particular, scientific journals, several studies have been conducted to understand as to how the expenses can be controlled. The Wellcome Trust, UK (www.wellcome.ac.uk/publications) has played an important role in this respect. This Trust is a leading bio-medical charity, which spends more than £ 400 million each year for scientific research. The Trust has stressed that as sponsors of R&D they have the right to understand and influence as to how their funds are utilized and in which way, the results of research are disseminated. An Economic and Management Consultancy Company, SQW was engaged to investigate the scientific publishing sector. The report of SQW has provided an in-depth knowledge about the economics of scientific publishing industry and the way in which scientific knowledge is disseminated. This study has shown that the projections of the production cost of printed literature are exaggerated. They have also concluded that sponsors of R&D in non-commercial and non-strategic sectors should ensure that the results of important projects are widely distributed. Therefore, it is necessary to look at alternative methods of dissemination of R&D results with due credit to all the key stakeholders.

The second report of Wellcome Trust is named as Costs and Business Models in Scientific Research (April 2004). In this study it has been concluded that Open Access should be able to deliver high quality peer reviewed research publications

at a cost that is substantially lower than that in the traditional model. It will also be beneficial in other aspects. These reports stressed that Open Access would allow far wider dissemination and much higher impact of the research work. Also, it will reduce the barriers to access of scientific information for researchers all over the world. Such an approach will have significant positive impact on the R&D organizations in the developing world. Several international scientific bodies have also recognized the importance of Internet as an emerging powerful media for dissemination of knowledge. It has led to the Budapest Open Access initiative, ECHO Charter, Bethesda Statement on Open Access Publishing and Berlin Declaration.

Berlin Declaration

The Berlin Declaration spearheaded by the Max Planck Society and signed by over 200 leading organizations including Indian National Science Academy, New Delhi have given a road map for Open Access materials (http://www.zim.mpg.de/openaccess-berlin/ signatories.html). Open Access has been defined as a comprehensive source of knowledge and cultural heritage that has been approved by the scientific community.It covers:

1. Original scientific research results;
2. Raw data and metadata;
3. Source materials;
4. Digital representation of pictorial and graphical materials; and
5. Scholarly multimedia materials.

The authors and right-holders of Open Access contributions have volunteered free world wide right of access as well as have granted license to copy, use, distribute, transmit and display their work publicly. Further works can be derived in any digital media for responsible purposes. However, it is expected that acknowledgement of authorship will be ensured and only a small number of printed copies would be made for personal use.

Open Access contributions including supplementary materials and a copy of the permission in electronics format is deposited in at least one online repository being maintained by an academic institution or scholarly society or a government agency or any other established organization which is committed to the basic principles of Open Access and long term archiving.

The Declaration wishes to find solution that will also improve the existing legal and financial frameworks to be relevant in the new paradigm.

Role of CODATA in supporting and propagating open access

CODATA, the Committee on Data for Science and Technology of the International Council of Science (ICSU) was born at Bombay in 1966 and has its headquarters at 5 rue Auguste Vacquerie, 75016 Paris with its own website–www.codata.

org. CODATA promotes and encourages on a worldwide basis the compilation, evaluation and dissemination of reliable numerical data of importance in all fields of science and technology. It may be emphasized that CODATA is concerned with all types of data resulting from experimental measurements, observations and calculations in every field of science and technology including physical sciences, biology, geology, astronomy, engineering, environmental science, ecology and others. In fact, the fundamental constants of science are released every few years under recommendations of CODATA and are available freely through Internet.

CODATA organizes biennial International Conferences, where topics of relevance to data science and dissemination of data are discussed. The last Conference was held in Beijing in October 2006 and the next Conference will be organized at Kyiv, Ukraine in October 2008. In addition, specialist meetings of experts are also organized from time to time. CODATA brings out a free peer reviewed electronic Data Science Journal, which can be accessed at http://dsj.codataweb.org. For specific activities, CODATA sponsors Task Groups in different fields including one on Fundamental Constants. Specialist groups are also working to tackle the difficult problem of digital divide. Some details are available at the CODATA website.

World Summit for information society

United Nations had organized a World Summit for Information Society (WSIS) in two phases. The first phase was organized in December 2003 at Geneva and the second and final phase was organized in November 2005 at Tunis. The Summit stressed the importance of access to information and knowledge for global welfare. CODATA presented the input of scientific stakeholders for WSIS at Geneva as well as at Tunis. In this effort, CODATA collaborated with ICSU, ICSTI, INASP, UNESCO, IAP and TWAS. For some of the activities, OECD also collaborated. CODATA had organized a Workshop at UNESCO prior to the Geneva phase. 175 countries adopted a landmark Declaration of Principles and Agenda for Action. Paragraph 7 of the Declaration of Principles states that "Science has a central role in the development of the Information Society". Article 10 of the Agenda for Action recognizes the importance of "Access to Information and Knowledge", and Article 23 recognizes the important role of "e-Science".

An International Workshop with ~100 experts from 25 countries having diverse backgrounds ranging from legal expertise to hard core scientific fields and economics deliberated upon ways and means of bringing more and more scientific knowledge and information in the open domain. A new initiative on Global Information Commons for Science (GICSI) was evolved after detailed deliberations at this meeting. The viewpoint of the scientific stakeholders was presented by Professor Shuichi Iwata, President, CODATA at the Plenary Session of the WSIS at Tunis in 2005. Just prior to the Summit, an editorial was published in the prestigious journal Science by Shuichi Iwata and Robert Chen (Iwata, S. &

Chen, R.S. Science and the Digital Divide (editorial). Science, 2005, 310(5747), 405). Professor Iwata stressed that GICSI is a multi-stakeholder undertaking with the following goals:

1. Improved understanding and increased awareness of the societal benefits of easier access to and use of scientific data and information, particularly those resulting from publicly funded research activities;
2. Wider adoption of successful methods and models for providing open availability on a sustainable basis and facilitating reuse of publicly-funded scientific data and information, as well as cooperative sharing of research materials and tools among researchers; and
3. Encouragement and coordination of the efforts of the many stakeholders in the world's diverse scientific community who are engaged in efforts to devise and implement effective means to achieve these objectives, with particular attention to data and knowledge transfer from haves to not-haves, e.g., next generations, nonexperts, developing countries.

CODATA and Geoss Taskon furthering the practical application of data sharing principles

Global Earth Observation System of Systems (GEOSS) had adopted a 10 years implementation plan in early 2005. CODATA was requested to lead the task concerning with practical applications of agreed GEOSS Data Sharing Principles (GEOSS Task DA- 06-01). CODATA constituted a Committee chaired by Dr Paul Uhlir of US National Science Academy. The Committee had prepared a White Paper, which was widely circulated among experts in this field and was finally presented at the GEOSS Ministerial meeting held in Cape Town, South Africa at the end of November 2007. This effort has been well appreciated.

Source: DESIDOC Jl. Lib. & Inf. Technol., 2008, 28(1)

Indian National Science Academy

- Apex body of Indian scientists working in all sectors of science and technology
- Promotes scientific knowledge in India including its practical applications for national welfare
- Coordinates among Scientific Academies, Societies, Institutions, Government Scientific Departments and Services
- Acts as a body of scientists of eminence for the promotion and safeguarding of the interests of scientists in India and to present internationally the scientific work done in the country
- Promotes and maintains liaison between Science and Humanities
- Present Fellowship of the Academy:
- Fellows 744 covering all disciplines of science
- Foreign Fellows 91
- INSA is the adhering body in India to the International Council for Science and its various affiliated Unions/Committees/Commissions, etc
- INSA has scientist exchange programmes with a large number of Academies and similar bodies in different countries
- Academy collaborates with other academies and similar bodies of the world to focus on important issues facing the world like Population

Indian Seminars and Workshops on Open Access

- Two Workshops organized by Indian Academy of Sciences, Bangalore on Open Access Journals March 2002
- INSA Seminar on Open Access to Scientific Data and Information, 27 December 2003, NCL Pune
- Workshops on Open Access by M S Swaminathan Foundation, Chennai, 2-4 and 6-8 May 2004

Phenomenal Growth of Science

- Democracy of intellect
- Free sharing of scientific data and information through scientific journals
- Evaluation of scientists and institutions emphasizes on publications in high impact factor (expensive) journals
- Today most universities find difficult to subscribe to important science journals

S & T a Key Element in Development Strategy

- Governments utilize S&T to solve societal problems of Food Healthcare Environmental protection
- Governments need data for planning and implementing welfare schemes
- R&D projects supported by public funds also generate new data and knowledge Open access becomes an important issue

Open Access to Data and Information

- Scientific data and knowledge are potential tools for wealth generation. These create conflicting interests.
- Laws are being enacted or existing laws are being widened, deepened and redefined to more rigorously the Intellectual Property and neighbouring rights.
- These situations limit the public domain and there is an encroachment of the traditional scientific domain and free availability of data.

INSA Seminar on Open Access to Scientific Data and Information

Main Issues

- IPR issues: global demands, societal concerns and legal angles
- Open Access: Global perspective
- Global Exchange of Meteorological Data: issues and solutions
- Bioinformatics: commercialization of data bases, quality assurance issues
- Quality of Data
- Digital Storage, Publications (journals) and Dissemination: digital libraries, journals, and constraints in developing economies
- Dr. Krishan Lal: Welcome and background to the Seminar highlighting some of the recent international initiatives.
- Prof M.S. Valiathan: Remarks on Key Issues in Open Access
- Dr. R.A. Mashelkar: Inaugural Lecture on Scientific Data & Information: The Developing World Perspective on Access and IP Protection.
- Professor Shuichi Iwata: Basics of Open Access of Scientific Data
- Dr. R.R. Kelkar: Access to Meteorological Data
- Prof. N. Balakrishnan: Digital Library - A million books to the web - Technological Challenges and the Concept of 4C - Consortium for Compensating for Creating Contents.
- Prof. A.S. Kolaskar: Future Trends in Bioinformatics - Open Access
- Prof. R. Kochhar: Collation of Data
- Dr. D.K. Sahu: Open Access in Medical Science: An Indian Perspective
- Dr. S. Arunachalam: Open Access and Increasing Visibility for Developing Country Science.
- Participation: About 150 persons, majority of them were INSA Fellows

INSA Seminar Some Highlights

- There is a global system of free sharing of meteorological data among national meteorology services- introduced in 1970s
- However, weather information is vital for several military operations and therefore these services are under Ministries of Defense in several countries
- Several reputed International organizations have issued statements on free sharing data in the field of environmental science. These include:
- ICSU, IGBP, GCOS, SWCC, SCOSTEP, ISSC, URSI, WOCE, WMO, WDC, IOC, OECD, UNCED.
- Technology Driven Vision for the Universal Digital Library
  - A mission to digitize 1 Million Books and make them freely available
  - To be a leading and contributing partner to world wide efforts in making knowledge free
  - In the Digital Economy- Companies that give more and more software free capitalize more
- Issues Regarding Databases
  - Up-to-date-ness
  - Accuracy
  - Structure of Databases-granularity and open-ended-ness
  - Disappearance

INSA Seminar on Open Access to Scientific Data and Information

- Issues that could not be covered
  - Open Access: perspective of the Government (Department of Science and Technology)
  - A Major Area of Conflicting Scientific, Strategic and Economic Interests: Geo science and engineering

Other Important International Initiatives

- World Summit on Information Society, Geneva 2003, Geneva in 2005
- Symposium organized by five well known international bodies, ICS (ICSU), UNESCO, The US National Academies, CODATA and ICSTI, held at UNESCO premises, March 2003 Discussion on wide ranging topics in view of WSIS

Right to Information Initiative of Some Socially Active Organizations

- A law had been passed by Rajasthan Legislative Assembly granting free access to information on development projects. To improve transparency leading to higher efficiency and lower corruption level

Source: www.insaindia.org

Chapter 3

Science, Communication and Society: The Contribution of Publications on Neuroscience for Scientific Literacy

Roberto Torres Tangoa, Maria Inês Nogueira

Abstract In a time such as this, when information and knowledge play a central role, the communication of science stands out as an important means to foment the expansion and democratization of knowledge in all segments of society and culture, especially in the realms of Health Sciences, Biosciences and Physics, it is a paramount duty of a researcher to talk to the people about his or her work. In a natural partnership with contemporary information and communication technologies, the dissemination of science optimally leverages these tools to help promote literacy and the flow of scientific production. Study results demonstrate that there was intense activity and publications during the time range of the research, and our conclusions and epistemological reflections allowed discussions to take place between experts about issues concerning communication, scientific literacy and social inclusion in Brazil. We have approached the area of neuroscience because we find it an interesting and emerging field of knowledge. The mind-brain dichotomy remains fascinating, and it becomes a new challenge in this new century and new millennium, because, indeed, the frontier of science is represented by neither time nor space, but by the point towards which the mind is directed.

Keywords*:* *Neuroscience and society, social scientific inclusion, public understanding of science, NEC, dissemination and scientific communication.*

It is through science that man tries to see the world and finds answers to many situations and phenomena. Scientific communication is important for science because it enables findings to be widely disseminated. The flow of information involves research and the production of literature. The channels, both formal and informal, provide professional updating and dissemination of information that is important for the development of science in certain cultural and socio-economic contexts, which are ultimately determining factors when considering the intensity of the flow, as well as the dissemination and appropriation of knowledge produced

by a scientist. Science plays an important role in society through a dynamic and continuous search for 'truths' by the use of scientific methods.

This is the context in which we have developed our approach, whereas science communication uses mainly technical and scientific publications to disseminate research results. Meadows (1999) corroborates this hypothesis by stating that "communication is at the heart of science". The flow of information is a process of transferring information from a sender to a receiver. The flow of information in scientific communication encompasses activities related to production, dissemination and the use of information, from the conception of an idea to its explanation and acceptance as part of a universal knowledge.

As we are interested in this theme, our aim is to analyze the bibliographic production and publication of 54 researches, four lines of research that comprise the Center of Neuroscience and Behavior Studies– NEC, USP, which are: Sensory and Motor Systems, Development and Plasticity, Neurotransmitters and Behavior, Human Perception and Expression, during the period of 2000 - 2010, with the purpose of understanding the importance of communication and dissemination of science in society, both for heterogeneous group, pairs or odds.

In order to analyze the results of the volume that was produced, quantitative and qualitative survey of their publications was performed with the use of pictures, charts, tables and statistic interpretation for flow analysis. We used the case study method which facilitated organizing what was being produced, and the contribution of areas of the NEC at that stage. Regarding the theoretical and conceptual framework, specific review of the literature on science and society was carried out in order to supplement the meta-analysis.

The concern about the relationship between individual and society was at the core of sociological reflections of classical thinkers like Marx and Mannheim at the turn of the 19th to the 20th, and also in the early decades of the 20th century. Today, society recognizes that science, technology and innovation are factors that distinguish the social and economic development of countries and regions (Rocha & Ferreira, 2004). In this context, the popularizers of science become important in actions to bridge the gaps between science, government and media to ensure that there is, in fact, dialogue between these groups.

The challenge of acting as an interpreter of the facts of science to the lay public of any age is what is most exciting for those working with the popularization of science. In recent decades, advances in neuroscience have evolved by the availability of new technologies that now enables us see what happens in the brain as we make a decision, meditate, laugh, feel, fear, pray, and so on. These completely new horizons awaken and stimulate the growing interest in knowledge, while developing a broad interdisciplinary

chain of information that benefits the general public. This leads to the ambience in which we face new paradigms of knowledge about the future in the era of information technology (P. Lévy, 2011).

In terms of communication, the scientist can leave his "own" legitimate place in favor of a dialogue with another scientist so as to produce dialogues with other readers that are not scientists. This place is absolutely not to be confused, it needs to be differentiated. The term "popular science" fulfills that role. It introduces another scene, as shown in Authier-Revuz (1998, 107-131).

Undeniably, the adoption of computing resources and the existence of the Internet made possible a remarkable diffusion and a concomitant expansion of opportunities of access to academic literature.

Another aspect emphasized is the inclusion of science in society with the efficient help of new information technologies, and the fact of how these new technological tools can contribute to implement cognitive knowledge, and to outline new user profiles, taking us beyond the linear approach to knowledge imposed by traditional education, opening new areas and methods of teaching and learning collaboratively and interactively. This reinforces trends that consider knowledge today as being scattered in cyberspace, and in order to be inserted one only has to make use of "technologies of intelligence" (Levy, P., 2000) related to the computer, or of "connective intelligence" (Kerckhove, D. 2009) of networks.

Scientific information has been the catalyst for the scientific and technological development of a nation. More than ever, the popularizers of science must help to bridge the gaps that separate the socio-cultural gaps in order to ensure that there is indeed a dialogue between science, government and the media, thus the role of the publisher or science communicator becomes absolutely relevant.

The apparent obviousness of the expression "scientific communication" makes us forget its association with a whole set of ideas and values about science itself: the texts that are associated to it, and the imaginary that differentiates them in terms of legitimacy with respect to the knowledge that they convey and the places where these texts can/ must be circulated.

This approach highlights the role of science communication as an educational tool included in the broader context of public education and endowed with a unique potential to meet the aspirations of a society that is beginning to rebuild its relationship with science and technology. It is construed as a collection of practices in the field of communication, a display of knowledge, values, assumptions, attitudes and languages that surround the production of knowledge.

In general, there are few initiatives that consider the potential of disclosure and propagation of new findings; unfortunately this task is being performed by those with little social integration, but not less important, as interactive science museums, for example. In terms of other forms of mass media, as is the case of television, it has been observed as revealing a somewhat simplified notion of scientific practice/ technology.

What we call scientific publication is the reflection of a restricted mode of knowledge production whose consequence is the formation of a specific reader-effect related to institutionalization, professionalization and legitimization of modern science, that opposes producers and users/ consumers, engendering the figure of the promoter, who would imaginatively restore the split and minimize the tension established throughout history in the social fabric of modernity.

We appreciate the fact that what this study of quantification/ qualification of the work in neuroscience shows in the end is the account to the society of what is being produced in terms of science and technology in research institutions throughout the country.

The holistic approach seeks answers and methodologies that will allow the meeting between science and art with people outside the academy, to leverage interactivity and creativity with the use of *"hands-on", "heart-on", "mind-on" and "social-on science"* that will enhance their human ancestors, as they become a *"homo faber":* the manager of their socio-cultural, scientific and humanistic development.

It should be noted, therefore, as occurs in technologically developed countries, that scientific publications: a) indicate the scientific training and qualification of each country, especially in global comparisons; b) are guaranteed to produce new knowledge, a basic archive that underlies the conception of new patents, as indicated by Narin et al. (1997).

References

Authier-revuz, J. "A encenação da comunicação no discurso da divulgação científica", In *Palavras incertas: as não coincidências do dizer*. Campinas, SP: Editora da unicamp, 1998, p-107-131.

Horgan, John. *O fim da ciência. Uma discussão sobre os limites do conhecimento científico.* CIA. Das Letras, São Paulo, 2006.

International scientific information. ISI. *Products & Services* (online). 2002. (cited 2001 Nov 21). Available from: URL: http://www.isinet.com

Kerckhove, Derrick de. *A pele da cultura. Investigando a nova realidade eletrônica*. Annablume, Ed. São Paulo, 2009.

Lévy, Pierre. *Cibercultura,* trad. Carlos Irineu da Costa. São Paulo: Editora 34, 1999,

Mannheim, Karl. *Sociologia do conhecimento.* Obras escolhidas, editado por Kurt H. Wolff. Berlim, 1964.

Meadows, Arthur Jack. *A comunicação científica*. Brasília: Briquet de Lemos/Livros, 1999.

Morim, Edgar. *Os sete saberes necessários à educação do futuro*. São Paulo - Cortez; Brasília, DF: UNESCO, 2001.

Narin F, Hamilton KS & Olivastro D.. *The increasing linkage between U.S. technology and public science*. Research Policy,1997,26:317-330.

Nonaka, I. & Takeuchi, H. *Criação de conhecimento na empresa: como as empresas japonesas geram a dinâmica da inovação*. Rio de Janeiro: Campus, 1997.

Prigogine, Ilya, *O fim das certezas: tempo, caos e as leis da natureza*, Ed. Unesp, São P. 96.

Rocha, E. M. P. & Ferreira, M. A. T. *Indicadores de ciência, tecnologia e inovação: mensuração dos sistemas de CT e I nos estados brasileiros*. Ciência da Informação, Brasília, 33(3), 61-8., 2004.

Sagan, Carl. O Mundo Assombrado pelos Demônios: a ciência vista como uma vela no escuro, Companhia das Letras, São Paulo, 1996.

Scheler, Max. *Sociologia del saber.* Ed. Revista de occidente, Madrid, 1947.

Seung, S.V. Jain, H. S., and S. C. Turaga. **Machines that learn to segment images: a crucial technology for connectomics. *Curr. Opin. Neurobiol***, Oxford, 2010.

Stocklmayer, Susan M. et al. *Science communication in Theory and Practice.* Kluwer academy publisher, Dordrecht, The Netherlands, 2001.

TARGINO, Maria das Graças. *Comunicação científica: uma revisão de seus elementos básicos*. Informação & Sociedade: Estudos, João Pessoa, v.10, n. 2, p.67-85, 2000.

Yarkoni t, poldrack ra, van essen dC, Wager TD. *Cognitive neuroscience 2.0: building a cumulative science of human brain function.* Trends Cogn Sci, 2010 Nov; 14 (11): 489-96.

Chapter 4

The Creation and the Creator: Experiences from a Functional Neuroanatomy Teaching Course

M.I. Nogueira, W. Allemandi, C.A. Chirosa-Horie, C. Sitamoto, S. Sitamoto

Abstract The adoption of alternative methods of teaching is essential in any educative approach, but they are precious tools when the purpose is to stimulate and awake creativity in students. The innovation we introduced consisted of requesting those groups, formed by three or four students, elaborate two three-dimensional anatomic models; one a general model of the central nervous system and the other specifically related to their area of interest. They should use the knowledge of the theoretical classes and respect anatomical proportions and relationships. Their creativity was encouraged through their choice of the anatomic region or structure of the nervous systems to model. It was required in their selection of the materials to be used too. The materials used were the most diverse; wool, electric strings, wires, wood, nails, hangers, fabric, paper, cardboard, plastic, hand moulded material, gelatine, and glue along with others. The beauty, diversity of form and richness of details enchanted both the experts and laity involved with the subject. The exposition by the students of the models at the end of the course, the exhibitions we performed at different places of the University and at the Science Museum during a special event of VI Exhibition of Material for Science Teaching and Social Inclusion, made us sure of how much the students got in return of their efforts at both: knowledge and self confidence, working as volunteers in extra periods to show their creation to undergraduate and high school students, teachers and general visitors in a clear exercise of "hands-hearts and minds-on" as creators.

Keywords *science teaching, hands on science, creativity in teaching, 3D models, arts & science neuroanatomy.*

Introduction

Teaching in anatomy as well as in related disciplines has been improved with more detailed knowledge of the body, of its macro- and microstructures, and the availability of such new resources as multimedia, computational equipment and programs. The increasing number of publications and events dedicated to the subject confirms this dynamic (1,2). These efforts reflect the dedication and enthusiasm of committed professionals convinced of their ideals, and has thus influenced the conclusion that basic education is as fundamental as is research for the sense of nationhood of a people and country.

Individual efforts have been made to minimize the lack of necessary investment in education, and in both human and material resources (3). The emphasis has been to strengthen pure research and the educational polices of many institutions have served to amplify the imbalance between research and education, especially where the professional has to shine in both activities, and besides administrative tasks as well. Some subjects, like Anatomy, face even additional difficulties (4).

Not only the educators but also the institutions recognize that even though many students have a natural motivation and even excitement at the possibility of handling and exploring anatomic material, still others are apprehensive and concerned about fixatives' smell, appearance of the corpses and presumed health risks. Actually, without proper warn and adherence to necessary security precautions, those risks might indeed become real. On the other hand, the specificity of some school program also promote disappointment to some students not complete aware of their choice Another source of concern might be the presence of this discipline in the first semesters of college, when students are beginning their lives at the university. This period represents for many of them the revealing of challenging possibilities and a traditional independence. These changes taken together with the absence of a direct or indirect tutor might promote concern and distraction. In addition, the students' erroneous impression that learning anatomy is limited to memorizing endless lists of names must be challenged.

In this scenario, goodwill and the right attitude might be decisively significant in overcoming or minimizing difficulties, attracting and getting the students engaged. Willing to try new approaches, we adopted many interactive procedures illustrating the vital compromise between form and function in the body's structures. In tandem with this, we decided to explore the creativity of the students asking them to plan and construct 3D models of the nervous system.

Fig. 1: Collection of the different 3D models of the Central Nervous System produced. The mostly used materials was porcelain Doug (biscuit), strings, plastic tubes, glass bowl filled with gelatine (eye with nerves and muscles).

Material and methods

Students registered in the courses of Speech, Audiology, Physiotherapy and Occupational Therapy, enrolled in our discipline of Neuroanatomy (one semester long) were challenged to be creators.

The innovation we introduced consisted of requesting those groups, formed by three or four students, elaborate two three-dimensional anatomic models; one a general model of the central nervous system and the other specifically related to their area of interest. Their creativity was encouraged through their choice of the anatomic region or structure of the nervous systems to model. It was also required in their selection of the materials to be used. The construction of the model would have to reflect the anatomical and topographical relations and proportions of the human bodies, according to a selected biotype. This proposal aimed to offer an opportunity to the students to apply the knowledge obtained in theoretical lectures and practices, to the task of configuring and constructing the 3D models. This activity, besides demanding attention to the spatial organization of the body, emphasized anatomic and functional differences, intra-specific and gender variability, and also pathologic alterations.

The proposal was received with the usual enthusiasm and receptivity displayed by students. The appraisal of the completed models was scheduled for the end-of-term, through a presentation in front of the whole class, when not only the presentation but also the fulfilment of the required topics and the quality of the model would be considered.

Results

We were positively impressed at the creativity and dedication reflected in the models. The beauty, diversity of form and richness of details enchanted both the experts and laity involved with the subject. The materials used were the most diverse; wool, electric strings, wires, wood, nails, hangers, fabric, paper, cardboard, plastic, hand moulded material, gelatine, glue along with others. For example, among the produced models there were an anatomic brain atlas made with superposition of transparencies, and an animation program of neuroanatomy for PC computer (figures 1-6).

The enthusiasm these models aroused among colleagues from others disciplines encouraged us to prepare the first exposition. In this particular instance we felt attracted by the opportunity to recall and reinforce the following aspects: the history of the anatomy, its social, artistic and scientific importance, but also, specifically to illustrate to the students that: the manifestation of creativity in its various forms is essential to the accomplishment of the continuous exercise of living at the professional and personal activities. This first exhibition was mounted at the library of the Institute of Ciências Biomédicas of the Universidade de Sao Paulo (Brazil), as part of the library's annual commemorations week. An explanatory card with a clarifying text was developed to accompany each model displayed. The written information consisted of the title, the objectives and significance of each model, a list of the materials used as well as the name of the students and their basic specialization. An oversized poster explaining the origins and development of this experience was added to the exhibition as a whole. This poster summarized the history and scientific importance of the anatomy and neurosciences.

Among the many positive comments related to the exhibition, we point out the observation of one professor on the model of the upper member. This model was built up over a wood plate, in which wool strings of different colours and nails were used to represent the contours of the arm, forearm and the hand, depicting their respective innervations in different levels of depth (figure 2A) according to the height of the string as attached to the nail. The professor found very interesting and didactic the resource promoted by this model, because it made so easy to visualize the effects of an anesthetic on a certain area in relation to the point of its injection.

Fig. 2: 3D models of the Nervous system. A. Spinal nerves of the arm represented by strings of wool attached to nails in a wood plate. B. Woman body depicting the central nervous system and at the left side different spinal nerves and respective dermatomes, produced with biscuit and cardboard.

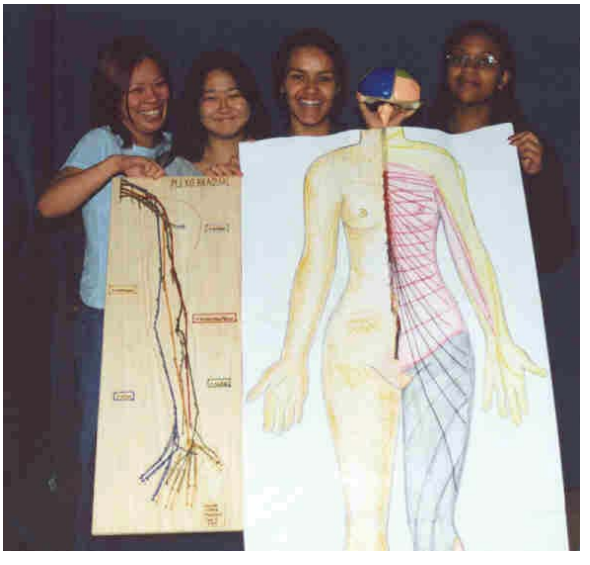

Fig. 3: Afferent nerve fibbers passing through the various levels of the Central nervous system. Strings and cardboard drawings were used.

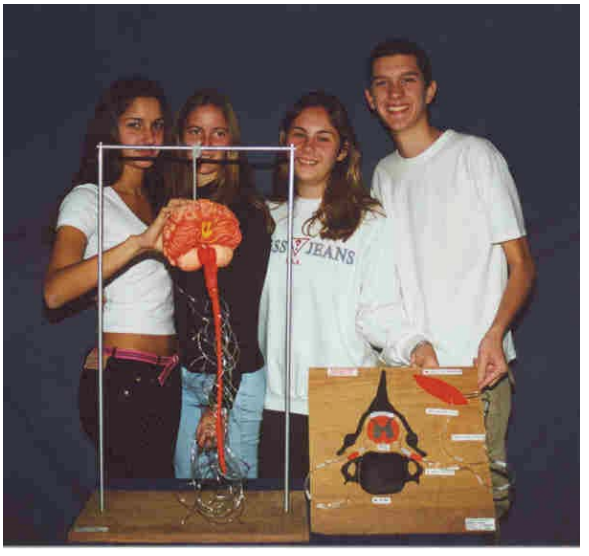

Fig. 4: 3D models of the Nervous system. A. Central nervous system produced with biscuit and plastic tubes hanging in a metallic support. B. Model of a spinal cord inside a vertebra, illustrating a muscle reflex, the same material as model A was used.

The repercussion of the exhibition performed at the library and the enthusiasm of the participants and visitors, encouraged us to register it in the VI Exhibition of Material for Science Teaching and Social Inclusion, a symposium of the Estação Ciência of the Universidade de Sao Paulo, The Science Museum. Once accepted for registration, the models and their explanatory texts and poster were exhibited for five days (figures 7 and 8). Undergraduate students and some of the post graduate students of the Anatomy's program took alternating turns as volunteer monitors to explain the objectives and details of the models.

The low cost, beauty, functionality of the models along their didactic possibilities made a very good impression on teachers and students of the primary and high school levels. A similar exhibition was requested by the Institute of Psychology, Program of Neuroscience, at the beginning of the classes of that year. This last one deserved a special report at the newspaper of the university "Jornal da USP" nominated "Nerves of string". Later, this same exhibition was installed at the Institute Biomedical Sciences to the arriving students in general. Part of it, was also at the internet in the site of the Section Culture and Extension Program, for some time, it was relatively well consulted, and was also reached by the Google site. Most students report at the end of the semester they never had so much fun and leaned so enthusiastically, what was confirmed by their grades which median was 40% higher when compared to the students of the previous course.

Fig. 5: 3D model of the Nervous system inside a plastic doll. A. Dermatomes drawings at the anterior surface and B. inside representation with electric strings of the spinal nerves at the right side of the body attached to the central nervous system made of biscuit.

Fig. 6: 3D model of the muscle spindle reflex, representation with the central nervous system. Strings and biscuit were used and a raincoat hanger.

Fig. 7: Stand with the models at the VI Exhibition of Material for Science Teaching and Social Inclusion "ICB / USP" – Estação Ciência.

Discussion

The knowledge of human anatomy is indispensable to the exercise of professionals in the area of health and physical activities. It requires a basic code, as the alphabet, say, of some basic structures from which others are derived, obeying topographic and functional relationships. This understanding is accomplished with the comprehension of the specific relations pertaining to the different components of the human body (5). Aristoteles (384-322 AD), considered the first comparative anatomist, identified the human being as the most complex animal, recognizing that the diversity of forms results from the variable potential of each organism to explore the environment. Approximately 500 years later the Greek physician, Galeno of Pergamon (living in Rom, second century AD), in recognizing the preponderance of the function over the shape, achieved contributions that lasted for more than 11 centuries, period of the decline of the roman kingdom (6). Thus, these contributions established the influence of the environment and its function on the shape and architecture of the body (6,7). Aspects we planned the students to understand through the constructions of 3D models observing the structural relationships and proportions in the human body.

However, art and science exert a crucial role in awaked creativity that should not be ignored. Which would be the relations among: Anatomy, Art and Science?

Fig. 8: Part of the student team working as volunteer to present the models at the VI Exhibition of Material for Science Teaching and Social Inclusion. At the right we see Prof. E.Hamburger, Director of the Estação Ciência, using glasses, and at the center C.Mattos, Director of events of the same Science Museum.

Let's rescue some history; in the Renaissance, the artists habitually studied the human body in detail, to better reproduce it. According to that movement, art is a creation of the intelligent linkage of conception and observation. Thus art is under the rule of perfection that might be conquered even formulated to be taught with precision (6). A splendid result of genius and rigor of representation of human body is the artistic work of Michelangelo Buonarroti "The Creation of Adam" (part of the ceiling of the Sistine Chapel, at the Saint Peter's Basilica, Rome). A contemporaneous important renovation at the academic-scientific environment was promoted by Andreas Vesalius, physician considered the founder of the modern anatomy. Vesalius, against the principles of the Catholic Church, studied and taught through dissecting corpses. One of his important contributions is the awesome book "De Humani Corporis Fabrica" (1543), illustrating in different planes and positions, the various parts of the human body, which until that time was bare and many times erroneously represented. The title of the exhibitions we performed was a reference to the splendid Michelangelo's work referred to, and the creative process experienced by the students, reaffirming and illustrating the audacious contribution of Vesalius.

At this point, one might be curious about neuronatomy, its origins, the evolution of the nervous system and its role as science. The phylogenetic aspects of the nervous system were considered by Charles Darwin (1809-1882), with his contemporary Thomaz Laycock (1812-1876) referring to the phylogenetic

scale emphasized in the encefalization process the organic basis for the gradual substitution of simple vital process, by the instinct and from this by the mental faculty. The higher complexity of the encephalization is observed in the human being, and it is evident in arts and science as an expression of mental power. The integrated and plastic ability of the nervous system deriving from its hierarchical functioning was identified by Herbert Spencer, 1855, when he established that in the CNS, new structures or layers were superimposed to attend the demand of exploration of diverse environments (6, 7, 8).

Among other considerable landmarks, the origin of the neurosciences is attributed, at the beginning of the XIX century, to the German Ludwig Edinger and to the American brothers Clarence and Charles Herrick, whose works acknowledge that the complexity of the CNS was achieved by the addition of new elements (forebrain) over one basic structure, phylogenetically ancient, related to the vital functions (the brainstem) (6). The end of the century XX presented a considerable evolution in the amount of information related to the nervous system concerning its organization, connections, and mechanisms of action, cognitive and behavioural process, among many other aspects. The years 1990-2000 were nominated "The Brain Decade" due to the amount and the quality of research accomplished (9). Nevertheless, challenges still remain; provoking our minds, depicting that there is much more to be explored.

Working with the students on their feelings and the impression left with "lay people" it became easy to them realize how frequently the acquired knowledge might be classified as banal or trivial. That is, in the workday environment where it was generated; but when considered alongside diverse cultural backgrounds its importance stands out (10, 11).

The student's oral presentations of the results conformed to the usual pattern to their age, with some allowance for inhibitions and undervaluation of their own efforts. However, when reporting to the class the impression made and on their family, friends and whoever had followed the evolution of the work their admiration and interest on the task in progress became evident along with its scientific and clinical implications.

This additional exercise of reflection confirmed the value of the study in light of the different ways of reporting it, in both personal and professional life. An additional interesting gain of this task – again of students producing models based on outside information they had to acquire – was the achieved integration among the disciplines they were taking at that time, whose dynamics involved other teachers, and their disciplines, in questions about the body and the specific subject they choose to represent. For instance, in the building up of a model on the monosynaptic spinal arc reflex, comprising the muscle, its muscular spindles and its different afferent and efferent fibbers, the spinal cord level at the origin of that specific nerve, as well as its dorsal, ventral, ipso- and homolaterals horns, the physiology teachings were linked to the anatomy ones. Impressions registered by other teachers, lecturing those students, confirmed how important

was the adoption of the philosophy of hands- hearts- and minds-on (12,13) since it promotes activation of multiple brain areas therefore making learning, memory consolidation more effective (9,11).

Conclusion

Teaching and learning might represent a simultaneous enjoyable and effective activity. Science and art might coexist, awaking interest and spreading knowledge. Joining different generations; as was the case in this experience seniors and young adults promoted enriched contributions and proved the multidisciplinary nature of the construction of knowledge. Teaching and learning are activities that require dedication, but that also bring rewards, which deserve personal and institutional investments. The generation of this manuscript was stimulated by the belief that a positive experience should be shared, but even more important, it aimed to encourage procedures that grow out of the emphasized aspects of this work – cooperation, creativity and search.

"A teacher affects eternity; he can never tell
where her/his influence stops"
A. Henry Adams.

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References

Chopin, SF. Undergraduate Research experiences: The translation of science education from reading to doing. The Anatomical Record. 269:3-10. 2002

Haines, DE., Hutchins, JB. and Lynch, JC. Medical Neurobiology: Do we teach Neurobiology in a format that is relevant to the clinical setting? The Anatomical Record (New Anat.) 269:99-106. 2002

Duschl, RA, Schweingruber, HA. And Shouse, AW. Taking Science to School: Learning and Teaching Science in Grades K- 8 Committee on Science Learning, Kindergarten through Eighth Grade. 2007

Philips-Conroy, J. The uncertain future of Gross Anatomy. Science, V.300. p. 2031.2003.

Blits, KC. Aristotle: from, function, and comparative anatomy. Anat REc (New Anat.) 257:58-63. 1999.

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Chapter 5

Science Communication as a Preventive Action to Minimize Effects of Anoxia and Promote Social Inclusion

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Abstract Public Science Understanding is crucial to deal with Neonatal oxygen deprivation and the ensuing sequelae. It is a worldwide clinical problem that causes encephalic lesions in human neonates leading to serious and lasting consequences. Therefore, finding a suitable animal model to evaluate neonatal anoxia was our goal in order to address this multidisciplinary study under controlled conditions. The model was developed and validated by various procedures. After that, experiments were performed in control, basal and anoxia groups of neonate rats. The achieved results confirmed that neonatal anoxia in rats promotes long-lasting structural and behavioral effects. Therefore, conscious of the relevance of the neonatal oxygen deprivation in health and social interactions, we organized a course in the National Congress of the Brazilian Society for the Progress of Science. In this activity, the scientific findings were discussed in relation to the need of preventive actions along with mothers and health professionals. Moreover discussions on physical rehabilitation, education, accessibility and social inclusion were also approached. The analysis of the various items explored with the participants of the course, revealed that, in general, even in the academic level, this is a not well-known subject. Therefore, it became clear that to change this picture and offer better quality of life to those who are handicapped, a multi- and interdisciplinary science communication approach, involving various segments of the society, is necessary.

Keywords *science communication, public understanding of science, accessibility, oxygen deprivation, neonatal anoxia, developing brain, social inclusion*

Introduction

The structural and behavioral effects of neonatal anoxia are part of a study in our laboratory, which involves students and collaborators from different institutions. Oxygen deprivation might be experienced in different situations, but it is specially drastic in early life, when the nervous system is developing and the effects might be amplified with outcomes that could lead to lasting damage in motor and behavioral deficits in human newborns, among them are mental retardation, cerebral palsy, epilepsy, hearing and visual deficiencies (Rogalska et al., 2006; Majeed et al., 2007; Chen et al., 2007). Statistics data report that 2-4/1000 full-term infants suffer perinatal asphyxia, however this rate reaches approximately 60% in low-weight premature newborns, configuring an important public health concern (Vannucci, 1997; Laviola et al., 2004).

Therefore, finding a suitable animal model of anoxia was our goal in order to address this multidisciplinary study under controlled conditions, and search for interrelations between particularities of the ensuing sequelae and morph-functional changes. Thus, a model of neonatal anoxia in rats was improved from the literature, which comprises a semi-hermetic system suitable for complete oxygen deprivation. The efficiency of the model was confirmed by pulse oximetric assessment of peripheral arterial oxygen saturation, arterial gasometry, observation of skin color and motor behavior and also by proteins (S100beta and Fos) immunoreactivity analyses (Takada, 2009; Takada et all. 2010). Using this model in basal, control and anoxic groups of neonate rats we could confirm that neurons and glial cells were activated in respiratory neural control areas. Significant differences ($p<0,05$) in the proteins immunoreactivity in glial and neural cells were observed in the hippocampus of the oxygendeprived animals in relation to control groups.

Interesting data were provided by behavioral tests performed with adult animals that suffered neonatal anoxia. Comparisons of the results of those three groups revealed that the animals of the anoxia group presented significant alterations in the following behavioral tests: spatial reference memory; working memory; sensory disturbance and anxiety and, also, acquisition of conditioned fear to sound and context (Ito, 2010).

The mentioned findings were discussed in relation to the background of the research group in science communication, physical and cognitive rehabilitation, accessibility, and social inclusion. Some doubts were raised: at what extent the academic and scientific communities are aware of the causes and mechanisms, and of the needs, of those who experienced neonatal anoxia? Which approaches would they propose to minimize the deficits and to promote physical social inclusion? Therefore, a course was elaborated and presented at the annual meeting of the National Society for the Progress of Science (SBPC- July 2010) in order to address these questions and explore, in a sample, the thoughts and involvement with the subject.

Materials and methods

The proposed workshop was named: Neonatal anoxia: cell and behavioral alterations and its implications in public health, education and socio-cultural inclusion.

Its objective was to explore the comprehension of the problem by the participants, to contribute to a better scientific knowledge of the causes and mechanisms underlying the deficits that ensue neonatal anoxia, as well as to get a sense of their feelings on the situation of those who present disabilities. In addition, it was also aimed to improve the understanding, stimulate interdisciplinary research and the construction of a more fair and conscious society.

The activity was offered to 50 participants of the general community attending the meeting: teachers, graduate and undergraduate students in different academic areas. The program was scheduled for four meetings of two hours, during four days. There were selected subjects that were developed as oral presentations and discussions in groups. A workshop was developed with the attendees in which a participant would simulate visual, auditory or motor disabilities. Also, interactions between his/ her group, as caregivers, would be explored. The topics were:

Day 1: Brain structural alterations due to neonatal anoxia, etiology, animal models and their methods of research.

Day 2: Behavioral effects of neonatal anoxia in animal models and in humans.

Day 3: Relevance of the public understanding of neonatal anoxia, its implications in physical and socio-cultural inclusion and the status of educational accessibility

Day 4: Strategies of interaction between patients and caregivers; expectations and possibilities.

The multidisciplinary group of researchers involved a senior neuroscientist, a physiotherapist and physical education professionals in the doctoral level from the Postgraduation Program in Morph functional Sciences (Biomedical Science Institute), and from the Neuroscience and Behavior Post- Graduation Program (Psychology Institute), a Psychologist (master level) a Linguistic (doctoral level) and a Science Communication Post-Doc researcher.

A previous evaluation was processed to verify the participants' knowledge and also their eventual experience with someone presenting physical and/or behavioral disability. A postcourse evaluation was also done, in order to assess the participants' opinion on the topics approached, by answering some questions and by grading their satisfaction from 1-10. The data were analyzed and the results expressed in percentage of the attributed grade and the number of participants that were involved.

Results

The Congress was held in Natal, a city in the northeast region of the country. Forty-three participants attended the course; they were from various states of

the mentioned region. Their background ranged from physiotherapy, nursing, education and business. The business students came by mistake or accompanying a friend. Among the attendees, four had a son or daughter who suffered from neonatal anoxia and were having troubles to follow rehabilitation due to the distance of the Health Centers. Only 37% had some knowledge on the proposed subjects.

Their interest in the issues approached in the course (table I), was mainly in the consequences of neonatal anoxia, followed by characteristics of anoxia; how to take care of persons with disabilities and in the social inclusion of persons with these conditions.

Table 1 Evaluation of interest in the approached issues

Item	%	Item	%
Consequences of anoxia	33,3	Prevention of anoxia and its consequences	1,9
Characteristics of anoxia	11,7	Activities with disabled children	1,9
Area of health and quality of life	9,8	Adaptations for people with disability	1,9
How to deal with disabled people	9,8	Neonates' conditions	1,9
Inclusion of people with disabilities	9,8	Thematic importance of anoxia to society	1,9
Animal models of research	3,9	Presentation multi-interdisciplinary approach	3,9
Visual impairment	3,9	Dynamics and experience of presenters	3,9

Table 2 Evaluation of knowledge improvement by approached subject

Approached issues	Percentage of participants by attributed grade, n=43						
	3	5	6	7	8	9	10
Neonatal anoxia characterization	-	2,3	-	-	7,0	18,6	72,1
Consequences of oxygen deprivation	-	-	-	2,3	7,0	25,6	65,1

Socio-educational communication policies	-	9,3	-	6,3	9,4	12,5	62,5
Methods to evaluate cognition and behavior	-	4,6	2,2	2,3	21,0	27,9	41,9
Relevance of inclusion of disabled people	-	-	3,1	6,3	25,0	28,1	37,5
Animal models used in research	2,3	2,3	-	7,0	23,3	27,9	37,2

Table 3 Evaluation of the Developed Programme and used methods

Topics	Excellent	Good	Regular	Poor
Lecturer's speech	79,1	20,9	-	-
Workshops	74,4	23,3	2,3	-
Thematic content and discussions	72,1	23,3	4,7	-
Lecturer's experience	69,7	27,9	2,3	-
Movies	39,5	58,1	2,3	-

The participants considered that the course had a relevant contribution on their

comprehension of the topics addressed, attributing themselves grades ranging from 8-10, most of them were graded 10 in the various items (table II). The most relevant topic was the characterization of neonatal anoxia, followed by consequences of oxygen deprivation and socioeducational communication policies.

Most of the participants considered excellent the lecturer's speech, program: schedule and content, and workshops (Table III). The short movies related to disabilities and lack of oxygen were rated as good and excellent.

Discussion

Although, some research reveal that certain achieved results in rats does not apply to humans (Demeter et al. 2008, Sarter, 2006, 2004), by moral and ethical

principles, rats are still a good start to explore causes, consequences and strategies of some issues. The rat is the most widely used animal in experimental studies, due to their easily handling and housing conditions, for what they were chosen in this study. The stage of maturation of a newborn rat brain is comparable to that of a 24-week-old human fetus. A ten-day-old rat's brain is nearly at the developmental stage of a newborn human brain (Nyakas et al., 1996). Therefore, the periods of analysis employed are also an important aspect to take into account when establishing research correlations between these animals and human neonates.

Structural alterations were observed in brain areas of rats which suffered neonatal anoxia, this study is now looking for a better characterization of the phenomena (Takada 2009). Structural studies and behavioral test conducted in adult rats that experienced neonatal anoxia revealed that their performance was low than the ones of the control groups. These data confirmed the presence of the damage promoted in early life with lasting effects (Takada et al, 2010 and Ito, 2010). It was observed that their performance might be greatly improved as they go through repeated learning or training procedures (Ito, 2010). These data emphasize the importance of the frequency of therapy sections to suitable rehabilitation, but the public attending the SBPC- course reported difficulties to keep the frequency of treatment of their children because the rehabilitation centers are too far from their homes and also by the current changes in the schedule for making an appointment at the national health system (SUS- Single Health System).

Brazilian Institute for Geography and Statistics (IBGE – 2009) reports that about 24.000 Brazilians present some kind of severe disability. This rate is increasing, what demonstrates either a better system to report the cases or a worse condition of public health. In spite of very good rehabilitation centers, the difficulty to set an appointment with the sufficient frequency does not help the situation.

Science communication might improve the picture; this is the hypothesis that stimulated the offer of the SBPC-course. Actually, the results confirmed that this problem is not well known by the general public, in any of its aspects: causes, mechanisms, consequences, prevention and rehabilitation. Fortunately, the attendees enjoyed the program and reported the strategies and language as suitable for their comprehension, even by those not related to health area. The students from the business field acknowledged the positive effect of this course in broadening their understanding of disabilities. They now feel enabled to structure offices considering the biodiversity of human conditions Again, the workshop as practice of hands- heartsand minds-on constitutes a useful tool to engage and stimulate participants to work on discoveries of new approaches and solutions to the problem focused (Nogueira et al.,2007, 2008, 2009). The interactions of simulated disabled persons and their caregivers showed that this problem has to be taken into account in all its aspects; the person himself/herself with strengths and weakness, the family, the health systems and both the physicians and therapists,

but also the health centers administration. Moreover, the society comprising the educational, transportation and entertaining sectors should be prepared to shelter those in need.

The major problem in special education is not only physical but mainly social (Vigotsky, 1997). The increasingly isolation of handicapped children from collective experiences and different relationships has to be changed. In Brazil, the law empowers family, school and society committed to a school for everyone. However, in spite of the therapeutic pedagogy (Manton, 2005), the practice does not come well along with the theory. The pronounced difference of these children is just one more piece of data, in the plural and biodiverse universe we live in, emphasizing the essence of human being essence, his-her humanity.

One should ask: how can science communication make difference? The answer is: at all levels! A better understanding of causes/consequences can prepare relatives to look for medical advices when suspecting of problems with the fetus; those dealing with births can be more careful in many instances. The pediatricians should be more attentive at clinical examinations to early detect or correct problems. The comprehension by the disabled person of his/her condition can also help or stimulate to look for rights at all levels, to understand and collaborate in following rehabilitations protocols. Teachers, as multipliers of knowledge, can help the socio-cultural inclusion. Meanwhile society, as a whole, better instructed, might improve quality of life in general, by considering, and not forgetting, that we all, for some period, or at some time, might be disabled to some degree.

In summary, this experience was very positive for bringing closer the course's attendees and experimental research students in the problem; respectively deprivation of oxygen and lack of science communication, with knowledge gain for both. New aspects were brought, concerning disabilities and sociocultural inclusion, to be discussed and worked on, but the relevance of science communication was emphasized in the construction of a better quality of life and a more fair society.

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References

Chen, W. F.; Chang, H.; Wong, C. S.; Huang, L. T.; Yang, C. H.; Yang, S. N. I mpaired expression of postsynaptic density proteins in the hippocampal CA1. region of rats following perinatal hypoxia. Experimental Neurology, v. 204, n. 1, p. 400-410. 2007.

Ito, P.H. Avaliaçao comportamental de ratos submetidos à anóxia neonatal. Dissertação de mestrado apresentada no Programa de Neurociências e Comportamento do Instituto de Psicologia da Universidade de São Paulo. 103 p. 2010.

Laviola, G.; Adriani, W.; Rea, M.; Aloe, L.; Alleva, E. (2004). Social withdrawal, neophobia, and stereotyped behavior in developing rats exposed to neonatal asphyxia. Psychopharmacology, v. 175, n. 2, p. 196-205, 2004.

Majeed, R.; Memon, Y.; Majeed, F.; Shaikh, N. P.; Rajar, U. D.. Risk factors of birth asphyxia. Journal of Ayub Medical College, Abbottabad, v. 19, n. 3, p. 67-71, 2007.

Nogueira, MI; Takeuchi, MY; Perez, CA; Alegrias, RP. Ensino de Ciências no séc XXI. R. Rev. Mundo Jovem v. 8.p 7733, 2007.

Nogueira, MI; Takeuchi, M; Moreira, A C. Santana, A.B.S; Martins, BM. Eloise Silva, E.C.A; Silva, E.S, Ferreira, F.R.M, Manjon, K; Nair, Fiorot; N. Neuza, N.G; Tangoa, R.T. Tamara Dias de Vasconcelos, R.D; and Araújo, T, M. 3D PET DOLL MODELS, Creativity and action in exploring the theme Water and Human Body. International Journal on Hands-on Science (ISSN (print): 1646-8937;and (online): 1646- 8945, 2008.

Nogueira, M.I., W Allemand, Chirosa-Horie, C, Itamoto,B and Itamoto, S The Creation and the Creator: A Rewarding Experience in a Functional Neuroanatomy Teaching Course. International Journal on Hands on Science. 1646- 8937. 83-88, 2009.

Rogalska, J.; Caputa, M.; Wentowska, K.; Nowakowska, A. (). Stress-induced behaviour in adult and old rats: effects of neonatal asphyxia, body temperature and chelation of iron. Journal of Physiology and Pharmacology, v. 57, n. 8, p. 17-34, 2006.

Vannucci, R.C.. Hypoxia-ischemia: Clinical aspects. In: Fanaroff, A. A.; Martin R. J. (Ed.) Neonatal perinatal medicine. 4. ed. Philadelphia: Mosby-Yearbook. p. 877-891, 1997.

Dermeter E., Starter M. Lustig C. Rats and Humans Paying Attention: Cross-Species Task Development for Translational Research. Neuropsychology. Nov;22(6):787-99, 2008.

Mantoan, M.T.E. A Integracao de pessoas com deficiencia. São Paulo: Memnon: Ed. Senac, 1997.

Nogueira, MI ; Takeuchi, M.Y; et al. 3D pet doll models, Creativity and action in exploring the theme Water and Human Body.. International Journal on Hands-on Science (ISSN (print): 1646-8937;and (online): 1646-8945), 2008.

Nogueira, MI; Allemand. W, Chirosa-Horie, C; Suguro, S-C. The Creation and the Creator: A Rewarding Experience in a Functional Neuroanatomy Teaching Course. International Journal on Hands on Science. 1646-8937. 83-88, 2009.

Nyakas, C.; Buwalda, B.; Luiten, P.G.M. (). Hypoxia and Brain Development. Progress in Neurobiology, v. 49, p. 1-51, 1996. Sarter, M. (). Animal cognition: defining the issues. Neuroscience and Biobehavioral Reviews, 7, 645-650, 2004.

Sarter, M. Preclinical research into cognition enhancers. Trends in Pharmacological Sciences, 27, 602-08, 2006.

Vigotsky, Lev S. Obras Escogidas: fundamentos de defectologia, Tomo V. Madrid: Visor, 1997. Takada, S.H. Efeitos da anóxia neonatal no encéfalo de ratos: estudo da distribuição de neurônios imunoreativos a Fos. Dissertação de Mestrado apresentada no programa de pósgraduacao em Ciências Morfofuncionais do Instituto de Ciências Biomédicas da Universidade de São Paulo, 2009.

Takada, SH, Takada, SH; Allemandi, W; Ito, P. H; Takase, L. F. Sampaio, C. A. G and Nogueira, M. I. Animal Model of neonatal anoxia: Development and Efficiency Evaluation by pulse oximetry, arterial gasometry and Fos immunoreactivity. J. Neuroscience methods, resubmitted, 2010.

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Chapter 6

Popularization of Biotechnology: Indian Scenario

Pawas Goswami

Abstract Biotechnology is a multidisciplinary science with several branches such as animal biotechnology, plant biotechnology, microbial biotechnology, etc. In India, several agencies, both at the central and state level are involved to promote science research pertaining to various aspects of biotechnology. Some of the central agencies are Department of Biotechnology, Department of Science and Technology, Central Universities, Indian Council of Agricultural Research, Council of Scientific & Industrial Research, while state level organizations include State Universities and State Agricultural Universities. Apart from conducting research, these agencies are also involved in extension activities for popularization of biotechnology and generating biotechnology based programmes where people are trained in biotechnology packages for income generation. Krishi Vigyan Kendras (KVKs) and non-governmental organizations (NGOs) are involved in this kind of work. India has several science museums/ centres working under National Council of Science Museums. These museums display exhibits related to biotechnology and biotechnological revolutions as well. Several movie shows and mobile exhibitions for popularization of science are also arranged by these organizations from time to time. Indian government is also taking steps for promoting science by programmes such as INSPIRE (Innovation in Science Pursuit for Inspired Research) to target youth and to attract talent towards higher studies in basic sciences. These, organizations such as National Service Scheme (NSS) involving school and university students, with units all over the country working for the awareness of deprived sections of society regarding social reforms can also be roped in for popularization of biotechnology amongst rural/ slum areas. Role of media to increase awareness of science among common people is also very important and cannot be ignored. In India specific programme 'Krishi Darshan' aired on National Television is dedicated to awareness of farmers regarding sustainable agricultural techniques for their benefit.

Biotechnology, in its simplest form can be defined as the use of living organisms by humans. Based on the type of living organisms used, biotechnology is further divided into microbial technology, plant biotechnology and animal biotechnology. Biotechnology is an applied science and encompasses various fields such as molecular biology, genetic engineering, fermentation technology, bioinformatics, etc. It is having immense application in agriculture, medicine and food industry. DNA fingerprinting has been developed as a result of research in molecular biology that finds extensive use in forensics and for settling of paternity claims. An important issue of environmental pollution has also been addressed by using biotechnological approaches to carry out bioremediation. In India, several agencies and institutes are dealing with the key issues and popularization of biotechnology. These include both the governmental and non governmental organizations (NGOs).

Department of Biotechnology

The Department of Biotechnology (DBT) was started under the Ministry of Science and Technology in 1986. The department has made significant achievements in the growth and application of biotechnology in the broad areas of agriculture, health care, animal sciences, environment and industry. Apart from funding hardcore research programmes and developing various guidelines on regulatory issues, etc., DBT supports programmes for societal development by implementing various community based projects intended to benefit a large number of target population of farmers, women and scheduled castes (SC)/ scheduled tribes (ST) through skill development with various interventions of agro-based, horticulture, animal husbandry and value based product and process development through training and demonstration programmes undertaken in various income and employment generation activities. In last few years programmes based on sericulture, vermin-composting, mushroom cultivation, aquaculture, apiculture, post harvest management, piggery development, goat rearing, poultry farming, livestock development, banana cultivation, turkey farming, rabbit rearing, floriculture have been carried out that benefited the targeted population by disseminating new knowledge or by enhancing the existing knowledge and methods by scientific approach to increase the output. DBT also takes part in various exhibitions and events and supports national and international seminars/ conferences for popularization of biotechnology. The DBT has a popular programme for organization of popular lecture series on emerging areas of biotechnology across the country.

Department of Science and Technology

Department of Science and Technology (DST) was established in 1971for promoting new areas of science and technology and to play the role of a nodal department for organizing, coordinating and promoting S&T activities in India.

Popularization of science and technology is one of the important mandates of the department. National Council for Science and Technology Communication (NCSTC) is an apex body under DST which focuses on communication of science and technology and stimulation of scientific temper. Important partners of NCSTC are government ministries and departments, universities and academic institutions, research laboratories, science and technology councils in states and union territories and Prasar Bharati that includes All India Radio and Doordarshan. One of the major programme partnered by NCSTC along with Max Plank Society, Germany, Vikram A. Sarabhai Community Science Centre, Indian Railways, etc is 'Science Express', a unique 16 coach custom built AC train showcasing a state-of-the-art Indo-German science exhibition. The exhibits have primarily been developed by several Nobel laureates from Max Plank Society, Germany. Two coaches of Science Express were devoted to the exhibits from Life Science i.e. building blocks of life and from gene to organism. The train exhibition also have Joy of Science lab where students can perform various experiments. NCSTC has may programmes such as celebration of National Science Day, Initiative in Research and Innovation in Science (IRIS), Science behind Miracles, mobile planetariums, etc. NCSTC also designs training modules for resource teachers such as those on microbiology, vermin-composting, etc.

Vigyan Prasar (VP) is yet another autonomous organization established in 1989 under DST which takes up large scale science popularization tasks to promote and propagate scientific and rational outlook and to act as a resource-cum-facility centre for S&T communication.

Indian Council of Agricultural Research

Indian Council of Agricultural Research (ICAR) is the apex body for coordinating, guiding and managing research and education in agriculture including horticulture, fisheries and animal sciences. With 97 institutes and 47 agricultural universities spread across the country, this is one of the largest national agricultural research systems in the world. ICAR has a strong element of extension and training activities for farmers and weaker sections of society, especially through Krishi Vigyan Kendras (KVKs) spread over 567 places in the country. KVKs are involved in setting up of exhibitions. KVK at National Dairy Research Institute (NDRI), a premier ICAR institute in the field of dairying routinely carries out trainings and exhibitions on various aspects of dairying including tests for milk adulteration, animal health camps, dairy meals, etc. Various radio talks are delivered by the resource persons on vermin-composting, crop production and other aspects from time to time. NDRI has produced a documentary titled 'NDRI at a Glance', including NDRI songs popularizing their activities. NDRI publishes a magazine *'Dairy News'*.

National Council of Science Museums

National Council of Science Museums (NCSM) is the largest network under a single administrative umbrella in the world having 27 science museums/ centres and science city displaying galleries and exhibits on various aspects of science. One of the important objectives of the council is to popularize science and technology in cities, urban and rural areas for benefit of students and for common man by organizing exhibitions, seminars, popular lectures, and science camps. Birla Industrial and technological Museum, Kolkata is having a gallery dedicated to biotechnology revolution.

Conclusion

In India several government agencies are working for the popularization of biotechnology. Apart from these, several non governmental organizations and voluntary efforts such as National Service Scheme, etc., work in the social spheres in rural and slum areas.

References

Annual Report (2010-11). Department of Science and Technology. Ministry of Science and Technology. India

Annual Report (2009-10). Department of Biotechnology. Ministry of Science and Technology. India

Annual Report (2009-10). National Dairy Research Institute, Karnal, India.

http://dbtindia.nic.in

http://www.dst.gov.in

http://ncsm.gov.in

http://vigyanprasar.gov.in

GZ-RAIS

Technological Perspective

EOZEM-OS

Chapter 7

E-Governance: A Digital Pathway for Science and Societal Communication

Pramod K. Verma

Introduction

The modern age of globalization is witnessing the electronic dependence and utilization of data especially by the people turning into one of the driving forces towards socio-economic growth and development. The scenario that is emerging may not be significant to developed economies, but it could be an important area of focus for emerging economies, like India in various sectors, i.e. education, governance, commerce, and so on. Since, India has emerged as an ICT hub in the world, it is imperative to consider the e-governance and the related issues for analysis.

Definition: "E-Governance is a procedural approach in which the Government and its citizens, businesses, and other arms of government are able to transact their activities using Information and Communication Technology (ICT) tools. It is an emerging field, facing various implementation problems related to technology, employees, flexibility and change related issues."

"E-governance is the application of ICT to transform the efficiency, efficacy, transparency and accountability of informational and transactional exchanges within government, between government and its agencies of National, State, Municipal & Local levels, citizen and businesses, to empower citizens through access and use of information."

E-governance has evolved as a model of governance in present information-age. It is the application of Information and Communication Technologies in the processes of Government interaction with citizens and business as well as in government's internal operations with the objective to ensure the highest standard of services to the citizens by providing instant access to selected Government information, and interfaces for communicating with the various government functionaries, wherever and whenever they need it. The Stakeholders in e-governance are the Government, Investors, Employees, Vendors and Intermediaries, and Citizens. Various environment variables exerting an impact upon implementation of e-governance are Social, Political, Legal and Economic variables. E-governance is the process of service delivery and information

dissemination to citizens using electronic means providing the following benefits over the conventional system (Jayaradha and Shanthakumar, 2003):

- Increased efficiency in various Governmental processes,
- Transparency and anticorruption in all transactions
- Empowerment of citizens and encouragement of their participation in governance.

Scope of e-governance

E-Governance is the use of information and communication technologies to support better governance. It has the following main dimensions;

Government to Citizen (G2C): G2C aims at connecting citizens to government by talking to citizens and supporting accountability, by listening to citizens and supporting democracy, and by improving public services. It will involve better services to the citizens through single point delivery mechanism and will involve areas like.

E-Citizen: Under e-citizen integrated service centres will be created. The purpose of these centres will be to take over the various customer services in due course. It will offer services, like issue of Certificates, Ration Cards, Passports, Payment of Bills and taxes, etc. These centres will become one-stop Government Shops for delivery of all services.

E-Transport: The transport aspects that can be easily e-governed include: Registration of motor vehicles, Issue of driving licenses, Issue of plying permissions, Tax and fee collection through cash and bank challan, and Control of pollution.

E-Medicine: It will involve linking of various hospitals in different parts of the country and provide better medical services and information to the citizen.

E-Education: E-Education will constitute various initiatives of educating the citizens with ICTs.

E-Registration: E-Governing the registration and transfer of the properties and stamp duty to be paid thereon will bring substantial reduction of paper work and reduce the duplicate entries. Further, the transparency in work will increase and the overall time of process registration will reduce.

Consumer to Government (C2G): C2G will mainly constitute the areas where the citizen interacts with the Government. It will include areas like election when citizens vote for the Government; Census where he provides information about himself to the Government; taxation where he is paying taxes to the Government.

E-Democracy: The e-democracy is an effort to change the role of citizen from passive information giving to active citizen involvement. In an e-democracy the Government will be informing the citizen, representing the citizen, encouraging the citizen to vote, consulting the citizen and engaging the citizen in the Governance. Taking the citizens input about the various government policies by organizing an e-debate will further strengthen the e-democracy. The concept of

e-debate is similar to chat over the Internet, wherein not only the citizens but also the political leaders contesting the elections participate. The citizens give their feedback about the various policies of the parties and particularly the manifesto of the party. The initiative will further strengthen the process by enhancing the representative role, improving accessibility of citizens to their elected members and developing the capacity of elected representatives to engage in e-government. Elected members will also be provided with access to the local authority's Intranet and e-mail systems so that they become available online for decision making and people can easily access them.

Government to Government (G2G): This can also be referred as **E-Administration:** It involves improving government processes by cutting costs, by managing performance, by making strategic connections within government, and by creating empowerment. It will involve networking all Government offices so as to produce synergy among them. The major areas are:

E-Secretariat: Secretariat which is the seat of power has a lot of valuable information regarding the functioning of the State. The cross-linking of various departments and exchange of information amongst various components will simplify the process of Governance.

E-Police: E-Police will help to built citizen confidence. There will be two databases. One of police personnel and the other of criminals. The database of personnel will have the records of their current and previous postings. This will help to track policemen specialized in certain geographical regions and skills. For example; we want to look for a forensic expert. The database within seconds gives the list of all forensic experts. The same database will give the track of their details like service record, family background etc which will also be helpful in intelligent posting and promotion of personnel. The second database will be of criminals. This database has to be upgraded to national database for its total utility. By just typing the name of a criminal a police officer will be able to know the details of his past activities, including his modus operandi and the area of operation. Further a database like this will help tap the criminals easily for all the police stations will have simultaneous access to their record. The module will also include G2C activities like online filing of FIR's, finding the case status of an FIR. Creating a database of Lost and Found can assist further lost and found of valuables and individuals.

E-Court: The pending court cases in India has brought the legal system to a halt. Not only are the consumers asking for changes in the administration, but also the system will collapse if it continues in this manner. IT can transform the system and bring in the court cases to a level of zero dependency. Creating a database of cases can do the same. In fact such a system will help to avoid all the appeals to High Courts and Supreme Court, for the Judges can consider the appeals from an intranet wherein the case remains in the same district court but the Higher Court gives their decision online based on the recorded facts of the case. Such a step will not only help the citizens but will also reduce the backlog of cases. Further

the use of IT in the areas like recording of court proceedings, high resolution remote video to identify fraudulent documents, live fingerprints scanning and verification, remote probation monitoring, electronic entry of reports and paper work will further speed up the court proceedings.

State Wide Networks: This will involve linking all the departments of the Government with various district headquarters and the state capital, facilitating the flow of information between the various state departments and its constituents. Here various blocks will be linked to district Headquarters, district headquarters to State Headquarters and State Headquarters to the National Capital.

Government to Business (G2B)

E-Taxation: This will constitute the various services a business house needs to get from the Government, which includes getting licenses etc. In a similar scenario, it can also flow from a business house to the Government as in the case of procurements, from such business houses by the Government. This will become a B2G service.

Government to NGO (G2N)

E-Society: Building interactions beyond the boundaries of government by developing communities, by building government partnerships, and by building civil society. It will involve building various associations or interest groups that will ensure the betterment of the society. Such initiatives deal particularly with the relationship between government and citizens: either as voters/stakeholders from whom the public sector derives its legitimacy, or as customers who consume public services.

Issues for e-governance

- Funding
- Management of Change
- Privacy
- Authentication
- Interoperability
- Delivery of services
- Standardization
- Technology Issues
- Use of local languages

Challenges for e-governance in India

The governments both– the Union and the states must make earnest efforts to complete the daunting, but formidable task of quicker and effective E-government programs by:

- Making a policy choice in favour of computerization to overcome issues radically the even if it requires huge investments for the purchase of hardware and software;

- Serious efforts would be required to mobilize resources for this arduous job. One way to deal with the situation could be that governments enter into arrangements for leasing of computers. This would reduce initial heavy capital investments.
- Establishing complete connectivity between various ministries and departments so that transfer of files and papers could be done through Internet thereby choosing efficacious speed as an alternative to manual labour. To make this really effective, there is a need to make databases of various departments compatible with one another. Thus, interoperability of e-governance projects is of vital importance if the citizens are to feel the benefit of IT in day to day life
- Supplying information to the public in a language that they understand and are comfortable with, and generally, it is the local language. As technology is available by which transliteration from English into other languages can be made.
- Changing the mindset of the government employees who are used to working only in the manual mode. This is a big task and needs patience and careful planning. Workshops, seminars, and training programmes are required to be organized to spread awareness among the employees at all levels
- Making cyber laws available to the public as early as possible so that the IT systems and information documents stored in the systems has the same legal validity as the documents stored today on paper; and
- Build supporting infrastructures of power and all weather surface transport system to bridge the digital divide between the rural and urban India.

The framework of e-governance

When one refers to the use and impact of ICTs on the public sector, a wide variety of terms come up – most notably the use of e-government, government on line, digital government, e-governance, and e-democracy. These are sometimes used interchangeably. But, more importantly, they are rarely used consistently.

E-Administration: improving the internal workings of the public sector with new ICT-executed information processes. Some examples are: integrated human resources and payroll systems, integrated financial management systems, web-based data resources to improve decision-making, intranet system to improve information flows within governmental instances. Some authors refer to this dimension as back-office capability and it is generally recognized as a precondition for developing e-services and e-democracy.

E-Services: providing information and delivering services to citizens. Providing citizens with details of public sector activities mainly relates to certain types of accountability: making public servants more accountable for their decisions and actions. It implies as well improving the services delivered to members of the public along dimensions such as quality, convenience and cost. This uses all the

potentials of ICTs to deliver the informational components of public services to citizens in digital form.

E-Democracy: increasing the engagement of citizens in public decisions and actions. The rationale is to make public decisions more responsive to citizens' view or needs by opening information flows from citizens to government. E Democracy suggests greater and more active citizen participation enabled by the ICTs in today's representative democracy as well as through more participatory or direct forms of citizen involvement in addressing public challenges. Some examples are: citizen panels, forums and petitions, opinion polls, referendums, online voting.

Most developed democracies have established e-governance agendas, which are mainly concerned to deliver government services online. E-government policies hold out the prospect of greater cost efficiencies as well as broader public convenience, but there is no intrinsic link between successful e-government and strengthened democracy. Some of the world leaders in e-government service delivery are far from active democracies. The challenge is to create a link between e-government and e-democracy- to transcend the one-way model of service delivery and exploit for democratic purposes the feedback paths that are inherent to digital media. So, instead of citizens simply being able to pay their taxes online, they would be able to enter into a public debate about how their taxes are spent.

Global and regional trends of e-governance development

According to a research study undertaken in 2001 by the UN Division for Public Economics and Public Administration (UNDPEPA) and the American Society for Public Administration (ASPA) to analyse the e-government landscape in the 190 UN Member States, several global and regional trends can be mentioned:

- Despite the significant progress of e-government programmes among UN member states during 2000-2001, the majority of initiatives remain at the information provision stage.
- National e-government programme development remains desultory and unsynchronised. A compelling lack of coordination exists across administrative and policy boundaries. Ultimately this may compromise program effectiveness and performance efficiency.
- The developing countries have been slow in accepting a coordinated approach to e-government implementation. This is particularly true for countries in sub-Saharan Africa.
- For countries, like the United Kingdom, launching an e-government programme is an extensive, meticulously planned exercise with ambitious goals and targets. The UK also enjoys the advantages of unabridged political support. For other nations, especially those in Sub-Saharan Africa, just going online can be a frenetic leap from the past into the future with little time to absorb the present.

- For a large majority of countries, national e-government programme development is occurring in a swift and dynamic manner- and as for now, change is the only constant.
- Increased access to the World Wide Web does not automatically transform into increased use of e-government as user interest has been low and indifferent.
- There exists a significant digital divide within national public administrations.
- Single entry portals are an accepted and important standard.
- Prioritising online service delivery to the business community is an implementation strategy in several emerging economies at the expense of citizen centric service delivery. This is particularly true in Latin America for countries, like Chile, Uruguay and Paraguay and to a lesser degree Brazil and Argentina. Such a policy or strategic approach supports the premise that ICT led economic growth has consistently raised national productivity, created jobs and increased income.
- Countries with a long tradition of social service delivery, on the other hand, have prioritised a citizen centric approach. The Nordic countries are excellent examples.
- National e-government/e-governance managing teams are an exception rather than the rule.
- There is a considerable lack of public awareness campaigns informing citizens that governments are offering online service delivery.
- The belief that online service delivery is less costly than other channels is not wholly unfounded. However there is little empirical evidence to support this assertion.
- Although e-government encompasses many applications and incorporates virtually all ICT platforms, the Internet is the most widely recognized and identifiable component driving e-government.
- In the case of developing countries, the priority is to upgrade internal administrative capacity in order to support e-governance. In the developing world, citizen-focused online services barely exist and websites are still static and politicized. The reasons for this are the lack of resources and the lack of creativity on the part of ICT strategists.

In countries where e-government is evolving autonomously or without a coordinated national strategic programme, transactional service delivery will occur regularly with local governments demonstrating such a capacity before national government.

E-Government initiatives at the sate level: Quite a number of state governments have initiated measures to introduce information technology and its tools in the governance process. Most of these states are using these applications for improving service delivery to their citizens. They are moving from manual processes to on-line delivery by using conveniently located service centers in public places. Counters at these service centers are manned by public/private

agencies and multiple services are provided on-line at each location. Empirical evidence reveals that it has not been an easy task to implement ICT related reforms particularly at the state level and hence needs to be planned carefully for their successful implementation (Bhatnagar, 2004). In this regard, it is, therefore, of utmost importance to study and examine the various experiences for evolving effective strategies for future.

Project "Gyandoot" in the State of Madhya Pradesh: "Gyandoot" was launched on 1 January 2000, in poverty stricken, tribal-dominated rural areas of Madhya Pradesh after gathering information from the villagers regarding their problems. Lack of information about the rates of agricultural produce, difficulty in accessing information on land records; and absence of grievance redressal mechanism were their main problems. The Government selected villages, which function as block headquarters, or where weekly markets were held, or villages along the major roads, for establishing information kiosks equipped with computers connected through Internet. These information kiosks were run by rural educated youth having matriculation with working knowledge of computers. The services provided at these kiosks include:

- supplying information regarding current rates of crops at the local and other auction centers in the country at a very nominal fee of Rs. 5;
- All documents containing information of land records to be given on the spot at a fee of Rs. 15;
- All applications with regard to domicile or income or caste certificates can be sent through e-mail at a cost of Rs. 10.
- complaints of poor quality of seeds/fertilizers, drinking water, functioning or nonfunctioning of schools or panchayats, village committees, etc can be lodged at a cost of Rs. 10;
- Auction facility for land, machinery, and any other durable commodities at a fee of Rs. 25 for three months; all information on government development programmes and grants on various development projects; and
- Data regarding families below poverty lines. Some of these centers were also rendering miscellaneous services including online matrimonial advertisements; Photostat STD, PCO and horoscope services.

'Gyandoot' is instrumental in establishing a link between government and the local population residing in the remote villages. It has also provided an opportunity to marginalized tribal citizens to have an access to knowledge at a little cost.

Implementation of e-governance

The benefits of ICTs to enhance governance are perhaps most strongly felt at the local level. ICTs and the Internet in particular, provide an opportunity for improving local government services, and a new way for ordinary citizens to participate more directly in the decisions that affect their environment.

Owing to their potential to integrate data in a more structured and comprehensive form, they contribute to a better knowledge management, improved information sharing and help to create conditions for an open and transparent society based on trust and accountability.

Decision-making can be strengthened through better sharing of information and increased involvement of all stakeholders to the political process. Another important benefit of using ICT is that it offers the possibility for reintegrating into political life minorities that have been marginalized in politics because of the exorbitant costs of running a campaign. The Internet offers the possibility for individuals or organizations, who would not otherwise be able to participate, to make much more of an impact on voters and at much lower cost.

Finally, ICTs can eventually transform the processes and structures of government by creating an administration that is less hierarchical and more responsive to the citizens' needs.

However, many of ICT experiments aiming at enhancing citizen participation and engagement have not fulfilled the potential offered by new technologies, and many of them have manifested a regression towards improved information provision models of e-governance. This is mainly due to the lack of institutional and legal e-readiness, as well as the lack of political will to fully explore the potential offered by ICTs. Another challenge lies in putting in place necessary infrastructure, creating conditions for capacity building and awareness raising, and in defining a clear vision and strategic goals of e-governance implementation.

Recommendations

- Promotion of types of content meeting the needs of populations (information on health issues, agricultural development, democratic mechanisms, etc.) should be supported.
- Appropriate applications to meet the specific needs of the populations expressing themselves in local languages should be developed.
- Links between the Internet and traditional forms of communication, such as the radio should be developed.
- Various features of the Internet like voice in conjunction with touch screen technology to increase access to information should be used.
- Use of graphics for the illiterate should be extended.
- Occasions for International comparisons and best practices sharing should be multiplied.
- Government information should be accessible and easy to find. This can be achieved by making navigation user-oriented, and by publishing internet-adapted guides and details of administrative procedures.
- Local presentations and training should be used to make the population more familiarised with ICTs.
- Development of local e-democracy should be encouraged by involving a wide

variety of stakeholders Opportunities should be sought to develop meaningful consultative online relationships with citizens.

GIS - National spatial data infrastructure

A NSDI enables the establishment of a national repository of a digital "warehouse" of the national map data holdings. It will facilitate Sharing and access to the digital spatial information.

Current and accurate spatial data must be readily available to contribute to local, state and national development and contribute to economic growth, environmental quality and stability, and social progress. This would be best achieved by making accurate and timely spatial data readily available to support sound decisions over a geographic area and to do so with minimum duplication of effort and at a reasonable cost. Establishment of a NSDI to support efficient production, easy access to and shared use of accurate, high quality spatial data to meet national needs is an urgent national requirement.

As a national infrastructure, NSDI will have the potential to serve as a "one-stop" source of spatial information and the "mining" of these GIS layers from the NSDI would be the major source for all GIS activities in support of sustainable development and economic growth.

NSDI will support to planning and development activities – specially the management of natural resources, disaster management, watershed management/ development, district planning, state planning, resources monitoring, rural development, Land capability Analysis; Optimal landuse Planning; Water Resources Development; Agricultural Development; Irrigation planning; Watershed Development; Wasteland Development settlement hierarchy, facilities planning etc. Government would find use of NSDI to prepare spatial plans for the whole country - annual plans, five-year plans, perspective plans; inventory of natural resources and changes; for quick assessment of damages during natural calamities and disasters and monitoring and evaluating the various governmental policies and programs.

Information bases for infrastructure development in the country – specially the road, telecom, water distribution, sewerage management and so on. The NSDI would provide the base information for addressing issues related to landuse, environment, land acquisition, visibility and line of sight, costs of projects etc.

National e-governance plan: Over the past decade, India has seen islands of Electronic Governance initiatives in the country at National, State, district and even minor government level. A need was therefore felt for taking a holistic view towards the entire e-Governance initiative across the country. The National e-Governance Plan (NeGP) has been conceptualized with the following vision:

"Make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency and

reliability of such services at affordable costs to realize the basic needs of the common man".

The Government approved the National e-Governance Plan on May 18 2006.

Mission mode projects

27 Mission Mode Projects (MMPs) identified by the NeGP – 8 integrated projects; 8 central projects and 11 state projects.

The 8 integrated projects are: e-BIZ, National Service Delivery Gateway, Common Service Centers, e-Procurement, e-Office, e-Courts, India Portal, Electronic Data Interchange (EDI);

The 8 central projects comprise: Income Tax, MCA213) Insurance, Central Excise, National ID/UID, Pensions, Banking, Passport, Visas and Immigration;

The 11 state projects involve: Agriculture, Employment Exchange, Commercial Taxes, Land Records, Road Transport, Gram Panchayat, Municipalities, Police, Property Registration, Treasuries, e-District.

State Wide Area Network (SWAN)

The Government has approved the SWAN Scheme for establishing State Wide Area Networks (SWANs) across the country in 35 States and Union Territories, at a total outlay of Rs. 3,334 Crore over a period of five years. The objective of SWAN Scheme is to establish converged network consisting of data, voice and video circuits with minimum 2 Mbps capacity, linking the State with the Union Territories Headquarters, right up to the Block and Tehsil headquarters, through the district and the Sub-division headquarters. The aim is to create a secure government closed user group (CUG) network, for the purpose of delivering G2C and G2G services.

Human resources

Human Resource Development for e-Governance will not only include building training programs in e-Governance but should start up with building strategy for IT qualified Manpower. A complete framework with performance based promotion needs to be incorporated in Government Services.

Changing recruitment qualifications: Certain changes in the qualifications for recruitment of employees can be made so as to employ persons with keyboard skills combined with the required levels of computer training. A system of incentives would go a long way in ensuring that employees have the requisite skills for effectively using computers.

Changing Civil Services Subjects: IT as a subject should be introduced in civil services. It is a pity that the IAS curriculum does not have IT/E-Governance/ Computer Science as a qualifying subject.

Security policy

A security policy is a set of rules stating what is permitted and what is not permitted in a system during normal operation. It is written in general terms and describes the security requirements for a system. The task to define a proper security policy is often a political decision to be taken by corporate management.

The security policy regulates how entities can gain access to objects in a system. The security policy should describe the well-balanced cost-effective protection of the system, and should include all objects as well as all entities in the system.

A security policy not only for the whole National network but departmental intranet as well.

After the security policy has been defined, it can be used to decide what security mechanisms to select. Security mechanisms are the basic mechanisms used to implement security. In a system, for example an access control mechanism, which decides what entities, is allowed to access an object.

An information security policy document is essential for many reasons. Beyond the definition of roles and responsibilities for workers, a policy document sensitizes workers to the potential problems associated with modern information systems. This education and training helps minimize the cost of security incidents, helps accelerate the development of new application systems, and helps assure the consistent implementation of controls across an organization's information systems.

Examples of e-governance implementation

The use of ICTs in governance can be illustrated through the following examples:

1. **Informing the citizen examples** - making information widely available to citizens with the aim of increased transparency and accountability, providing information about the political process, about services and choices available.
2. **Improved service delivery examples -** by giving the citizens a greater choice, faster delivery and improved efficiency of services.
3. **Increasing citizen participation examples** - improving accessibility of citizens to their elected members, creating a vision for partnership in the decision making process)
4. **Consulting and involving the citizen examples** - stimulating debate, two-way communication and interaction, public information and feedback

Online citizen participation: The objective of online participation is to use ICTs to make it easier for people to access public information, follow the political process, discuss and form groups and get engaged in policy formation. It means that citizens take an active part in the policy-making process. Citizens are no longer seen as passive, but as pro-active with the possibility of proposing policy

options and shaping the policy dialogue, although the responsibility for the final decision or policy formulation rests within government.

Conclusions

E-governance has been responsible for the progression in technology of developing countries. The goal of e-governance is the ability to access and interact with the world on an even plain. No country should be left behind when it comes to being able to communicate with one another. Without e-governance, developing countries will be left behind when it comes to technology because almost every day, ICT technologies are advancing and changing. Developing countries now have the opportunity to better themselves through electronics and make their society be more advanced and mote efficient than ever before. In brief, e-governance provides a digital pathway for interacting amongst the people and between people and Government and thus, paves the way for effective developmental process.

References

Alkire, S. (2002) Valuing Freedoms: Sen's Capability Approach and Poverty Reduction, Oxford University Press, Oxford

Avgerou, C. (2003) The Link between ICT and Economic Growth in the Discourse of Development. in Organizational information systems in the context of globalisation, M. Korpela, R. Montealegre, and A. Poulymenakou (Eds.), Kluwer Academic Publishers, pp. 373-387.

Bhatnagar S.C., "E-Government: From Vision to Implementation – A Practical Guide with Case Studies", SAGE Publications Pvt. Ltd., New Delhi, 2004.

Braun, J & M. Torero (2006). Introduction and Overview. In M Torero & J Braun (Ed), Information and Communication Technologies for Development and Poverty Reduction: The Potential of Telecommunications (1-20), Baltimore: John Hopkins University Press.

Castells, M. (1998) The End of Millennium. The Information Age: Economy, Society and Culture, Vol 3, Blackwell, Oxford.

Centre for Electronic Governance (CEG) 1999 Information Technology in Developing Countries. (http://www.iimahd.ernet.in/egov/ ifip/nov99.htm)

Compendium of e–Governance Initiatives in India (ed. Piyush Gupta, R K Bagga), Universities Press, Hyderabad

Corbridge, S., Williams, G. (2005): Seeing The State: Governance And Governmentality In India, Cambridge, Cambridge University Press

e-Governance Action Plan for India http://unpan1.un.org/intradoc/groups/public/documents/apcity/unpan014671.pdf http://www.egov.vic.gov.au/Documents/egovactionplanindia.doc

Government of India, 'Information Technology Action Plan: IT for All Indians by 2008',http://it-taskforce.nic.in.

Gupta, M.P. (2004). Towards E-Government Management Challenges, Tata McGraw-Hill Publishing Company Limited, New Delhi.

H. M. Jha "Bidyarthi" and P. V. Bokad (2004): Managing Multiplicity in Citizens' Identity – A Taluka Level Case Study, First International Conference on E-Governance held during 18-20 December 2003 at Indian Institute of Technology, Delhi, pp. – 23 – 30.

Kirkman, G. (Ed.) (2002) The Global Information Technology Report 2001-2. Oxford University Press USA.

Little, D. (2003) The Paradox of Wealth and Poverty: Mapping the Ethical Dilemmas of Global Development. Westview Press, Boulder, Colorado.

Madon, S. (2003) IT Diffusion for Public Service Delivery: Looking for Plausible Theoretical Approaches, in: Information Systems and the Economics of Innovation, Avgerou, C. and La Rovere, R.L. (Eds.), Edward Elgar, Cheltenham, 71-85.

Mahapatra R, and Perumal S. 2006. "e-governance in India: a strategic framework", International Journal for Infonomics: Special issue on measuring e-business for development. January.

Matambalya, F. & S. Wolf (2006). Does the Use of ICT Improve the Productivity of SMEs in East Africa? The Case of Kenya and Tanzania. In M Torero & J Braun (Ed), Information and Communication Technologies for Development and Poverty Reduction: The Potential of Telecommunications (184-197), Baltimore: John Hopkins University Press.

Misra, D.C. (2008): Emerging E-government Challenges: Past Imperfect, Present Tense but Future Promising, E-governance Compendium, New Delhi, Department of Administrative Reforms and Public Grievances (DARPG), Paper 1, pp 3-11, Paper contributed to the XIth National Conference on e-Governance, February 7-8, 2008, Panchkula, Haryana, India, http://darpg.nic.in/

Sen, A. (1999) Development as Freedom, Oxford University Press, Oxford.

The E-Governance Strategy White Paper http://unpan1.un.org/intradoc/groups/public/documents/APCITY/UNPAN014672.pdf http://topics.developmentgateway.org/egovernment/rc/ItemDetail.do?itemId=272186

Chapter 8

Challenging Intellectual Property Theories and Statutes

Artur Matuck

Abstract E-writing (electronic writing) generates theories, practices and computer applications that evolve and continuously redefine our perspective on writing. E-writing tools will challenge deep-rooted cultural habits at the base of our language and thought processes. Once e-writing becomes widespread and acknowledged in theory, collective web-based writing, machine-assisted and machine-generated authorship will be investigated as human-developmental tools. Writing, and by extension thinking, science, design, expression, art-making, architecture, economics and philosophy will be more and more understood as a dialogical process between human abilities and machine-mediated actions. As we let our imagination delve into these future forms of thinking, we come to the conclusion that instituted theories, enforced by legal systems, act as insurmountable obstacles to the advancement of creativity, authorship and invention. Thus, current intellectual property values and legal theories will be obliged to readapt to new forms of authorship involving human machine integration.

Keywords *Digital writing, computer-generated writing, authors' rights, intellectual property, inter-writing, re-information*

Telecomputational language-related tools

The whole idea of the computer as a writing tool is now associated with telecommunications. Since writing through the computer cannot be isolated from networking anymore, it is actually telecomputing that will provide for e-writing technology. Writing, and therefore thinking, will acquire new telecomputational language-related tools.

E-writing has thus become a multi-individual activity even if individual authors do not acknowledge the fact. Writing today can be seen as an activity in which the individual and the social are strongly intertwined. Thus, writing through a system integrating the keyboard, the screen, the software and the web implies that the resulting information resonates within larger networks.

E-writing design must therefore provide for the writer's simultaneous or alternate interaction with text-processing applications, large data-structures, and autonomous machine-writing and distant or local co-writers. The new e-writing technologies would allow for optional or automatic data interaction, text-filtering, textual de-construction and re-construction. Consequently, this would intensify hybrid man-machine dialogues.

Texts will then be analyzed through computer-assisted reading devices that would offer statistical, mathematically-based textual analysis for the writer. The improved functionality of those applications and the human-machine dialogue will foster a culture of hybrid textuality; humans will learn new abilities and tools not only for reading and writing, but also for analyzing, thinking and inventing. Authors would be redefined as e-authors, writers as e-writers and writing as e-writing.

The text as a matrix of interrelations

The text can be printed, digital, web-present, virtual; the text is becoming translocal, collective, distributed, interconnected and hyperlinked. Texts are increasingly available to be read, duplicated, circulated, disseminated, but also abstracted, altered, contradicted and even rewritten by human or machine agents.

The text, specially in its printed format, has been considered an enclosed object, the conclusion of a strenuous thinking process fixed in a multitude of copies; but it can now be seen as an evolving entity, a potential source for re-information, an elementary matrix for interrelation and reconstruction.

The new dimensions of texts indicate multiple still unheard possibilities for human-machine fusioning for e-writing and e-imagining, opening up mind-venues for rethinking information as a particle for higher aggregation. It will be our re-conception of the text as a mindtool, as an object embodying valuable information, as an indispensable social instrument that will lead us to perceive and conceive a completely new horizon for human thought processes.

At the basis of this evolutionary process lies the re-perception of information as a matrix. The original text will be seen as more valuable the more it interconnects, the more it triggers a generative process and the more it becomes part of a hybridly constructed informational cluster. Texts should always be available to be analyzed, transformed, translated, reformatted and aggregated. Such re-conceptualized information will prompt us to design new tools and processes which would re-inform texts, images, art, culture and science in unimaginable ways, because seeing information as a matrix and not as a proprietary, isolated entity has not yet entered into mainstream culture.

The gradual acceptance of the concept of re-information will propel our tools, our writing practices and cultures to a differentiated mind-frame. We will have to re-adapt, to descript and rescript our institutions, certitudes and habits.

In this new writing environment, our words, phrases, paragraphs would instantaneously reverberate through massive data structures, providing mediate feedback. Furthermore, intelligent agents could interact with our textual propositions to pose us questions, to alter our syntaxes and to make available complementary data. As the web manifestations of our thoughts provoke systemic responses, they could also reverberate in a distant writing node.

Writings pertaining to similar categories could be automatically interlinked and aggregated so that new content is generated and communities are formed along interests, styles, abilities or customs.

A political movement could be formed to demand that the Internet be turned into a more democratic tool. Sites would facilitate encounters, interactions and collaborations. Sites, for instance, could tell users about the identity, location and interests of other users. Technology could then be a tool for community formation and intellectual collaboration.

Although the technology is already available on educational sites, it has not been widely used. The unstated objective is certainly to ensure that horizontal communication does not become one of the web's main features. This would shift worldwide power structures to a more multilateral orientation, empowering people through their interconnections.

E-written authorship as a planet-wide socio-machinic process

E-writing reformulates individual authorship into a multi-individual, socio-machinic, planet-wide process. Once e-writing becomes widespread and acknowledged in theory and practice, collective web-based writing, machine-assisted and machine-generated authorship will be investigated as human-developmental tools.

Writing will no longer be a solitary endeavor. Traditional writing methods, in which the mind of an individual conceives sequences of words and phrases, will be just one in a sequence of writing phases. Writing, and by extension, thinking, science, design, expression, art-making, architecture, economics and philosophy will be more and more understood as a dialogical process between human abilities and machine-mediated actions.

New writing practices involving group integration, specialized role playing, machine agency and different levels of creative involvement will instantiate emerging theories of authorship. Thus, the reality and potential of machine-mediated practices would have to be taken into account whenever philosophies of authorship are discussed.

In a foreseeable scenario, writing would proceed through networking so that every word sequence, every newly conceived phrase would immediately reverberate through net-bases, causing responses in diverse formats.

Present sites are already announcing what e-writing could become in the future. New technologies can direct specific ads to users based on their demographics. Google, for instance, created an automatic response system that displays personalized advertising according to specific keywords in the messages.

Newly released writing software introduces a number of features that makes writing an easy and automatic task providing templates for many styles and objectives. In the process writing can become a depersonalized activity implying textual standardization and normalization.

However, if writing and thinking communities are formed and empowered, they could use similar, improved, yet to be invented writing tools. Language systems with semi-automatede- writing capabilities could then favor a socially oriented purpose, enabling re-information, connectivity, aggregation and co-invention. When those e-writing technologies become widespread, we will be better positioned to discern even newer venues for individual and collective expression.

Net-bred writing processes challenging intellectual property theories and statutes

As we let our imagination delve into these future forms of thinking, we come to the conclusion that instituted theories, enforced by legal systems, act as insurmountable obstacles to the advancement of creativity, authorship and invention. The problem is that legal theories and legislation ingrained in almost unchangeable statutes restrain emerging collaborative authorship models and practices.

However, if the vision of writing as a socio-machinic, planet-wide process prevails, current intellectual property values and legal theories will need to re-adapt; they should not remain obstacles to thinking.

They shall be confronted in their ideology, assumption of large-scale control, and imposed authority. Finally, they would be proven to be obsolete tenets of an old mentality and would thus have to be rethought. Current intellectual .

Values and legal theories will be obliged to re-adapt to new forms of authorship involving inter-human and human-machine integration.

Information as an inter-connectable entity

As planetary net-integration evolves, e-writing processes will make so much use of data structures that invention will normally be thought of as and realized through re-invention or co-invention.

E-writing will then naturally challenge the present theoretical basis of intellectual property and authors' rights since it will need to make full use of proprietary material.

We are currently on the brink of a new conception of information which that will demand a reconsideration of the underlying philosophies of creative acts, technologies and related rights.

Each new writing, invention, design or proposition is now being sensed, perceived and reconceived through its web-presence as a potential element in a larger textual construction.

Information should be considered as re-information, as data-in-flux. It will therefore be increasingly analyzed within new parameters such as availability, interconnectivity, formatability, translatability and disseminability.

Consequently, hardware, software, communication protocols and file formats will have to be redesigned to augment, improve and facilitate interconnectivity, aggregation and knowledge formation.

Texts as informational entities will have to be fully interconnectable and legally free to interact so that new propositions can be conceived or automatically constructed. Then the full potential of presently available and yet to be created communication technologies can be achieved.

Semionr: an international symbol for re-information

The proposition proposal for SemionR responds to a need to innovate, reevaluate and expand the philosophical, spiritual, conceptual, semiographic and legislative work initiated in 1972 with 'Semion: an international symbol for released information'. The article "Information and Intellectual Property, including a proposition for an International Symbol for Released Information: Semion", was published in Leonardo magazine, the International Journal of Arts, Sciences and Technology, in 1993, first disseminanting the Semion concept.[1]

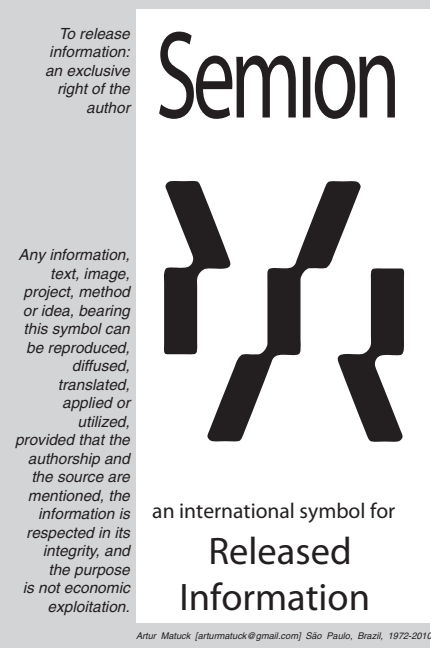


Fig. 1. Semion, an International Symbol for Released Information, São Paulo, Brazil, 1972-2010 (conceived by Artur Matuck)

Presently, the principle of information sharing, publicized through Semion, has gained unprecedented relevance with the implementation of computer networks, Web-communication resources, and digital writing applications.

Semion's original proposal from 1972 states, "Any information, text, image, project, method or idea bearing this

[1] Artur Matuck, Information and Intellectual Property, including a proposition for an International Symbol for Released Information: Semion, Leonardo, Vol 26, No.5, 1993, pp. 405-413.

symbol can be reproduced, diffused, translated, applied or utilized, provided that the authorship and the source are mentioned, the information is respected in its integrity, and the purpose is not economic exploitation."

In 1997, there emerged a need for an extended conceptual legal initiative: 'SemionR, an international symbol for re-information'. The new symbol will be presented with the following text: "Any information, text, image, project, method or idea bearing this symbol can not only be reproduced, diffused, translated, applied or utilized, but also altered, modified, reformatted, interconnected and aggregated so that newer information can be generated".

SemionR was conceived to mark information that is continuously web-present, available to be interconnected and aggregated to form new data structures. SemionR then proposed that any human, machine or hybridly- produced information should become visible and interconnectable, keeping its potential to participate in a continuous, collective, hybrid e-process of knowledge formation. Through SemionR, we declared to worldwide policy-makers that information is such a valuable resource for present and future human survival that it can no longer be restrained by legislation.

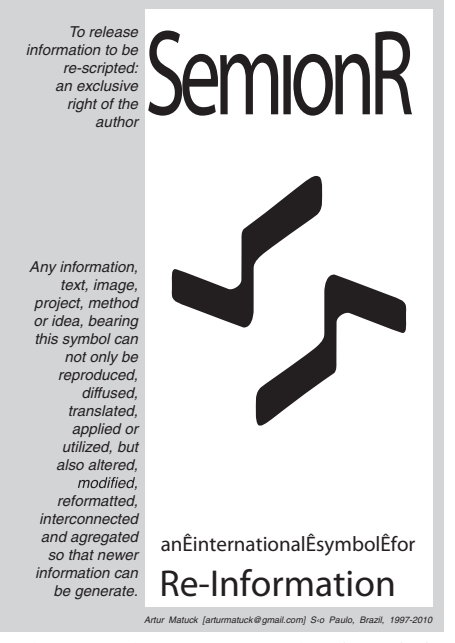


Fig. 2. SemionR, an International Symbol for Re-Information, São Paulo, Brazil, 1997-2010 (conceived by Artur Matuck)

However, we should also note that once all information becomes acknowledged as re-information, once relevant information becomes widely disseminated and known, available to be applied, utilized, re-formatted, aggregated or re-used, both Semion and SemionR would not be any longer necessary. Those two symbols and other licenses such as those proposed by Creative Commons are only necessary while information is still regarded as an entity liable to become proprietary and therefore restricted.

References

Matuck, Artur. Information and Intellectual Property, including a proposition for an International Symbol for Released Information: Semion, Leonardo, Vol 26, No.5, 1993.

This article is marked with SemionR, an international symbol for Re-Information.

Chapter 9

Environmental Interpretation in Forest Urban in PUC Minas

Ana Cristina Sanches Diniz, Lídia Poliana da Rocha Afonso, Jésica Alves Leite Dutra

Abstract. The environmental interpretation in natural areas leads to reflections, giving each participant to review its stance in the face of natural environments. For the people of urban centers, the tracks provide diversification of routine work, study and wasted. The interpretation of the Trail Bem-Te-Vi in urban forest in Belo Horizonte, Minas Gerais, Brazil has been contributing as an alternative method of contact with nature in the big cities Combining content hands-on activities, the interpretation is developed in an attractive, provocative and enjoyable with the various profiles of public.

Keywords *environmental interpretation, conservation, educational practices, track, urban forest.*

Introduction

The learning with play contact with the natural environment presents us the opportunity to break with ways to feel, think and drive our actions, with values sedimented by a routine that keeps us regarding our animal / natural: intuition, instinct, ability to deal with the unexpected, it all lost the daily urban environment. And being in nature breaks the force, negotiations and confrontations that lead to the construction of new readings on ourselves, our joys, our beliefs about who we are what we like and what we believe. (Cassino, 1998). The Earth gives clear signs of exhaustion due to the adverse impacts caused by human society that has been causing disharmony in nature, affecting the current quality of life and significantly compromising the survival of future generations.

Everyone must know that each one, each citizen is part of the whole and individual attitudes directly affect the environment and land that make up this planet a larger system that also interacts with other systems ... Environmental education comes to rescue the positive relationship between man, nature and the universe, helping to develop an ethical awareness of all forms of life with whom we share this planet.

The consumer society needs to change their concepts about the nature, interacting with the environment positively and not just exploratory.

The taste for hiking and exploration in natural refuges always existed and people sought for this purpose trails in natural refuges. The groups were usually led by natives, local people, familiar with the route, pointing curiosities. These activities served as the basis for what is now called the Environmental Interpretation.

The term interpretation of the nature or environmental interpretation refers to a set of principles and techniques to encourage people to understand the environment by practical experience merge. The basic goal of environmental interpretation is to reveal the meanings, relationships or natural phenomena through practical experience and means of interpretation, instead of a simple statement of facts and figures. (TILDEN, 1967).

The environmental interpretation includes the translation of technical language of a natural science to be understood by people in general, so interesting for the listener. (HAM, 1992)

The objectives of the Environmental Interpretation are to facilitate the knowledge of nature in order to conserve its natural resources, historical and cultural, to achieve the satisfaction of visitors, adding value to the visitor experience, show the need for heritage conservation visited.

The visitor satisfaction is directly related to the new. The more you learn new things, his greatest satisfaction.

Thus, the form of mediation of content must be well done. Interpretations should be more provocative than explanatory, arousing curiosity in the participants, avoiding the implementation of content in long exposures. The visitor must be na active rather than passive.

The interpretation is characterized by informality and charm, the provocation stimulus, curiosity and reflection and the use of interactions, comparisons and analogies with real life experiences, covering topics relevant aspects often overlooked and / or seemingly insignificant.

Initiatives to environmental interpretation in forests are extremely important in process of changing paradigms, review, recovery and reversal of values, because the approach to environmental issues leads to reflections, giving each participant to review their posture facing the environment natural.

For residents of urban centers, trails in natural environments, may have the role of psychological recovery and diversification of activities, offering something different from the routine of work, study and consumption, promoting a closer relationship with nature.

Often the lack of alternatives is that prevents this approach and, according Boo, 1992, Takahashi, 1998, “this fact makes the demand for natural areas increase, especially among urban populations, who are seeking more contact with nature”.

People in cities do not have money or time to go to remote forests, in this way the interpretive activities in urban forests are an alternative to more contact with nature for these people.

Tilden, 1977, in his book "Interpreting Our Heritage", underscores the importance of direct contact with the elements that are being interpreted through practical activities, in order to give participants a real ownership of the content and inserting each as part of the whole.

The area of this work, the "Forest of the PUC," is a fragment of 10 ha of seasonal semideciduous vegetation (plants lose some of their leaves during the dry season), inserted in a residential area and isolated from any other type of vegetation (Figure 1).

Fig. 1. Urban Forest PUC Minas

This urban area has a good diversity of flora and fauna, habitat of several species of invertebrates and reptiles, with two species of mammals recorded, the possumeared white (Didelphis albiventris) and the marmoset (Callithrix penicillata). The greatest diversity of species is the birdlife, as well-te-vi, soul-to-cat, toucans, among others. The native vegetation is well preserved, with species such as cedar, alligator-wood, jatoba…

The forest of the PUC is frequently visited by students, such as access to campus officials. The forest is also frequented by school students and public visitors, led by educators, as complement the activities of the Education Program of the Museum of Natural Sciences PUC Minas.

Methodology

The idea of environmental interpretation at the PUC Mata came up with bibliographic research on interpretation and environmental education and the need to improve the educational activities developed in the local tracks.

Then began the project "Implementation of the Forest Interpretive Trails PUC Minas, Campus Eucharistic Heart," which began in February 2009, with the main objective to plan and prepare scripts for interpreting the tracks of the Mata da PUC Minas.

There are several types of audiences that visit the Museum PUC Minas suggesting the construction of interpretative activities differentiated to meet children and adults, teachers and students, the elderly and disabled.

In the first stage of the project, which gave her between February and May 2009, the path chosen for implementation of the Interpretation was already used by educators in the museum activities, from then on called "Trail Bem-Te-Vi" due to the constant presence of this bird throughout the route.

Were defined themes and stopping points for organizing the work of educators. This paper describes the techniques, phrases and educational material for interpretation, such as plates, replicas and choice of natural elements to touch.

The proposal also includes ongoing evaluation of activities through questionnaires at the end of the trail, beyond the analysis of perceptions of visitors and educators.

There are many initiatives by the museum educators, to promote lectures, trail rides and other recreational or educational activities that result in better informed and well-being for visitors. However not all of these activities can be classified as Environmental Interpretation. These activities can be considered techniques and instruments that make up the approach of Environmental Interpretation.

The process of interpretation begins in 1957 with the philosopher Freeman Tilden, which considers the interpretation "educational activities, it disseminates meanings and inter-relations through the use of original objects, direct contact with the resource and the ways illustrative rather than simply communicate the literal information."

Thousands of naturalist, historians, archaeologists and specialists are engaged in the work of revealing, to such visitors as desire the service, something of the beauty and wonder, the inspiration and spiritual meaning that lie behind what the visitor can with his senses perceive. This function of the custodians of our treasures is called Interpretation. (Tilden 1977: 10)

1. Any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile.
2. Information, as such, is not interpretation. Interpretation is revelation based upon information. But they are entirely different things. However all interpretation includes information.

3. Interpretation is an art which combines many arts, whether the materials presented are scientific, historical or architectural. Any art is in some degree teachable.
4. The chief aim of interpretation is not instruction, but provocation.
5. Interpretation should aim to present a whole rather than a part, and must address itself to the whole man rather than any phase.
6. Interpretation addressed to children (say, up to the age of twelve) should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. To be at its best it will require a separate programme.

Tilden (1977:9)

To maintain interest and attention, information needs to be presented in interesting and stimulating ways. Interpretation which is boring and monotonous, difficult to read, listen to or work out is not likely to attract much attention or hold an audience for long.

Sam Ham (1992) defines the qualities of effective communication as the PEROT principle. That is Enjoyable, Relevant, Organised and Thematic.

Organised and Thematic. In "Manual de Introdução à Interpretação Ambiental" – Projeto Doces Matas – Minas Gerais (IEF/IBAMA/Fund Biodiversitas/GTZ. Outubro de 2002), "Environmental Interpretation is meaningful, relevant or irrelevant when we are able to relate its contents with something we already know or experience ... because the information passing through our list of experiences and personal experiences, so finding, meaning."

"Humans as a species instinctively pay greater attention to differences and changes. Any repetition will quickly lose visitor attention, and without attention it is difficult to create successful communication." Moscardo (1999:28)

In a provocative interpretation the interpreter invites visitors to reflect, ask questions and allows the theories are developed by the visitor, from their observations and perceptions.

"To be at its best it will require a separate programme." (Tilden1977)

The "identity" of the interpretation is provided by the main message, according to some authors, is the main feature for an interpretation of good quality.

Studies on the capacity of the human shows that only five to nine ideas are treated at the same time, yet the ideas follow a logical sequence. For an interpretation organized, "there must be a beginning, middle and end."

"The interpreter must prepare a presentation so that visitors can distinguish easily the main points."

"The interpretation should be interesting, pleasant, charming, hold public attention and entertain you. The media used must provide a non-formal atmosphere." (Projeto Doces Matas – Manual de Introdução à Interpretação Ambiental. Minas Gerais, 2002)

The process for conducting an environmental interpretation of quality depends greatly on the interpreter and the way they communicate with the public. Some factors may compromise the quality of interpretation, such as reporting isolated,

disconnected and the use of technical language, that for the general public, causes a certain distance. Moreover, the interpreter must allow freedom of the visitor, without influencing their perception, so that it (yet) have their own feelings and draw your own conclusions. The interpreter can still avoid the use of large text, with too much information, but without reducing it to undermine the content.
Below are the technical data of the Trail Bem-Te-Vi:
Extension: approximately 800 meters
Level of difficulty: average time duration (with interpretative activity): approximately 1 hour. Input: area adjacent to the Museum PUC Minas. (Figure 2).
Audience: Community school, organized groups and visitors to the Museum PUC Minas in general.

Interpreting the Trail Bem-Te-Vi The topic is the general idea of the interpretative approach. The themes are the messages passed along the way, related to the topic. The topic set for interpretation of the Trail Bem-Te-Vi was the Environmental Conservation, and the themes covered are: characteristics of the fauna and flora, fauna versus local impacts (construction, deforestation, garbage), personal contributions to sustainability, sustainable activities in environmental natural

Fig. 2. Trail Bem-Te-Vi

Ways and Means interpretation techniques are the various resources used to accomplish the Environmental Interpretation. On the Trail Bem-Te-Vi were selected points, information boards and objects to touch.

Interpretative Points:

The visitor is invited to play in the tree (Figure 3) and observe carefully, because its trunk resembles the hull of the alligator. The natural process of nutrient cycling is shown in an area full of dry leaves.

"What we observed in these trees is that in the winter, the leaves change color and fall. This phenomenon is natural life of these trees. This phenomenon helps reduce loss of water during the dry period. Visitors are invited to observe the trees. (Figure 4).

Na clareira é aplicada a dinâmica Teia da Vida, adaptada ao tópico Conservação Ambiental.

Adaptation of the dynamic "Web of Life"

All are important in the vast web that is life. The web represents the links between people, which are linked both by their positive attitudes, which help in conserving the environment, as the negative, that contribute to degradation. So it becomes essential to know the consequences of human intervention in environments, so that from the acquisition of consciousness, each one takes its importance in the transformation and reconstruction of an environment conducive to all forms of life. Small acts taken together can and do make a big difference.

The web of life is a dynamic normally used with the goal of integration between teams, through the exchange of knowledge and relationships between participants and, based on this principle, several adjustments are made according to the message you want to work with the group .

Fig. 3. The visitor is invited to play in the tree (Piptadenia gonoacantha)

Fig. 4. Visitors are invited to observe the trees

The dynamic "Web of Life" was adapted to work awareness of the need for change in attitudes and habits by encouraging a more positive relationship with nature, emphasizing the cultivation of respect in general.

Participants are invited to stay in a circle and say a positive action and a negative relationship with nature. With one end of the string held in the hand, throw the roll to another participant of the wheel, at random. The next person picks up the ball and, after winding the line on one finger, will repeat the same process as the guide. And so, the activity will continue until all of the group have been presented and described their attitudes. At the end of the activity there will be a kind of web formed inside the circle, where the wires are joined to each other. Participants perceive the interaction between all actions, both positive and

negative with respect to nature. The reflection on the need for paradigm shift and attitudes is automatic at the end of the activity (Figure 5).

Rapel were installed in some parts of the trail. This initiative provides plenty of adventure and fun and ends the activity with pleasure. (Figure 6).

Fig. 5. Dynamic web of life

Fig. 6. Rapel - ending with adventure

Results and discussion

The interpretation of the Trail Bem-Te-Vi was developed in May, June and July, with students and teachers in nursery and elementary schools, as well as spontaneous public who attend the museum, composed of families, youth and adults. Approximately 300 people visited the trail during this period.

In the July holidays the script was developed in Project Holiday at the Museum, with children of 04 and 09 years, with the presence of characters of Brazilian culture, such as "Caipora" and "India Mayara. (Figures 7 and 8). With the help of children, the characters addressed the environmental education, collecting the garbage from the forest and saving the animals of the hunter.

Structures for the interpretive trail are being implemented gradually. Feeders were installed at strategic points to supply the fruit, which act as attractive to birds and the monkeys (Fig. 9).

Fig. 7. "Índia Mayara"

Fig. 8. "Caipora"

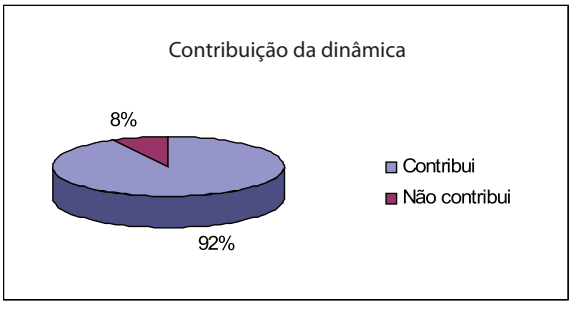
Fig. 9. Feeders for birds

The evaluative questionnaires were administered randomly at the end of each activity to at least 5% of the public who developed the trail. In general the trail, even with little infrastructure, was evaluated as satisfactory by the public, as follows below:

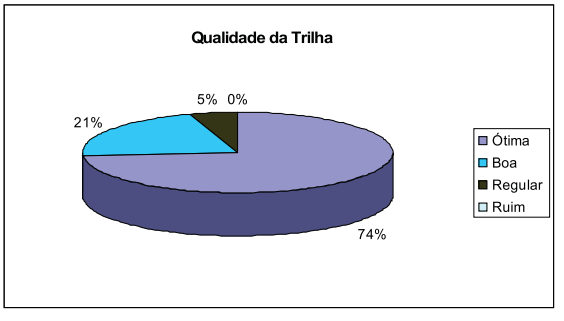
In evaluating the dynamic "Web of Life," 92% of the public interviewed considered that it contributes to awareness. The remaining 8% thought that it does not contribute. (Diagram 1).

74% considered the trail in very good condition. (Diagram 2).

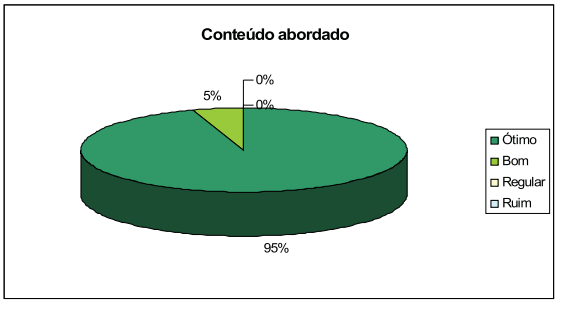
95% considered the content being used as very good, and 5% rated it as good. (Diagram 3).



Dig. 1. dynamic "Web of Life,"



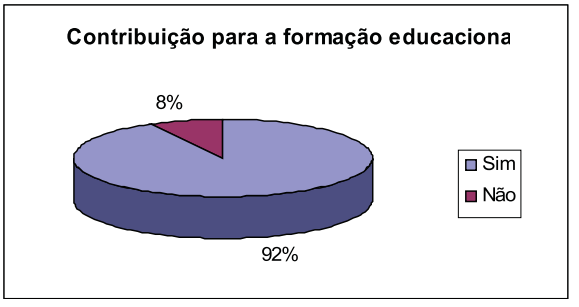
Dig. 2. Quality trail



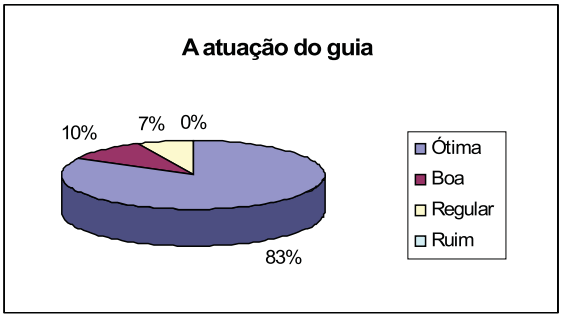
Dig. 3. Quality Content

Of the respondents, 92% considered that the Interpretation has been educational. (Diagram 4)

In assessing the performance of the educator, 7% marked the item "regular" 10% "good" and 83% marked "excellent". (Diagram 5).



Dig. 4. Interpretation educational aspect



Dig. 5. Performance of the educator

The development of the draft interpretation of the Trail Bem-Te-Vi helped in Environmental Education staff, reducing impacts before observed, such as garbage and unnecessary deforestation. It also encouraged the creation of the Revitalization of the Forest of PUC (in preparation), the responsibility of the Museum of Natural Science and the ICB (Institute of Biological Sciences) PUC Minas.

The project "Implementation of the Forest Interpretive Trails PUC Minas, Campus Eucharistic Heart" was proposed and performed by students of Biological Sciences at PUC Betim, Minas Gerais, Jesica Alves Leite Dutra and Lidia Poliana da Rocha Afonso, in the 1st half of 2009 by Discipline Bachelor Stage I, under the guidance of Professor Miguel Ângelo Andrade (Professor at PUC Betim and Coordinator of the Biological Sciences at PUC Minas), and Co-supervision of Ana Cristina Diniz Sanches (Division of Education - Museum).

The second phase of the project, underway since August 2009 is the construction of parts and development of interpretive script from a universal design, aimed at the accessibility of various groups, including the blind, wheelchair users and the elderly, promoting and encouraging interest in conservation.

The trails are excellent tools for environmental education, stimulating the capacity for observation and reflection.

The environmental interpretation is a way to bring men to rethink the way they see and feel the planet as a whole, from direct contact with the natural surroundings, revealing the everyday reality and rethinking their attitude.

References

BOFF, L. Ecologia e espiritualidade. In: TRIGUEIRO, A. (org.). Meio Ambiente no século 21. Rio de Janeiro: Sextante, 2003.

desafio para a educação do século 21. In: TRIGUEIRO, A. (org.). Meio Ambiente no século 21. Rio de Janeiro: Sextante, 2003.

50 Coisas Simples que as Crianças podem fazer para Salvar a Terra. The Earth Works Groups. Tradução: Reynaldo Guarany. Ed. José Olympio

DIAS, G. F. Educação Ambiental: princípios e práticas. São Paulo: Gaia, 1992.

DIEGUES, Antonio Carlos. O mito moderno da natureza intocada. 4. ed. São Paulo: 2002.

FERRARI, Aída Lúcia; CAMPOS, Elisa. De que cor é o vento? Subsídios para ações educativo-culturais com

deficientes visuais em museus. Prefeitura de Belo Horizonte, 2001.

FREIRE, P. Pedagogia da Autonomia. Saberes Necessários à Prática Educativa. 38ª Edição, 1996.

Manual de Introdução à Interpretação Ambiental elaborado pelo Projeto Doces Matas – Minas Gerais (IEF/IBAMA/Fund Biodiversitas/GTZ. Outubro de 2002)

MARANDINO, M. A Pesquisa Educacional e a Produção de Saberes nos Museus de Ciências. História, Ciências, Saúde-Manguinhos, Rio de Janeiro;

O Pequeno Cientista Amador. Organizadora: Luisa Massarani. Série: Terra Incógnita. Casa da Ciência, 2005;

Unidade de Políticas Públicas – UPP. Município Acessível ao Cidadão. Coordenado por: Adriana Romeiro de Almeida Prado. São Paulo, 2001.

VASCONCELLOS, Jane N. de O. Educação e Interpretação Ambiental em Unidades de Conservação. Paraná: Fundação O Boticário. Caderno de conservação. 2006. ISSN 1807 5088;

Chapter 10

Understanding and Acceptance of Evolution: Research in Geological Time and Cognition

Nelio Bizzo

Abstract History of Science can provide not only good ideas for classroom practice, but also can throw light on educational research. The main problems scientists faced in the past can be similar to those students find today. We present results of a historical reappraisal of the process of elaboration of evolutionary theories, showing that the conception of geological time, contrary to what is generally admitted in the educational community, had deep roots in the ground Charles Darwin was planting with his first thoughts on natural selection. We also present a summary of 39 interviews carried out in places plenty of fossils. Marine fossil remains in mountains had an original interpretation in Italian geology the century before, which had been fully incorporated by the geology of Charles Lyell. He was sure about the antiquity of our planet, and Darwin decidedly relied on him. The certainty of the antiquity of earth emerged during the 18th century, as a result of the findings of a place where fossils are very well preserved and plenty of clear evidence of past environments exists (*Konservat-Lagerstätten,* literally "place of storage"). This place is a small village, which invites visitors to revise their conceptions about the history of earth. We conducted interviews in this place with young students, in order to understand their views on geological time. Results show that interpretation of evidence follows different ways, as young students give several meanings to the extraordinary fossil remains they find every day. In addition, elements from History of Science suggest the need for a revision of the historical framework in which evolutionary theories are commonly seen in school settings and urge educators to pay more attention to scholar scientific definitions offered to students, which can give rise to unnoticed complex intellectual ecologies in the school context.

Keywords *Evolution Teaching, History of Geology, Geological Time, Science Curriculum Design*

Methods

Schools and educators try to provide understanding of scientific theories to young students, and there is a growing awareness that there is no direct transmission of knowledge from books or teachers' discourse to students' minds. Current instructional approaches for science teaching view learners as active agents in the processes of constructing meaning, which implies taking into consideration what the learner knows and believes on the subject. This set of ideas is frequently named "everyday knowledge" (or lay understanding) and is used by people to explain phenomena in their daily lives. In educational and cognitive psychology literature, such ideas have been described as "misconceptions", "prior knowledge" or "alternative frameworks". The knowledge that people hold is a potent force in determining which sort of evidence is judged as relevant and how information will be perceived. In social psychology, such ideas have been described as "social representations". One of our major aims is to understand processes which give rise to these social representations.

Explanatory statements of science are conceived as having a developmental history, which, together with its epistemological constraints, plays important roles in educators' decisions about curriculum design and teaching plans. Our group carries out research at these two levels, looking for contributions of the developmental history of science core concepts and teaching practices, considering wider social processes of meaning-making which influence students. This multifocal research program relies on what has been called "bricolage approach" (Berry, 2006), as a variety of tools and possibilities are brought together in order to help new understandings of apparently obvious social relations to emerge. Education is admittedly an area where complexity emerges, questioning some assumptions of causal relations, for instance, between teachers actions and student responses. This perspective does not allow isolating an object of the study from the complexity and multiplicity in which it is situated. Moreover, it decidedly does not aim at "solving problems" through the gathering of data which would drive drawing of answers and conclusions.

One of the major steps in these research programmes is *problematizing*, in the sense that obvious understandings, apparently not disputable, can be seen from a completely different perspective, focusing upon both epistemic and psychological levels. In other words, clear statements about the historical development of scientific theories ought to be seen as aporetic and near-to-equilibrium teaching-learning conditions should be seen as unstable, trying to avoid a monological, single path or research method. This perspective requires an open-minded understanding – and knowledge – of

> multiple *theories* and *methodologies*, multiple ways to collect, describe, construct, analyze, and *interpret* the object of the research study; and finally multiple ways to narrate (tell the story about) the relationships,

> struggles, conflicts and complex world of the study that maintains the integrity and reality of objects. (Berry, 2006:90).

We have been trying to avoid the conception of narratives about the historical development of scientific theories of evolution as a crystal clear and objective description of a straightforward process. The historical research follows this path, trying to problematize what is seen as a mono-logical development. There are rich contributions from the field of Critical Cultural Studies, as we recognize complex relationships between power and knowledge, the way knowledge is produced, accepted and rejected, what individuals claim to know and the evidence to which they refer . This brings the learners to the stage, and challenges researchers to understand the internal dialogs which admittedly take place in their minds. Such eclectic view of research involves the use of

> several research strategies from a variety of scholarly disciplines and traditions as they are needed in the unfolding context of the research situation. Such an action is pragmatic and strategic, demanding self-consciousness and awareness of context from the researcher. (Steinberg, 2006:119).

The focus of the present research emerged from previous studies, which showed us the need of a reappraisal of the History of Biology used in educational grounds and the way young students interpret and judge evidence which is traditionally seen as persuasive and unequivocally leading to a certain scientific understanding.

Socio-cultural construction of knowledge

This research programme began in 1995, when we first studied ways in which people construct meaning about heredity, focusing everyday knowledge and cognition. Cognitive skills are not fixed and fully predictable, as clear cut results of teaching tasks, but rely heavily on *contexts* (Rogoff & Lave, 1999). Although this understanding is not new, it is necessary to admit that there are many different ways in which the "context" can be defined, as it cannot be seen a structure or features of the task or domain of knowledge. The interpersonal relations and cultural aspects, such as values and beliefs, are important parts of the context in which action is embedded.

Social interaction includes cognitive activity, which implies sharing socially provided tools and *schemas* for action on reality, as

> cognitive activity is socially defined, interpreted and supported. People, usually in conjunction with each other and always guided by social norms, set goals, negotiate appropriate means to reach the goals, and assist each other in implementing the means and resetting the goals as activities evolve." (Rogoff & Lave, 1999: 4).

In the sociocultural perspective cognitive activity is not a lonely and purely logic mental task, but rather a two-leveled process which makes use, on the one hand, of tools for cognitive activity (such as scientific theories) and practices socially

negotiated, both related to the past. On the other hand, immediate social interaction creates a material basis for individual cognitive activity. In simpler terms, when one thinks about **heredity**, there are both historical and socially defined inputs, in the form of school books and medical doctors' discourses, as well as relatives and common people's narratives to explain the reason certain traits reached new generations. There are at least two sources of everyday knowledge, in the form of second-hand discourses, which reproduce other peoples' narratives, including repercussion of media diffusion of news, interviews, reports, etc. However, there are first-hand discourses, which focus on the "own life" experience, with narratives with plenty of evidence, referring to knowledge and beliefs.

Knowledge refers to what people know or understand about something, or in Kantian terms, a method that allows the understanding to apply concepts to the evidence of the senses (*schema*). Beliefs can be found in these discourses, as dogmatic social shared notions, which are very difficult to change using discursive and knowledge-based arguments. Obviously, they may vary according to one's academic background, etc., but they are important parts of what we consider *context* in a wider perspective.

We believe these first-hand discourses are more socially supported and may play an important role for the second-hand ones, which can spread knowledge and beliefs reaching a wider social group. However, both may play an important role in the shaping of the knowledge and beliefs students bring to the classroom. When one is asked to explain the colour of his/ her eyes, there will certainly be a reference to *schema* socially shared which allows conceiving heredity and possibly pending to the knowledge side. More complex questions, such as the reasons some people live longer than others may tend to be explained in terms of beliefs, such as God's will or luck!

Hunt at al (2001) interviewed 61 individuals belonging to families affected by coronary heart disease and concluded that people did not recognize deaths of distant relatives as evidence of genetic problems in the family, but rather attributed them to pure chance. However, when more than one relative was affected, a different picture appeared, as there was some concern about the number of relatives with heart disease on the same side of the family, and this could indicate the effect of heredity. To build their arguments, people often use counter-examples and they are also used to reduce the perceived significance of risks in the family history.

In an introductory pilot study, we interviewed 24 people who attended a genetic counseling service due to the fact that they had children or relatives affected by deafness. These interviews had taken place before patients and their relatives had attended their clinic meetings. The researcher talked to the patients' parents for about thirty minutes in order to collect their ideas. The interviews were semi-structured and asked participants to speak about the origin of the problem. We identified a number of understandings and beliefs of the causes of medical problems, almost all of them pointing to environment as a causal link, especially during pregnancy (Santos and Bizzo, 2005).

We then designed a research program looking for large families with a dominant trait which could not be easily attributed to the environment. In fact, we studied two large families and found very complex and rich narratives in which inherited traits were seen partly due to genetic transmission and partly to the environment, with plenty of evidence taken from second party and direct contact information. They were clearly first-hand narratives, with substantial quantities of evidence (Santos and Bizzo, 2002, 2005).

Knowledge and beliefs about evolution: first research questions and sources

Methods developed for the study of conceptions of heredity (Santos and Bizzo, 2005) were applied to design the research of conceptions of biological evolution. Individuals who belonged to families with genetic diseases would be replaced by people who lived near fossil deposits, as sources of conceptions using privileged evidence. The first research question was about history of science, referred to the understanding of deep time. When was a solid structured theoretical framework established, on which grounds? Did it involve sound evidence? Another research question referred to learners: what are their conceptions about deep time? How did they judge geological evidence? What are the social views in their environments related to deep time?

A two-leveled research plan was designed, looking for accounts of the development of geological knowledge in History of Science, and for people who had a privileged contact with geologic evidence. A revision of the development of Charles Darwin's published works and letters was carried out, focusing in the perception of geological time, concluding that, in fact, it paved the way for a deeper understanding of biological evolution as early as April 1835. Document research stressed an important part in Charles Darwin's writings, showing the relevance of geological evidence for the building of the notion of deep time, which could be important for teaching and learning (Bizzo and Bizzo, 2006).

This firm base was possible due not only to the recognized work of Charles Lyell, but also to the authors he admittedly was fully aware of, and derived directly from the 18th century Italian geology (Rudwick, 2008). Darwin's published work soon after the *Beagle's* voyage, more than twenty years before the publication of his major book, clearly shows that he was dealing with the issue of geological time before his first thoughts on natural selection. In fact, he had been reading Charles Lyell's work, in which he advocated a "modern perspective of geological time". However, one who reads Lyell's "Principles of Geology", as Charles Darwin did during the *Beagle's* voyage, finds many quotations of Italian geologists. They would have, Lyell wrote, "ridiculed the psycho teleological systems of Burnett, Whiston and Woodward", written more than one century before.

Interviews: sampling and design

As in previous works, we were aware of sampling decisions in the qualitative research process, and how difficult it would be to define groups defined in advance. We were looking for people who lived in places with plenty of geological evidence of deep time, and who knew this evidence in detail and, in addition, could explain their views in an interview. The *a priori* definition of targeting young students relied on the grounds that they could provide their own personal views, which would be comparable to published works as part of the alternative conceptions' literature. However, it was impossible to know how many young students we were going to find at each place, and how important their narratives could possibly be. Therefore, we had to make use of a strategy of gradual definition of sample structure, regarding decisions about choosing and putting together cases, groups and even institutions in the process of collecting and interpreting data. In the qualitative research literature this process is referred as "theoretical sampling" originally developed in the context of research on medical sociology in the 1960s (Glaser and Strauss, 1967, apud Flick, 2006).

In our case, what could be called a representative sample is guaranteed neither by stratification nor by random sampling, but rather by the researcher's perception of the potential of new insights for the developing perspective. In a first phase, it was possible to judge this potential from the knowledge of geological evidence of the place. The main question for selecting data is: "*What* groups or subgroups does one turn to *next* in data collection? And for *what* theoretical purpose? The possibilities of multiple comparisons are infinite and so groups must be chosen according to theoretical criteria" (Glaser and Strauss, 1967, apud Flick, 2006).

Semi-structured interviews were carried out in three different places in Brazil, with 27 students aged 12-16. One place was in southern Brazil, Formação Santa Maria, in a small town where a petrified forest was found (Mata- RS). Two other places were in northeastern region in the Crato Formation, in the Chapada do Araripe region, in the states of Pernambuco and Ceará, and involved students of the same age range. Interviews were transcribed and analyzed, showing rich discourses with explanations about the formation of fossils.

Conclusions showed that fossil formation processes were seen as short-term ones, some taking hundreds of years, despite the fact that a rich paleontological vocabulary was also present in the very same discourses (see appendix for age details; full interviews' transcriptions can be found in Oliveira, 2006). Terms such as "Albian", "Cretaceous", "100 million years" were often found, but had weak connection to the conception on fossils life span. Jesus Christ and indigenous peoples were frequently referred to as having lived before those animals and plants existed (Bizzo et al, 2006).

Knowledge and beliefs about evolution: new research questions and sources

During field work in Brazil we had collected data which was not initially taken as important as students' interviews. We had unnoticed evidence of social views about geological time in local culture. Artisans sell rocks with engraved images similar of the fossils. Contrary to the first impression, which would present them as simple counterfeit souvenirs intended to defraud tourists, they are artistic representations, which reproduce artisan's understanding of the meaning of fossils. They would be valuable for their intrinsic beauty of forms. These engravings are sold at the house of the artisan, who is proud to say that they are hand made, showing images not only of local known fossils, such as scorpions, dragonflies and insects, but also *Jurassic Park's* dinosaurs and even parrots, disregarding scale in all figures (fig 1a and 1b). These keepsakes express the local understanding of the meaning of fossils, not as proofs of what life was about 100 million years ago, in high Cretaceous, but rather as beautiful forms engraved in solid stone. The notice that a fossil feather was found there, which is presented in the local Paleontology museum, was not understood as a proof of the antiquity of birds in the region (and the whole continent), but took the form of a present-day parrot (fig 1b). So, what we had captured in students' discourse is part of a socially shared meaning of learned expressions like "million years ago", etc.

Fig. 1a and 1b. Engraved images produced in the region of the Crato Formation (Brazil).

One possibility to explain previous results of students interviews pointed to the fact that the popular names of fossils in these three places were quite similar to living species. For instance, the fossil remains of trees in Mata (RS) are called by the same name as the living trees (*araucaria*). In the region of Araripe, fossil fish

were named as "piabinha", the same as the living fish in small local rivers, which lose all water at least three months in the year – another feature which was part of the explanations about the origin of fossils. Fossilized insects were also named after living ones, for instance dragonfly ("zig zag") and beetles ("besouro").

The similarities between living species and fossil ones in one place, which we called *paleoisomorphies*, led to new research questions. Similar places with striking differences between present day and fossil fauna and flora could possibly lead to different conceptions of geological time, which we called *paleoheteromorphy* hypothesis. Therefore, another research program was designed aiming at finding historic references of scientific discussions in history regarding the meaning of heteromorphic fossils. In addition, we would try to travel to one of these places known for paleoheteromorphies and interview young students there in order to understand their ideas about geological time. Our new research questions referred to finding paleoheteromophic places in the literature of history of geology; and, in addition, we wanted to know if students' views were essentially different in these places. The new sampling would have to follow some constraints, as we would need to find students of similar ages as previously done. Moreover, as one place was found in Italy, we had to face not only questions of transcribing interviews, but also those related to translation.

It is recognized that in the context of qualitative research approaches translation involves deeper questions than interviews transcription, as the methodological literature on qualitative research has recognized that the task of generating accurate and meaningful data through translation processes is paramount. The translator is seen as an actual interpreter who "processes the vocabulary and grammatical structure of the words while considering the individual situation and the overall cultural context" (Esposito, 2001,p. 570, apud Marshall & Rossman, 2006). We decided that the same researcher would carry out the translation before the transcription, so that minimal loss of information would be expected. In addition, an objective task was designed as means of independent confirmation for interviews conclusions.

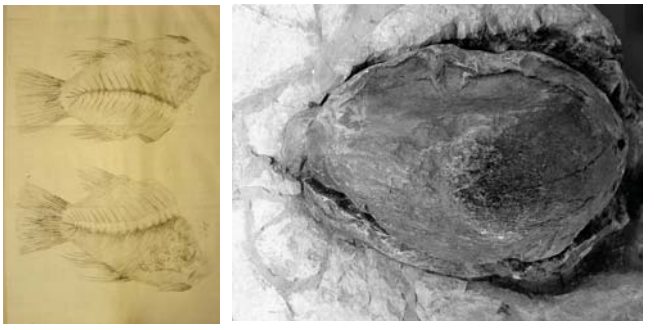
Results: *Nature's incriptions deciphered and read*

The discussion of the meaning of fossils is a very interesting part of the History of Science and certainly is part of ancient mythologies (Rudwick, 1976). At the end of (XVII) 17th century, as we could see, the Church of England was following theologies which regarded sea fossil remains in mountains as direct proofs of the biblical deluge, and therefore, addressed paleoheteromorphy, as the sea would have brought strange specimens to mountain tops. A turning point can be found in the first years of the 18th century, as debate took place at the French Academy of Science, when Phillipe de La Hire (1660-1718) proposed to regard fossils as

living beings which would have lived in the past, as others like Nicolaus Steno (1631-1686) had already proposed, but adding a very special detail. He faced the question of heteropaleomorphy in a quite new approach, without any reference to the deluge, but saying they were transported by water vapor of an underground ocean. Strange fossils would have grown up in the very same places where they are presently found, but inside the rocks, without leaving any external sign. Fossil fish, crabs, lobsters etc. found in high mountains would have been born to microscopic eggs supposedly carried out by water steam all the way up till the hill tops.

This view was criticized by Antonio Vallisneri (1661-1730), who had been a student of Marcello Malpighi (1628-1694), belonging to the school of Galileu Galilei (Rappaport, 1991; Harris, 2009). In his 1727 book "De Corpi Marini che su Monti si Trovano" ("About marine deposits found in mountains"), which brings up de la Hire statements and a study of the petrified fish found in the mountains of Lessinia, in the Province of Verona, which were long known for their extraordinary preservation (Vallisneri, 1727). There are records of the richness of such details, which led many people to describe them as "fish mummies", since the 16th century. A detailed drawing of a petrified fish was included (fig 2a), in order to show that eggs could be seen in the petrified fish, therefore they would belong to egg-producing creatures. In this book, he insisted that the biblical Flood could not account for his ow geological observations, having already developed a reputation as a "non diluvial geologist" before writing the first edition of his book (1721). In fact, both his published book and his private correspondence are plenty of views contrary to the literal undertanding of the Bible, regarded as "indissoluble knots", if one compared his own geological views with the Biblical time scale (Rappaport, 1991). Surprisingly, the book received an "imprimatur" stamp of the Inquisition, even if Vallisneri negated the view which attributed the presence of fossils from the sea on the mountains to the effect of the Great Flood affirmed that their presence was instead due to geological transformations, which had led to the rising of lands that had previously been underwater.

The place where the fossils came from was a small village in Italy called Bolca, in the *vicentino-veronese* border, in a place 800 meters above sea level, which is considered a peerless *Konservat-Lagerstätten* (literally "place of storage") or in other words, a place which preserved much of the fossils' details and give a good idea of the whole environment of the past. Without a very good preservation it would be impossible to address de la Hire propositions. There are abundant paleohetermorphic creatures which lived in tropical seas. Palm trees and even cocoa fossils (fig 2b) can be found in that region of the Alps.



Figs 2a and 2b. Page from Vallisneri's book (1727) and a fossil of a cocoa (palm tree fruit) found in Bolca.

This was an ideal place to address research as we had collected data in two other *Konservat-Lagerstätten* in Brazil, namely in the Crato and Santa Maria formations. This was important as we should find Italian students with the same opportunities as the Brazilian ones, who would have had contact not only with fossils, but also with a wider paleontological context. As we will see ahead, many similar details appeared in students' discourse. The discussion of Bolca's paleoheteromorphy can be found in several publications of the 18th century, as Vallisneri's conclusions were confirmed by Lazzaro Spallanzani (1729-1799) almost thirty years later. However, in the words of Charles Lyell:

> A lively controversy arose between Fortis and another Italian naturalist, Testa, concerning the fish of Monte Bolca, in 1793. Their letters, written with great spirit and elegance, show that they were aware that a large proportion of the Subapennine shells were identical with living species, and some of them with species now living in the torrid zone. Fortis proposed a somewhat fanciful conjecture that when the volcanos of the Vicentin were burning, the waters of the Adriatic had a higher temperature; and in this manner, he said that the shells of warmer regions may once have peopled their own seas. But Testa was disposed to think, that these species of testacea were still common to their own and to equinoctial seas, for many, he said, once supposed to be confined to hotter regions, had been afterwards discovered in the Mediterranean. (Lyell, 1835(I), p. 77)

Lyell's description of the debate between Fortis and Testa is not accurate, as the discussion was not centered on Subappenine fossil shells, but rather on the origin of the fossil fish found in Bolca. In addition, the proposal of the influence of volcanoes' activity on local microclimate was not Fortis', but Testa's proposal. More importantly, there was a third abbot involved, who actually initiated the debate, as early as 1789, Giovanni Serafino Volta (1754-1842), a very controversial naturalist, who had been recently expelled from Pavia University, after a well known *imbroglio* with Lazzaro Spallanzani. Apparently, Volta felt betrayed by Ermenegildo Pini (1739-1825), a catholic priest who did not support

Volta´s conclusions against Spallanzani in 1786(Mazzarello, 2004). As Pini also had links with Domenico Testa (1746-1825), it is likely that Volta considered both as adversaries. Volta announced in his published letter a tantalizing forthcoming publication, "Ittiolitologia Veronese" (ˆfossil Fish from the Province of Veronaˆ), which would prove, beyond any doubt, that Bolca fossil fish were witnesses of the Mosaic deluge, and, in addition, that it would have been a global ("universal") event. The "lively controversy" went on up to 1793, (see Gaudant, 1999 for a description of the debate).

In fact, Roderick Murchinson (1792-1871) and Lyell visited Bolca and the extict volcanoes of the *Vicentino* in 1828, and admitted that "the work of geohistory was necessarily interpretative, as nature's monuments could yield little insight unless nature's language could be learned and nature's inscriptions deciphered and read." (Rudwick, 2008).

We have been collecting and reading the production of Italian geologists of the 18th century, which admittedly developed the leading earth science of the *Settecento*. The epistolary debates of Alberto Fortis (1741-1803) (Ciancio, 1994, 2010), and Giambattista Brocchi (1772-1826), who actually published a work on Subapenine fossil shells as late as 1817 (see Domini, 2010; Domini and Eldredge, 2010) have been very rich sources in order to interpret the ways nature's language was "deciphered and read" then and now, as we also performed twelve interviews in two places: the place of the famous fossil fish, Bolca (Vestenanova, VR) and the nearby place plenty of extinct volcanoes, Roncà (VI).

Students' views: Research questions answers

Italian Interviews were performed individually in the small village of Bolca, northern Italy, in May-June, 2008, and nearby, in Roncà, in March 2011. Previous contacts were carried out with local museums (Bolca's "Museo dei Fossili", and Roncà's "Museo di Storia Naturale"), which were visited, and also Verona's "Museo Civico di Storia Naturale" where a larger collection of Bolca's fossils can be found. A semi-structured interview plan was designed and included three parts. The first part had questions about local living species, animal and plants. Other questions regarded local fossils and asked students the name of some of them, showing pictures.

The second part of the interview had questions about three small invertebrates, which were in resin and handed to the students: a large scorpion, and a spider and a beetle which were more or less the same size. We asked students to examine with their own eyes and tell which one was more similar to the spider. The intention of this part of the interview was, first, to investigate their ability to discriminate local living species from exotic ones. The question about the similarity of the spider was intended to see if students answered taking into consideration animal's size, or rather referring to number of legs or any other zoological term, feeling free to give their own opinions. A possible answer mentioning "arachnids" would be

taken as a sign that the interviewees were trying to meet researcher's expectations and were not considering their own genuine knowledge.

Students who answered with no reference to formal zoological terms and knew local fossils, were then asked to explain several aspects of their understanding about local geohistory. Students were asked to describe how often they used to go to the local museum, and how they conceived paleoheteromorphy, using examples of known plants and animals. The length of time required for fossilization to occur was another aspect and special attention was paid to any reference to the deluge (which, in fact did not appear at all).

Finally, in the third part of the interview, students were asked to use adhesive labels in order to show their views on deep time, using a pictorial linear representation (timeline), with the word OGGI (today) in one end and the figure of a dinosaur in the other. Red stickers represented local fossil animals, and green stickers represented plants. Once they had placed these two stickers, they were asked to do the same with an adhesive label with the image of Jesus Christ (fig 3a).

As the villages are very small, only twelve students aged 9-12 years old qualified for the full interview. The interviews were carried out individually, in students' own homes or otherwise in places suitable for them. Interviews were performed before their parents; however with no direct eye contact so that the child could not receive positive/negative feedback from his/her parent. They signed a written agreement for the interview, which was preformed in Italian (and not in *Veneto* dialect), which is considered the proper form to communicate at schools, and were tape recorded, translated into Portuguese and transcribed for analysis or summarized.

One interview can show how rich and original students' views were. Alessia (name not real) is a 10 years old, girl, who was born in the village of Bolca and knows the local museum very well. She used to play collecting sharks' teeth in a place near her home and knows very well the proofs of the existence of an ancient volcano, which had a crater near the place where the local church is located. The interview was carried out in the place where her father works, in Bolca. In the first part of the interview, she showed her knowledge of local fossils; in the second part, which involved the three real size invertebrates on resin, she had as an answer that the spider was more similar to the beetle than to the scorpion, therefore was qualified to go on, as it was a positive sign that she was not simply trying to meet the researcher's expectations. In the first part, she was showed some pictures of Bolca fossils, and asked if she recognized them.

A sample interview

Researcher (showing picture of a fossil plant): (…) *What about this one... Have you already seen this?*
Alessia: *Yes, but just on pictures* (actually it is not on display in Bolca's Museum, but in Verona's)
Researcher (showing a picture of the fossil fish *Ceratoicthys,* on display in Verona): *What about this one... Have you already seen it?*
Alessia (hesitatingly): *Yes. It is the angelfish.*(wrong answer)
Researcher (showing a picture of the fossil angelfish *Eoplatax papilio* on display in Bolca, considered the most important fossil of the place): *And what about this one? Do you know this fossil?*

Alessia (positively): *NO*! (meaning YES!). *This is the angelfish*! (she is correcting herself).
Researcher: (showing a picture of the fossil fish *Exellia velifer* on display in Verona): *And what about this one? Do you know this fossil*?
Alessia: *No. This one I do not know*.
Researcher (showing a fossilized plant): *And this one*?
Alessia: *This is a sort of algae*.
Researcher: *I learned that you know a lot of local fossils! Have you been to the "Museo dei Fossili"?*
Alessia: *Yes, we always go there with schoolmates*.
After answering that the beetle is more similar to the spider than to the scorpio, she was ten asked:
Researcher: *When you went to the* Museo dei Fossili *you saw many plants and animals. Did you have already seen them living outside the* Museo?
Alessia: *No! They do not live here*.
Researcher: *And how was it possible that their fossils were found here*?
Alessia: *Long ago this place was a seashore and there was a volcano here. And the volcano expelled a lot of lava, which burnt animals and some plants.*
Researcher: *Do you mean these animals and plants actually lived here*?
Alessia: *Yes, they lived here*.
Researcher: *They were very different from the one that live here today, weren't they*?
Alessia: *Yes, they were*.
Researcher: *How was it possible that these animals, which were not used to the cold winters you have now, could live here? How is it possible they could survive here?*
Alessia: *Yes, they lived here, 'cause of the volcano, it heated the water of the whole place.*
Researcher: *Ah! I understand. You mean the volcano heated the water, but also the land? The palm trees… We do not find palm trees here anymore… You may have already seen these trees on TV or pictures. They are found only in hot places. Did they actually live here?*
Alessia: *Yes… 'cause of the volcano*.
Researcher: *So… the volcano heated water and land here?*
Alessia (shaking her head positively): *Yes*.
Researcher: *And how did these animals and plants became rocks? They lived here and there was also a volcano… How there animals and plants became rocks*?
Alessia: *The volcano… There was a lot of lava coming out and it became rocks, and plants and animals also became rocks. But one day, there was no oxygen, and fish cannot live without oxygen. This is why many of them died at the same time. Lava thrown out by volcano formed rocks. Within the rocks there are fish*.
Researcher: *So,* …(thinking) *the rocks in which we find fish were formed by the volcano*… (stating);
Alessia (positively): *Yes*!
Researcher: *Alright… and there was actually a sea… was the sea here, at this height*?
Alessia: *Yes! It was here, at the top*.
Researcher: *But, how was it possible that the sea had reached this place?*
Alessia: *The whole of the* Pianura Padana (Padan Lowland) *was a large sea*…

The interview explored other aspects, and Alessia was asked to represent her ideas on deep time in an representative timeline (fig 3). Her representation is shown as #2 in fig 4A.

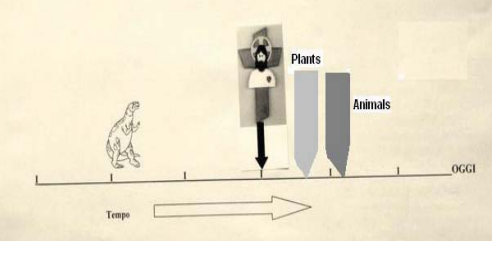


Fig 3. Representative time line which students were asked to stick in three figures: a green one (representing fossil plants), a red one (representing animals) and, after that, to show when Jesus Christ would have lived.

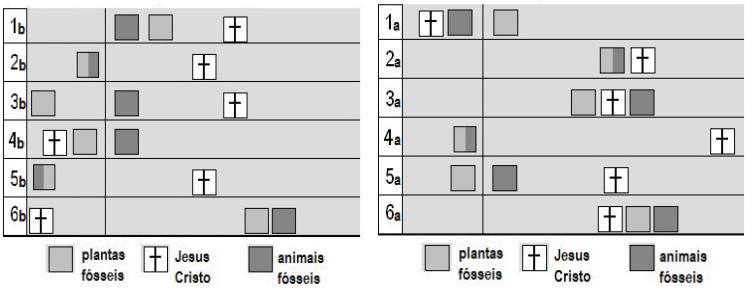


Fig. 4a and 4b. Timeline with summary of the six protocols collected in Bolca (4a) and Roncà (4b).

We were then able to see in objective terms the representation of relative age of the different fossils and time references. Protocol answers are shown in fig. 4a and 4b, where we can see several ways in which the local geohistory was conceived. When children speak freely, they show a rich and wide context, generally using a rhetorical expression which is very common in the Italian language, beginning with "*secondo me*" (which means "according to my opinion"). They express complex models, based on very sophisticated evidence available to them, which gives rise to complex intellectual ecologies (Limón, et al, 2009).The oral answers describe a rich knowledge of the Eocene (a term created by Lyell after being there), with two remarkable observations. First, there was no reference to biblical deluge or supernatural explanations; and, second, there was no real acceptance of the description of the uprising of the terrain. Some students declared their knowledge of the "correct" version, but they thought that it was easier to think that the sea had reached that height instead. This is surprising, as we are not facing a religion/belief denial, but a purely rational consideration.

Another interesting model referred to the extinct volcano that can be seen in terms of the abundant basalts that can be found near the local hilltop in Bolca and also in Roncà. The young girl, as we could see, argued that the volcano was once active, and therefore, the local climate should have been hotter; this would explain palm trees and tropical fish found there. There is a surprising coincidence with the argument put forward by Domenico Testa, as the argument of the microclimate was evocated in 1793 in order to explain local paleoheteromorophy. The "basalt waterfalls" are one of the local attractions for tourists, and provide natural stone bricks, after the action of ice in winter. These bricks were originated from basalt columns, which were described in detail in that epoch (Strange, 1778). Many walls and houses are made with those bricks. This partially explains the reason why the presence of the extinct volcano is so central in youngsters' minds.

As in previous works, we found rich schema, under peculiar ways of interpreting plenty of evidence, and some striking coincidence with similar ways to conceive that body of facts which were used in the past. Our paleoheteromorphy hypothesis showed as not consistent, as there are alternative ways to conceive completely different fossil fauna and flora, without taking into account geological time.

Despite the fact that more research is needed, both in the history of geology and in sociocultural aspects of thinking, results show that geological time is not intuitive and even those who have direct contact with very important and significant fossil remains do not easily construct the notion of deep time. Our conclusion is that there is a need to reconsider curriculum design, and provide students more experience with macro-evolution phenomena, adding new evidence to this proposal as presented in previous works (Dodick & Orion, 2003, Dodick, 2007, Bizzo & El Hani, 2009). Moreover, more attention has to be paid to adult and scholarly scientific definitions offered to students, which can give rise to complex intellectual ecologies in the school context.

References

Berry, K.S.,(2006).Research as bricolage: embracing relationality, multiplicity and complexity. pp.87-115 IN Tobin, K., Kincheloe, J. (eds), *Doing Educational Research: a handbook*, Roterdam/Taipei, Sense Publishers..

Bizzo**,** ***N*** and L.E. Bizzo,(2006) Teaching Evolution in the Context of Discovery: Charles Darwin in the Andes. *Journal of Biological Education* 40: 68-73

OLIVEIRA, J. B., FRANZOLIN, F., PAGAN, A. A. (2006). Researches about evolution education and school sciende p.123 – 127In: IOSTE XII Symposium, 2006, PENANG. Proceedings IOSTE XII Symposium. Penang (Malaysia): Zillion Circle (M) Sdn. Bhd.

& ***El-Hani***, C. N. (2009). Darwin and Mendel: Evolution and genetics. ***Journal of Biological Education*** 43(3): 108-114

Ciancio, L. (1995). Autopsie della Terra. Firenze, L. Olschki

(2010) Lettere di Alberto Fortis (1741-1803) a Giovanni Fabbroni (1752-1822). Chioggia, Il Leggio Libreria Editrice.

Dodick, J. (2007) Understanding evolutionary change within the framework of geological time. *McGill Journal of Education,* 42(2), 245-264.

Dodick, J.T. & Orion, N. (2003) Introducing evolution to non-biology majors via the fossil record: a case study from the Israeli high school system. *The American Biology Teacher,* 65, 185-190.

Dominici, S. (2010). Brocchi's Subapennine Fossil Conchology. *Evolution: Education and Outreach*, 3: 585-594,

and N. Eldredge (2010). Brocchi, Darwin and transmutation: phylogenetics and paleontology at the dawn of evolutionary biology. *Evolution: Education and Outreach*, 3: 576-584.

Gaudant, J. La querelle des trois abees (1793-1795): le Débat entre Domenico Testa, Alberto Fortis et Giovanni Serafino Volta sur la signification des poissons pétrifiés du Monte Bolca (Italie), in J. Tyler (a cura di) «Miscellanea Paleontologica» , VIII, Verona, Museo Civico di Storia Naturale, pp 159-206. (1999).

Hokayem, H. and S. Boujaoude. (2008). College Students' Perceptions of the Theory of Evolution. *Journal of Research in Science Teaching.* 45(4), 395-419.

Hunt, K.; Emslie, C.; Watt, G. (2001). Lay Constructions of a Family History of Heart Disease: Potential for misunderstandings in the Clinical Encounter? The Lancet, 357: 1168-71.

Limón, M., L. Mason & M. Limsn (eds), (2009). **Reconsidering conceptual change: issues in theory and practice**. Dordrecht, Kluwer (2nd ed.).

LYELL, C. (1830). **Principles of Geology** (iii vols), (available at: http://www.esp.org/books/lyell/principles/facsimile/)

MARTILL, D, Gunter Bechly and Robert F. Loveridge (2008). **The Crato fossil beds of Brazil: window into an ancient world**. Cambridge, Cambridge University Press.

Mazzarelo, P. Costantinopoli 1786: la congiura e la beffa. L'intrigo Spallanzani. Torino, Bollati Boringhieri, (2004).

Oliveira, J. B. (2006). O Tempo Geológico no Ensino Fundamental e Médio: os estudantes e os livros didáticos. Unpublished PhD Thesis, School of Education, University of São Paulo, São Paulo.

RAPPAPORT, R. (1991). Italy and Europe: the case of Antonio Vallisneri (1661-1730). *History of Science* 29: 73-98.
ROGOFF, B. and J. LAVE. (1999). **Everyday Cognition**. Cambridge (Mass) Harvard University Press.
Rudwick. M.J.S., (1976). **The meaning of fossils: episodes in the history of palaeontology**. New York, Neale Watson Academic Publications.
_____ , 2008. **Worlds before Adam: the reconstruction of geohistory in the age of reform.** Chicago, Chicago University Press.
Santos, S. and N. BIZZO, (2002). Inheriting Ideas about inheritance: a study of explanations to the genetic disorders affecting a large Brazilian family over generations. Pp 721-726 In: Bizzo et al (eds), Foz do Iguaçú, X Symposium IOSTE Proceedings. II vols.
Santos, S. and N. Bizzo.(2005). From "New Genetics" to Everyday Knowledge: Ideas About How Genetic Diseases Are Transmitted in Two Large Brazilian Families. *Science Education* 89(4):564-576.
Steinberg, S. R.(2006) Critical Cultural Studies Research: bricolage in action. Pp117-137, IN K.Tobin and J. Kincheloe (eds). **Doing Educational Research: a handbook**. Sense Publishers, Roterdam/Taipei.
STRANGE. J. (1778). **De Monti Colonnari e D'Altri Fenomeni Vulcanici Dello Stato Veneto**. Milano, G. Marelli.
Vallisneri. A. (1727). **De Corpi Marini che su Monti si Trovano**. Venezia, Domenico Lovissa Stampatore.

Appendics – Interviewed students' data

Locality	State/Province/Country	Girls	Boys	Mean Age (mín & max)
Mata	RS – Brazil	6	3	10 (8 -12)
Araripina	PE – Brazil	2	5	11 (9 – 13)
Santana do Cariri	CE – Brazil	5	6	12 (11 – 15)
Bolca (Vestenanova)	VR – Italy	2	4	10 (9-12)
Roncà	VI – Italy	0	6	10 (9-10)
Total		15	24	11 (8-15)

RS – Rio Grande do Sul, PE – Pernambuco, CE-Ceará, VR – Verona, VI- Vicenza.

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Chapter 11

The Relief in the Context of Environmental Projects: Potentialities and Fragilities

Jurandyr Luciano Sanches Ross

Abstract The relief analysis focused on the geomorphologic application in environmental projects has been developed recently with the perspective of having a better knowledge of natural environment characteristics in front of the environmental territory planning projects.

In this context, the geomorphologic researches with the purpose of developing relief shapes maps are dependent on cartographic scales applied in the study. Depending on the scale of mapping that is being used, it is necessary to define what sizes of landforms will be represented, as well as, what techniques should be applied to obtain the best results for identifying the environment potentialities and fragilities to be used or not to be used by society for varied interests.

The theoretic and methodological approach used in these geomorphology-applied projects is based on General System Theory with emphasis on Tricart (1977, 1992), when concepts theorizes about the eco-dynamics processes and eco-geographic assumptions. In the core of this systematic approach, the methodology also includes Ab'Saber (1969), Mecerjakov & Gerasimov (1968) and Ross (1992, 1994, 2006).

Considering these authors as theoretic, methodological and technical support, a structured research work was developed where the main technical product is the thematic map that is used to help generate synthesis geomorphologic map and the potentiality and fragility environmental maps. As the first product of this research, it was tried to apply the taxonomy of relief, developed by Ross (1990 and 1992) being a starting point for geomorphologic analysis and generation of geomorphologic map with integrated legend, where the relief shapes are pointed with their morphologic and morphometric characteristics associated with materials that support them as relating to lithological structure as the pedologic coverage. So, there is a map with legend from the morph structural units representing the major forms and increasing according to the scale to other

taxons, or better, morphosculptures, types of relief, landforms, and types of slopes and recent shapes of current anthropic induction.

The second product, derived from the first, consists of the environmental potentialities and fragilities, which have been applied to the methodology and technical-operational procedures developed on several works attempting to combine the morphologic, morphometric and eco-dynamics information with the characteristics of covering materials such as soils and deposits of superficial materials and support materials as the diversity of lithologies and their structural arrangements, as well, the rainfall dynamics during the year. In this context, it reaches a set of environmental units or landscapes, due to the combination of variables from natural environment. In each one of these sets are established several levels or degrees of environmental fragilities according to the theory and methodology used. From which it also evaluated the potential of natural environments, due to diversity of potential uses of the territory which is object of analysis. The environmental fragilities identified in the mapping process are classified into a hierarchy, since too weak fragilities, therefore, high potentialities for various uses, to very strong fragilities and low potential for productive uses, but very high environmental and ecological interests.

So is these geomorphologic mapping joined with their derivatives, fragility and potentiality environmental are extremely interesting for application to territory environmental planning projects from different scales and are directed mainly to the environmental zoning and for establishing the conservation of environmental units and ecological preservation.

Keywords *relief, environmental analysis, unitsecodynamics - weaknesses, strengths.*

Introduction

The understanding about relief and its dynamics passes through the understanding of the functioning and interrelationship among the other natural ingredients (water, soil, sub-soil, climate and vegetation cover). This way of understanding the relief forms is a significant interest for the physical and territorial planning. This planning with environmental-territorial bias should take into account the resource potentialities and the fragilities of the natural environment, combining with the technological and socio-cultural conditions.

In geomorphology researches, a fact that must always be on alert is that the relief forms of different sizes have genetic explanation and are interrelated and interdependent of other nature components. The land surface, which is made up of land forms from different sizes or taxon from different ages and different genetic processes. It is also dynamic, even though human eyes can't capture it.

The dynamics of land forms represent different speeds, being sometimes more stable and sometimes unstable. This behavior depends on natural factors and also the interference of human being.

In this paper, the basic concern is to put into evidence that the execution of technical studies ofgeomorphologic character engaged into social-economic and environmental issues planning with the use of remote sensors images and the systematic field control whichpresents social utility. For this reason, the main aim is the generation of geomorphologic maps with integrated subtitles, that allows direct reading, and which product subsidizes environmental planning in physical land spaces of different sizes.

Theoretical and methodological basis

The theoretical and methodological approaches which apply to work the geomorphologic research have their roots in the design by Walter Penck (1953) that defined clearly the driving forces of terrestrial landforms, or better, the driving forces from the antagonism of endogenous and exogenous processes. The endogenous forces that fall through the active processes, driven by the Earth's crust and the oceanic dynamics and by lithology erode resistance and its structural arrangementthat provides the action of exogenous or climatic processes. In this case a passive action is constant, however unequal, in the face of greater or lesser degree of lithology resistance.

The exogenous action is also constant, as well as differential, both in space and time, in view of local, regional and zonal climatic characteristics and climate changes by over the time. The process of weathering, erosion and transport is made by both mechanical action of water, wind, thermal variation and the chemical action of water, which changes primary minerals into secondary minerals and simultaneously carves the forms of relief.

Based on theoretical principle of the endogenous and exogenous processes as generators of large, medium and small terrestrial relief, Gerasimov (1946) and Mecerjakov (1968), developed the concepts of morph-structure and morph-sculpture. The morph-sculptural units are products of recent climate action, and also of past climates. They also reflect theinfluence of diversity resistance the lithology, and its respective structural arrangement, on which was carved. Thus, in a given morphstructural unit, which reflects the lithological diversity, climate types that happened in the past and those that happens nowadays, they can carve somevarieties ofmorphsculptures. For example: a morphstructural large sedimentary basin, where one can find several morphsculptureunits. Based on the genetic interpretation, there are two levels of understanding: the first taxon that is characterized by morphstructural of the sedimentary basin, whichstructural characteristics define a particular pattern of large relief forms, the second taxonis related to themorphsculptureunits generated by the climate action overgeological time, in the center of this morphstructure. In this morphstructural unit is possible

to find peripheral depressions, inclined depressions, plateaus and flat surfaces, summit residue plateau among others. The third taxon (of a smaller size) refers to the Standard Units of Relief Forms, or Relief Types or just Forms, thatis where recent morphclimatic processes can be more easily noticed. These Standards of the Similar Forms of Relief are collections of lesser forms of relief, which presenting the distinct appearance among themselves according to the topographic roughness or dissection index of relief, as well as, the shape of the tops, slopes and valleys of each existing standard. It's possible to have several Units of relief types or modalities of Standards of Relief Forms to each unit morphsculptural. The landforms in each individual unit Types of Relief correspond to the fourth taxon in descending order. The landforms in this category are either such as the degradation of the river plains, river or marine terraces, marine plains, lake plains among others; or those resulting from weathering erosion, such as hills, mountains, ridges, cliffs, erosion levels, among others. Thus a unit ofStandards of Relief Forms is composed by a large number of relief forms from the fourth taxon.

The fifth taxon in descending order is the slopes or sectors of slopes belonging to each of the individual forms of relief. The slopes of each type of shape are genetically distinct and each one of these slopes sectors isalso different.These sectors may have various inclinations that also helpto define their characteristics.

The sixth taxon, correspond to the smaller forms produced by current erosion process or current deposits. Those examples are collapse caused by hollow waters, ravines, land-slides marks, recent banks sedimentation, silting, cattletrampling terrace, productsof currentmorphgenetic processes and often induced by humans. It may also be mentioned anthropogenic forms such as cuts, embankments, land-slides ofhill among others.

The geomorphologic maps should follow the rules of the International Geographical Union, that is: the maps should represent the geomorphic landforms in morphology (morphography), morphmetric, morphgenetic and morph chronological. A fact of great complexity is to distinguish the representation levels of geomorphic events depending on the size and scale of their chosen representation.

Fragility and potentiality of land forms

Integrated studies of a given area require an understanding about the dynamic function of the natural environment with or without the human intervention. Because of all the environmental problems of predatory economic practices that have marked the humanity history, it becomes the Physical Planning Territorial even more necessary, not only undereconomic and social prospect but also environmental. This way, the concern of planners, politicians and society as a whole, exceeds the limits from economic and technological development benefits, but also must be concerned with the development that takes into account the

resource potentialities and especially the environment fragilities.In thatprospect of economic planning and environmental territory planning, being in the municipal district, state, national, watershed, or any other unit, it is absolutely necessary that human interventions are planned with clear aims for territory arranging.

The functionality of natural environments, as well as, thosechanged by human actions is driven by solar energy through the atmosphere, hydrosphere and the earth energies that discloses itself in the lithosphere (reliefs - soil - rocks). The frequent exchanges of energy and matter that is processed inside in these great masses, combined with the presence of water in its three physical states, allows the existence of plant and animal life on the planet.

Grigoriev (1968) defines these interactions as the "Geographic Stratum of the Earth" that is, a narrow strip between the top lithosphere and the lower atmosphere which corresponding to the environment that allows the existence of human being asa biological and social entity, as well as other biotic nature elements.

The different natural environments found on the earth surface, which resulting from different exchange of energy and matter between the components are known in the theory of systems such as ecosystems in the biological concept and as geosystem as a geographical concept. In these approaches, where the energy exchange relations are absolutely interdependent, it is not possible to understand the dynamics and genesis of soils without knowing the climate, the relief, the lithology and their structural arrangements, or even, the analysis of fauna without associating it with the flora that gives its support, for its turn can't be understood without knowing aboutclimate, the water dynamics, the soil types and so on.

In geographic perspective, human societies can't be treated as strange nature elements and therefore to environmental systems or geosystems where they live. On the contrary, they must be seen as a key part of this dynamic, represented by the energy flows that make the whole system works. However, the progressive changes inserted by human societies in different natural components, increasingly affect the functionality of the system and often lead to serious degenerative processes to natural environment. In this context is essential that the human inserts are compatible, by one side with the potential of resources, and other side withenvironment weaknesses.

The knowledge about potentialities of natural resources has been a constant practice on researches in the field of earth science. These practices include field surveys, laboratory analysis and thematic mapping of: soils, topography, rocks and minerals, water, climate, flora and fauna, and finally all the components of the geographic stratum that support wildlife and human life. To analyze the weakness, however, two principles are essential. First, that sectored knowledge must be understood in an integrated way, always based on the principle that nature has intrinsic feature of its physical and biotic components. Secondly that each identified environment (geosystem, environmental system, landscape unit), besides their potentialities, they also presents weaknesses. These weaknesses under human interventions destabilize the functionality of the system environment.

The fragilities of natural environments can be applied based on the concept of Ecodynamics Units recommended by Tricart(1977), who defends that ecologic environment is analyzed under the feature of Systems Theory that assumes the exchanges of energy and matter in nature occurs by a dynamic balance relation. This balance is often changed by human intervention in various parts of nature, creating a temporary or even permanent state of imbalances. Thus, Tricart (op cit) defined that the environments where they are in dynamic equilibrium are stable, when imbalances are unstable. These concepts were used by Ross (1990), in an opportunity to set new criteria to define Stable EcodynamicsUnits and Unstable Ecodynamics Units. Unstable Ecodynamics Units were defined as those whose human intervention changed the natural environment intensely through deforestation and practices of various economic activities, while Stable Ecodynamics are the units that are in dynamic balance and were spared from human action, therefore are in its natural state, such as a forest of natural vegetation. For these concepts could be used as a subsidy to the Environmental Planning, Ross (op cit), expanded the use of the concept, establishing Unstable Ecodynamics Units or Emergent Instability in various degrees: since aVery Weak Instability to a Very Strong. He applied the same for Stable Ecodynamics Units, which despite of being in a dynamic balance, they presentPotential Instability quite foreseeable in face their natural characteristics and always possible anthropogenic inclusion. Thus Stable Ecodynamics Units, present themselves as Potential Instability Ecodynamics Units in different degrees, or better from very weak to very vtrong.

Basis for environmental analysis of fragilities

The empirical analysis of fragilityrequires basic studies of relief, rock, soil, land use and climate. Studies must be done from field surveys, with the staff services, from which are generate thematic cartographic products of geomorphology, geology, pedology, climatology, water and use of land vegetation and fauna. These thematic products are accompanied by synthetic technical reports. Thus the study of soils is proper, by one hand,forestimation of agricultural potentialities (agricultural suitability or usability), by other hand, itsubsidizes the environment fragility analysis in face to human activities linked to agriculture and stock farming. The geological surveys are basic to understanding the relation of relief/soil/rock, with weather information, especially rainfall (intensity, volume, duration). They are also proper to evaluate the potentialities and fragilities of natural environments, like as roughness of the topographic relief (rates of dissection) and declivity of the slopes, as well as, surveys of land use types, soil handling for agriculture, treated in an integrated, enables to reach a diagnosis of the different hierarchical categories of the fragility of natural environments.

Phases and intermediary products

The Geomorphologic map accompanied by a genetic analysis of intermediate products to constructthefragility map. Its execution is done under the procedures defined by Ross (1990 and 1992), who establishes the theoretic technical concepts forconstructing thegeomorphologic map and genetic analysis from different forms of relief. For the analysis of medium and small scales like 1:50,000, 1:100,000, 1:250,000, it is used as the basis for information of Standards Forms with indicators of topographic roughness or dissection. When the analysis is more detailed, such as scales of 1:25,000, 1:10,000, 1:5,000 and 1:2,000, it uses forms of aspects and slope classes. In these cases one must use the classes ranges already established in studies of capabilities of Usability and Agricultural Fitness associated with those known values as critical limits of geotechnical, indicators oferosion force, the risk of landslides, mudslides and floods.

For the relief variable, taking the declivity of the slopes, the fragilities are defined as follows:

Fragilities classes by the variable declivities of the slopes	
1-Very weak	zero to 2% - plans and high reliefs, or 1º(degree)
2-Weak	3%to 15% or 8º
3-Medium	16%to 30% or 17º
4-Strong	31%to 50% or 25º
5-Very strong	50% or above 25º
5-Very strong	2% or lesser 1º - relief from the flood plains.

Weaknesses classes for the forms of slopes

For the shapes of slopes, mappable inlarge scales 1:5.000, 1:10.000, 1:20.000 and middle scales1:50.000, the classes of fragilities were ranked on:

1-Very weak	Tp-flat tops of hills, terraces and residual hills
2-Weak	Tc-convex tops of hills and mountains
3-Medium	Vc-convex slopes of hills and mountains
4-Strong	Vr-rectilinear slopes of hills and mountains
5Very Strong	Vc-concave slopes in headwater drainage

Fragilities of the standards of relief dissection (roughness)

For studies of medium and small scales, it is used as a morphometricreference theDissection Indicators Matrix developed by Ross (1992), based on the ratio of drainage density/dimension interfluvial average for dissection in the horizontal plane and in degrees of notching the drainage channels for dissection in the vertical plane:

This matrix provides the categories of influences from very weak and very strong,as shown in the figure below:

Matrix for dissection of relief index

Drainage density or dimension Inter fluvial (Medium Class) / Deeping Drainage	Very Weak (1) 3750m	Weak (2) 1750 to 3750m	Me-dium (3) 750 to 1750m	High (4) 250 to 750m	Very High (5) 250m
Very weak (1) (from 20m)	11	12	13	14	15
Weak (2) (20 to 40)	21	22	23	24	25
Medium (3) (40 to 80)	31	32	33	34	35
Strong (4) (80 to 160)	41	42	43	44	45
Very Strong (5) (160)	51	52	53	54	55

The morphmetric categories are classified into fragility classes:

1-Very weak	from matrix 11
2-Weak	from matrix 21,22,12
3-Medium	from matrix 31,32,33,13,23
4-Strong	from matrix 41,42,43,44,14,24,34
5-Very Strong	from matrix 51,52,53,54,55,15,25,35,45

The fragilities to the variable soils

The criteria used for the variable soil passes through the characteristics of texture, structure, plasticity, level of cohesion of the particles and depth / thickness of surface and subsurface horizons. These characteristics are directly related to relief, lithology and climate, the driving forces of pedogenesis, and determinant factors of physical and chemical soil characteristics.Thesecriteria use assupporttheresearchresultsfromInstituto Agronômico de Campinas (IAC) Estado de São Paulo, from Instituto Agronômico do Paraná (IAPAR), and Projeto Radambrasil do MME, amongothers.

1-Very Weak	Deep-lands, well-drained, sandy-clayey Oxisols and Clay porous
2-Weak	Deep-soils, well-drained soils, medium textured sandy Oxisoils
3-Medium	Soils moderately depth, medium textured, loamy Ultisoils, Nitosoils
4-Strong	Shallow soil with very thick B horizon, sharp-transition Cambisoils
5-Very Strong	Shallow soils and rocky or sandy-Sandysoils and Entisoils,
5-Very Strong	Organic Soil, with high-hydromorphismGleysoils, and Spodosoils,Tiomórficos

However, It should be noted that field observations in different regions of Brazil,which show evidences that it's necessary to distinguish clearly the differences between the fragility/erodibility of the soil when the flow is diffuse or when it is concentrated. It's a known fact that the concentrated flow along paths and roads, or even on land prepared for cultivation. It is much more aggressive in the sandy loam Oxisoils / sandy soils than in clay and even shallower as Cambisoils, and Ultisoils Nitosoils. However, the transport of fine debris and colloidal material are more abundant from the surface horizon of soils even by diffuse flow in the second group of soils.

Fragility classes for vegetation covering and land use

The analysis of soil protection by vegetable covering involves the construction of the map of Land Use and Vegetable Covering. This work is centered initially on the interpretation from satellite images, in the case of medium and small scales (1:50,000 to 1:500,000) and from air photography, in the case of large scale (1:2,000 to 1:25,000). About interpretation of air photos and satellite images, it was identified the polygons from different types of uses, such as: natural

forests, barns, forestry, long cycle crops (coffee, oranges, bananas, grapes, figs, cocoa, rubber, pepper and so on), short cycle crops (cotton, rice, soybeans, corn, wheat,oats, etc..) natural grasslands, pastures, cultivated among others. In the case of urban areas it is necessary to distinguish the patterns of urbanization as much as fencing the green areas, the infrastructure, such as channeling of rain water, paving, curbs, buildings and other patterns.

1-Very weak	Very high protection of soils, primary and secondary forests with a high stage of regeneration
2-Weak	High protection of soils, dense Savannah Forests, forestry with herbaceous cover
3-Medium	Medium soil protection of long cycle crops with curves and terracing to forage among coffee- streets, citrus, papaya, forestry, pasture of low cattle trampling
4-Strong	Weak protection of long-cycle crops soils without forage between streets and short cycle with terracing and in curves
5-Very Strong	Very weak soil protection, deforested land with burning down practices, exposed soils for cultivation and earthworks, short-cycle crops without conservation practices.

Classes of fragilities by rainfall variable: hierarchical levels of rainfall variations hierarchical levels rainfall characteristics

1- Very Weak	Situation with regular distribution of rainfall throughout the year, with annual volumes, not much above 1000 mm/year.
2- Weak	Situation with regular distribution of rainfall throughout the year, with annual volumes not much more than 2000 mm/year.
3- Medium	Situation with annual rainfall distributed unevenly, with dry periods between 2 and 3 months in winter; in summer with higher intensities from December to March, with volumes from 1300 to 1600 mm/year.
4- Strong	Situation with annual rainfall distribution unevenly, with dry period, between 3 and 6 months, and heavy concentration of rainfall in summer between November and April when there is 70% to 80% of total rainfall, with volumes from 1600 to 1800 mm/years.

5- Very Strong	Situation with regular distribution of rainfall, or not, all over the year, with heavy annual volumes exceeding 2500 mm/year, or even irregular rainfall behaviors throughout the year, with episodes of high rainfall intensity and weak annual volumes generally below 90 mm/year (semi-arid).

Source: Based on Ross (1994).

Conclusion

From the list of relief variables (morphology and morphometry), rocks, soils, climate (rainfall), land use, vegetation covering is established the classification of the fragility and potential and emerging from the association of Arabic digits where each of the numbers of the numbers set represents a certain value that according to the foregoing classification tables ranges from 1 to 5, or better, from the weakest to the strongest or from the most protected to least protected in the case of Land Use/ Vegetation.

Thus way, the numerical association represents a digit for the relief (1 to 5) other for the soils (from 1 to 5), the less resilient to the more resilient, another digit for the degree of soil protection by vegetation (natural or cultivated), that also ranging from the most to the least protective (1 to 5), another for the weather/ rainfalls (1 to 5).

So, there are Arabic sets of four digits, which combine with each other, numbers from 1 to 5, that can have areas with values of type 1111, 1215, among others and reaching the highest value 5555, where all the variables are absolutely unfavorable.

In order to follow the proposed ecodynamics Units, it must begin from the following number sequence combination: the first digit refers to the relief, the second is concerning the classes of soils, the third digit for land cover / Land Use, and the fourth digit for classes for rainfall. Thus, the set number 1111 - corresponds to a stable ecodynamics Unit, or very weak potential instability. Overall number 5555 –The ecodynamics Unit is Very Strong Emerging Instability, where land use is constituted by the deforested area with exposed soil, very strongly dissected topography and soils much fragile to erosion, soft rocks and very rainy weather. The Potential ecodynamics Units may have different degrees of potential environmental fragilities, but are stable due to little or no human intervention. While ecodynamics Emerging Units have fragilities,from different environmental gradation and are marked by unstable environments due to human interventions. For example are lief unit that is classified as very high fragility, when covered by primary forests is under condition of a potential very high fragility. If the same relief unit is occupied with long cycle crops without adequate management is classified as Emerging Very High Fragility.

The combination of these variables and their respective gradations make possible to generate a synthesis product of presentable by polygons on map to

highlight and distributed object of research within the different fragilities of environments (potentials or emerging). With these differences of fragilities,it's possible to establish an environmental zoning map or ecological-economic zoning, or better an indicative of territorial spaces with a range of productive-economic potentialities or conservation/preservation areas. For each one of these areas or environmental units there are uses/production potentialities or conservation potentialities and the environmental fragilities with limitations for using to human activities.

References

Bertoni J. & Lombardi Neto, F. – Consevaçao do Solo – livro Ceres – Piracicaba 1985.Bigarella, JJ. &Mazuchowski, J. Z – Visao integrada da Problemática da Erosão – Maringá PR. – 1985.

Casseti, W. – Ambiente e apropriação do Relevo – Editora Contexto, São Paulo 1991.

Gerasimov, J. – Problemas Metodologicos de La Ecologizacion de La CienciaContemporanea, in La Sociedad y El Medio Natural Editorial Progresso – Moscou 1980.

Grigoriev, A.A – The Theoretical Fundaments of Modern Physical Geography, in The Interaction of Sciences in the Study of Earth, Moscou, 1968.

IAC- instituto Agronômico de Campinas- Perdas por Erosão no Estado de São Paulo – Boletim TecnicoBragantia nº 47 Campinas, 1961.

Mecerjakov, J.P. Lesconcepts de morphostructureet de morphosculture: unnouvelinstrument de l´analysegeomorphologique. Ann. Geographie, 77. N. 423, p. 538-552, Paris, 1968.

Ross, J. L. S. – Geomorfologia Ambiente e planejamento,- Editora Contexto- São Paulo. 1990.

Ross, J. L. S. – O registro Cartografico dos fatos Geomorficos e a Questao da Taxomania do Relevo, in Revistado Depto. Geografia FFLCH-USP- São Paulo, 1992.

Ross, J.L.S.- Análise Empirica da Fragilidade dos Ambientes Naturais e Antropizados, in Revista do DG-USP-nº8-São Paulo 1994.

Ross, J.L.S.- Ecogeografia do Brasil, Editora Oficina de Textos-São Paulo 2006

Tricart, J. – Ecodinamicas – FIBGE/SUPREN, Rio de Janeiro, 1977.

Tricart, J. – Paisagem e Ecologia, in Rev. Interfacies nº 76 – IBILCE – UNESP – São José do Rio Preto, 1982.

Chapter 12

Public Awareness of Geo-informatics for Sustainable Development

Sandeep Goyal

Abstract Geo-informatics is an amalgamation of Remote Sensing technology, Geographic Information System and Global Positioning System. Remote sensing has proved its effectiveness in exploration, management and planning of Natural Resources, which leads to sustainable development, the need of the time. Remote Sensing data having a synoptic coverage has an added advantage for comparison of various factors working in an area. Remote sensing coupled with GIS and GPS technology has been widely used for mapping various features on earth surface. India is one of the leading countries in applications of remote sensing data for various purposes. Various studies have been carried out for natural resources, resource planning including human resource, health studies with a special focus on of vector-borne diseases, development of surveillance system and infrastructure development etc.

Public communication on these issues is also of a greater concern. Maps are effective way of communication and map reading and understanding require scientific awareness. Remote sensing and GIS can present the scenario in a very effective manner. Even a lot of secondary information collected in the form of text and tables can also be integrated and converted in presentable maps, which clearly depict the 'Spatial' distribution and relationships. Madhya Pradesh the heartland of India and widely using this technology for resource planning and awareness purposes. Madhya Pradesh Resource Atlas Division of Madhya Pradesh Council of Science and Technology is presenting the resource strengths of an area by publishing various types of Atlases and through a dedicated website. This not only helps in creating public awareness but also supports in resource planning for sustainable development of that area. Here is an attempt to present different examples through various case studies.

Keywords *Geo-informatics, Remote Sensing, GIS, Communication, Natural Resources, Sustainability, Resource Planning, Public Awareness, Resource Atlas.*

Introduction

Human life is fully dependent on natural resources for its survival. Development of human society is leading to excessive use of resources. In other words our need of resources is turning to our greed. Mahatma Gandhi said *"Earth provides enough to satisfy every man's needs, but not every man's greed."* Thus, sustainable development of resources is the prime need of the time. It is also necessary to create public awareness to not only conjunctively use the resources but also for their sustainable development. The concept of sustainability came into focus about a decade ago during the summit in Rio de Janeiro in 1992 (EEA, 2005), which was widely accepted by the scientists world wide.

Remote sensing is the art and science of making measurements of the objects on the earth from a distance using sensors on various platforms such as airplanes or satellites. These sensors collect data in the form of images. Remote sensing images provide a synoptic coverage; therefore able to provide accurate assessment of resources. These images can be interpreted to generate various thematic maps. These thematic maps can further be integrated with other complimentary and secondary information using GIS to create resource maps. These resource maps clearly depict the present status, future demand and availability, gap areas, and measures required for sustainable development. Since ages maps are being used for communication. The History of maps begins from about 2300 B.C. preserved in the form of Babylonian clay tablets in ancient Greece. "A map is a graphic representation or scale model of spatial concepts. It is a means for conveying geographic information. Maps are a universal medium for communication, easily understood and appreciated by most people, regardless of language or culture. Incorporated in a map is the understanding that it is a "snapshot" of an idea, a single picture, a selection of concepts from a constantly changing database of geographic information" (Merriam 1996). It is therefore necessary to fully understand and utilize the capabilities of geo-informatics in science communication for public awareness.

Resource atlases: An effective way of communication

Sustainable development of an area is based on proper planning of its resources on a regional scale. It requires analyzing the forces that shape the growth and development of that area, formulating plans and policies to meet the needs of the area's inhabitants, and coordinating programmes and projects to implement these plans and policies. The inhabitants should be aware of their resource strengths and future need.

Application of Geo-informatics is very effective in drawing the clear picture of the status of resources in a region/state with the help various thematic maps, charts and tables. Madhya Pradesh is a fast developing state with its present resource base and it is imperative to utilize these resources optimally employing our human resource. This necessitates exploitation and management of natural

resources on sustainable basis by application of viable technology, surveying and mapping methods for which large amount of data required from various sources and its compilation and analysis at single point in the form of a Resource Atlas. The resource atlases can be designed at various levels and on different scales. It is necessary to begin with a regional scale or state level and go up to district / sub-district level.

The regional or a state level atlas consists of information on larger administrative units such as Districts. It should emphasize incorporation/ presentation of district wise data on various physical, natural, socio-economic and infrastructure resources viz. Historical background, Culture and Tradition, Soil, Water Resources, Forest, Agriculture, Human Resource, Power, Health, Transport and Industry. Using the GIS capability these data are represented in the form of maps, tables and charts. All the maps, tables and charts are interpreted and analyzed in text form highlighting the rich endowment of resources in the state.

The District Resource Atlas is aimed at highlighting the resources of each district incorporating data at sub-district level. The atlas will consist of various maps on Land use/ Land cover, Rivers & Water bodies, Lithology, Geomorphology, Soil, Physiography and Slope prepared using remote sensing and GIS technique. Besides these secondary data collected on area and production of various crops (cereals, pulses etc), operational landholdings, livestock, rainfall, climate, education and health infrastructure and demography parameters will be presented in the form of maps, tables and charts. All the maps, tables and charts will be interpreted and analyzed in text form highlighting the rich endowment of each district in the state.

Methodology and approach

The resource atlas is designed in such a way that it represents the status of resources and infrastructure at a defined level. The most important element in this atlas is the Natural Resource Maps which are generated after interpretation of Satellite Images. These are primary thematic maps on Land use/ Land cover, Rivers & Water bodies, Lithology, Geomorphology, Soil, Physiography and Slope. These primary thematic maps are also used to derive some important thematic maps viz. Land Capability, Ground Water Prospects, Land Irrigability, Soil Irrigability, Agriculture and Forest.

The secondary or complimentary data viz. land use pattern, area and production of different crops (cereals, pulses, oilseeds etc), operational landholdings, irrigation(area and source), cropping pattern, livestock, rainfall, climate, education and health infrastructure, demography are collected from various government and research agencies. The data thus, obtained are entered, formatted and standardized in Microsoft excel data sheets to prepare thematic tables of different resources. The advantage of Microsoft excel is that both statistical and graphical analyses

can be done using same set of data tables. Using the different thematic tables, the resources are presented in different graphical forms like pie chart and bar diagrams, etc.

The thematic data tables are integrated with maps showing administrative boundaries to prepare different thematic maps. It is worth to mention here that GIS is a powerful tool to handle and convert tabular data into map form as well as integration of tabular data with maps. The information related to historical background, culture and tradition are collected from government publications and other published materials and relevant information are transformed into suitable table and maps.

All the thematic maps, tables and charts prepared are interpreted and analyzed in a meaningful way to show the peculiarity and resource strength of a state, district or sub-district.

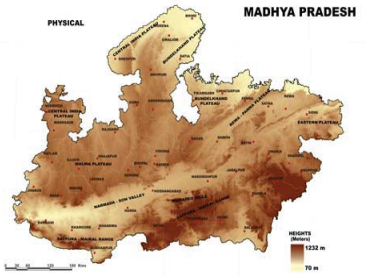
The datasets prepared for these atlases are presented before various groups ranging from policy makers, development planners, district officials from various execution departments, academicians and research scholars to common people to gather their views and suggestions about the datasets. Further these suggestions were incorporated and atlas is designed.

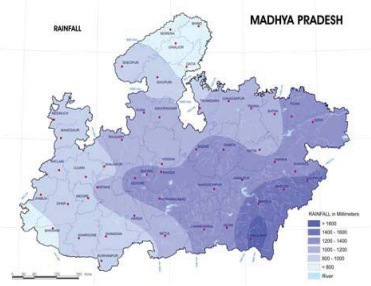
Discussion and conclusion

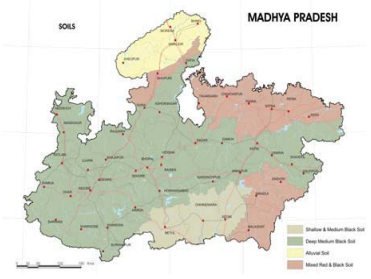
Public communication is a critical factor which influences the sustainable development and use of science and technology. Sustainable Development can be achieved by putting scientific and technical knowledge into practice. The sustainable development of resources is essential for the future development of human life. Therefore, creating public awareness on resource development and management is a prerequisite for the achievement of sustainable development. Thus, it is required to draw a clear picture of status of resources to make people aware about the resource strengths of their area. This kind of awareness on sustainable development enables individuals, groups and communities to judge in favour of sustainable development based on their critical thinking and proper involvement.

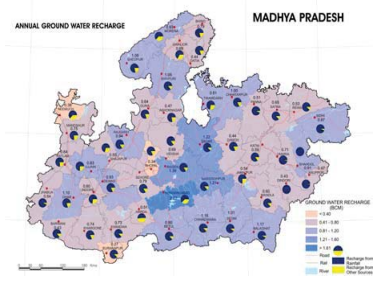
Today's modern world is full of various media tools viz. newspapers, magazines, advertisements, television, radio, internet with social networking sites etc. Geo-informatics is an effective tool to create documents and presentations for these media tools to create public awareness. It helps in creating useful and easily understandable maps, which can easily convey the complicated issues in a simplified manner. Using these maps, tables and charts the resource management plans can be easily prepared with the help of local people. This process also ensures people's participation for community development.

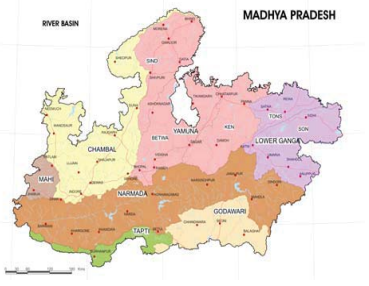
Glimpses of Madhya Pradesh State Resource Atlas
Natural Resources











River	Basin Area (Lakh
Chambal	57.12
Yamuna	82.98
Lower	41.35
Narmada	85.37
Godavari	24.66
Tapti	9.44
Mahi	7.22

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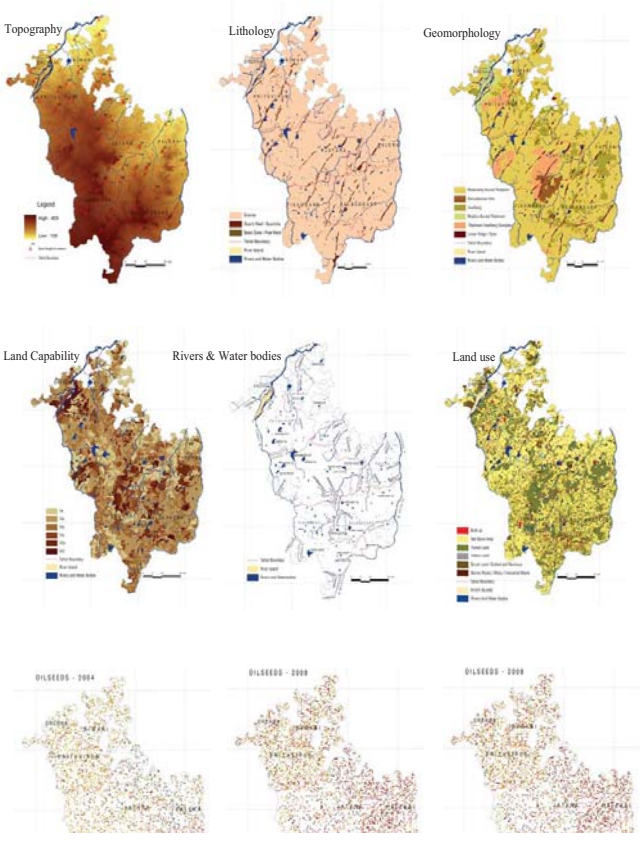
Glimpses of Tikamgarh District Resource Atlas
Natural Resources and Cropping Pattern



References

Burrough, P. A., 1996: Natural objects with indeterminate boundaries. Geographic objects with Indeterminate Boundaries, P. A. Burrough and A. U. Frank, Eds., Taylor and Francis, 2–28.

Merriam, D.F. 1996. Kansas 19th century geologic maps. *Kansas Academy of Science, Transactions* 99, p. 95-114.

James Osundwa, The Role of Spatial Information in Natural Resource Management International Conference on Spatial Information for Sustainable Development Nairobi, Kenya, TS12.2, 2–5 October 2001

European Environment Agency (EEA). (2005), Sustainable use and management of natural resources, EEA Report, No 9, 4-65, ISBN 92-9167-770-1, EEA, Copenhagen.

Combes, B. (2007), UN Decade of Education for Sustainable Development, 5th International Seminar and Training Course for Eco-Kids Instructors for Environmental Education for Sustainable Development based on Kids' ISO 14000 Programme, Paris, France, 6-8 November 2007.

Madhya Pradesh Resource Atlas (2007), Published by Madhya Pradesh Council of Science & Technology, Vigyan Bhawan, Nehru Nagar, Bhopal, India.

Jhabua Resource Atlas (2007), Published by Madhya Pradesh Council of Science & Technology, Vigyan Bhawan, Nehru Nagar, Bhopal, India.

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Communication Perspective

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Chapter 13

Science Journalism in India and Abroad

Jayant V. Narlikar

Introduction

In 1976 I delivered the 10th Jawaharlal Nehru Memorial Lecture in Delhi. The then Prime Minister Smt. Indira Gandhi was in the chair. The topic of my lecture was 'The Role of Scientific Outlook in the Development of Science and Society'. The lecture was meant to be a public lecture and its copies were freely distributed afterwards. However, at the end of the lecture, when I was leaving a newspaper reporter approached me for a written version.

I pointed out to him that copies of the entire talk were available then and there.

"I know it, Sir" he replied politely producing a copy from his bag.

"So what is the problem?" I asked.

"Well, Sir! I have to report the lecture in 100 words and I do not know how to shorten it. Could you tell me in a few words, what you said?"

This incident illustrates the dismal state of science reporting in the country. As in every case, there are a few exceptions, of course, who rise above the norm and are able to make a good job of it. But why should the norm be so low?

Take another example. A U.S. astronomer gave a public lecture in Mumbai on 'Violence in Astronomy'. He discussed in a simple language with a lot of slides of astronomical objects how the central (nuclear) regions of galaxies show evidence of violent activity such as explosions, ejection of matter, etc. He mentioned a conjecture that quasars, known to be highly compact bright objects might have been ejected by such active galactic nuclei.

The next day a leading English national daily announced that the scientist said that galaxies are ejected by explosions in quasars!

Whatever might be the reporter's training (or lack of it) I find it hard to understand how he could make this type of mistake of simply reversing the roles of quasars and galaxies.

It is against this background that I have ventured to set forth my comments on science journalism in India. But before I do so, let me say something about the almost universal fear felt by the layman that he is not sufficiently equipped to understand and appreciate anything that has to do with science.

Thanks to the way science is taught in our schools, a typical student looks upon it as a mysterious subject which is to be memorised by heart and reproduced ditto, much as a parrot trained to speak words and sentences does. None of the thrills of science, the agonies of unsolved problems, the ecstacies of finding the right solutions, etc. are conveyed to him or her. So the school children grow into adults who are happy to be relieved of the burden of science. It is something they were made to learn at school and are now glad to leave behind.

I can still see the venerable professor of Sanskrit who accosted me before my talk at the 'Vasant Vyakhyanmala' in Pune with the remark, "I am looking forward to your talk, not that I will understand any of it." The topic of my talk was 'what would the life be like hundred years hence?' I am sure, if I announce that I were reading out a story of mine, the reaction would have been the same. Even educated adults of non-scientific background have a complex that science is too difficult to understand and that whatever the scientist talks about will be unintelligible. So to project science to them is not going to be easy to start with.

Indeed science journalism does not mean only simplifying science and explaining it to the layman. It is not, I repeat, not an exercise in pedagogy. What does it cover, then? This is what I wish to outline next.

The age of science

It is often stated that we live in the age of science, that science and technology are shaping our very existence. No one described it more graphically than Alvin Toffler in his book 'The Future Shock'. I summarise below in my own words his description of the way science and technology have become increasingly rapidly integrated in our lives.

Divide the last 50,000 years or so of known human existence on this planet into some 800 human life spans – each life span comprising of 62.5 years. Of these, the first 650 or so were spent by man in primitive conditions in the caves. The art of writing is not more than 70 life spans old and that of printing only 6 life spans old. The electric motor is two life spans old. In fact most of the things we use in our daily existence involve technology much younger, some of it not more than one life span old. The discovery of atomic energy, use of space technology and the proliferation of computers are all less than a life span old.

This indicates how rapidly scientific ideas are being translated into technological inventions and how rapidly we are assimilating them in our lives. Yet the rapidity with which this is taking place is not proving entirely beneficial to the society. Rather, the situation resembles that of a human being confronted with a feast of excellent eatables served in rapid succession and tempted to eat them as fast as they come. The banquet may look dazzling but the diner ought to pick and choose keeping in mind his limitations of health and capacity to digest. This the human society has not managed to do.

The diner in the above example may ask, 'How do I know what is good for me – how much of it is good for me – and what items I should avoid?' Who is to tell him? This is where science journalism has a role to play. I shall shortly discuss a few typical examples.

The support for research in science and technology is broadly by the governments of the different countries, although private sectors also contribute small fractions depending on the economies of the countries. So by and large the taxpayer is the ultimate source of the funds. To what extent should he or she exercise control on the funding? How do we make wise collective decisions today to ensure a better tomorrow?

With the rapid changes taking place in science and technology, forecasting their status even ten years from now is not easy. Yet some assessment of how things will go in the future is necessary for planning. For example, the Science Advisory Council to the Prime Minister set up by the late Prime Minister Rajiv Gandhi during 1986-89 undertook such an exercise. In a paper entitled 'An Approach to a Perspective Plan for 2001' the council said:

"It is clear to us that not everything that we plan can be accomplished by government machinery alone. We need to fully exploit the potential of voluntary movements in crucial areas such as population control, family welfare, school education and adult literacy. It is likely that many of these tasks are better executed by motivated citizens, especially the educated women who are not yet fully utilised for the benefit of our society."

So here we have another possible role for science journalism – that of motivating the people about future prospects so that they are prepared for them and can take far reaching wise decisions now. I shall return to this aspect later.

Reporting on scientific events

What appears as a technological marvel today has roots in some scientific discovery in the past. Very often the former is ignored while the latter is highlighted. In fact while the discovery was made the discoverer or his contemporaries had no idea what the implications of the development would be. Here are a few examples.

1. **Aircrafts are impossible**

   The demonstration that no possible combination of known substances, known forms of machinery and known forms of force, can be united in a practical machine by which man shall fly long distances through the air, seems to the writer as complete as it is possible for the demonstration of any physical fact to be.

   Simon Newcomb (1835-1909)

2. **Alternating currents are too dangerous to be of any use**

   There is no plea which will justify the use of high-tension and alternating currents, either in a scientific or a commercial sense. They are employed solely to reduce investment in copper wire and real estate. My personal desire would be to prohibit entirely the use of alternating

currents. They are unnecessary as they are dangerous… I can therefore see no justification for the introduction of a system which has no element of permanency and every element of danger to life and property.

I have always consistently opposed high-tension and alternating systems of electric lighting, not only on account of danger, but because of their general unreliability and unsuitability for any general system of distribution.

Thomas A. Edison (1889)

3. **Intercontinental ballistic missiles are too hard to make**

   There has been a great deal said about a 3000 miles high-angle rocket. In my opinion such a thing is impossible for many years. The people who have been writing these things that annoy me, have been talking about a 3000 mile high-angle rocket shot from one continent to another, carrying an atomic bomb and so directed as to be a precise weapon which would land exactly on a certain target, such as a city.

   I say, technically, I don't think anyone in the world knows how to do such a thing, and I feel confident that it will not be done for a very long period of time to some… I think we can leave that out of our thinking, I wish the American public would leave that out of their thinking.

   Vannevar Bush (1945)

4. **The atomic bomb will never explode**

   That is the biggest fool thing we have ever done. The bomb will never go off, and I speak as an expert in explosives.

   Adm William Leahy to President Truman (1945)

Nevertheless, there are a number of cases where the future implications of the discovery can be imagined. The implications many not be practical; they may represent advance in pure knowledge. When Stephen Hawking found that a black hole can (and does) radiate energy, the result was hailed as an important advance in our understanding of how quantum processes operate in the strongly curved spacetime, near black holes for example. Why did the scientists feel excited by the result even though there was no chance of observing it in operation now?

There are occasions, on the other hand, where a new discovery, serendipitous though it is, opens out numerous technological fall outs. The discovery of high temperature superconductivity was of this kind.

The point, I wish to make is that scientific events of either kind are worth reporting to the layman. He may not appreciate the details but he should be given a chance to capture the excitement of creativity, of unravelling one of nature's secrets, of the vista of future applications, etc. such reporting brings science one step closer towards humanity – a step away from the ivory tower in which humanity has placed it.

Science frauds

Investigative journalism covers these days many cases of corruption, crime, spying, conspiracy and war stories. Once in a while the scientific world too offers

challenging and highly interesting cases. In a typical case, a claim to an important discovery is made but without proper substantiation. In some situations the result is based on fraud while in others it is a genuine mistake.

In 1903 the eminent French physicist R. Blondlot claimed to have discovered a new type of radiation called N-rays (N for the town Nancy where the discovery was supposedly made). Coming shortly after the discovery of X-rays in Germany, this discovery of rays with remarkable properties was hailed widely in France partly because of the competition between the two neighbouring countries in many fields including science. The N-rays became fashionable and a large number of research papers began to appear in French journals. Soon Blondlot was awarded the prestigeous Lalande Prize by the French Academy for this discovery.

However, a scientific experiment should be repeatable. This was not happening in the case of N-rays. The rays could not be detected in similar experiments in England or Germany. What was wrong? To find out the British scientist asked R.W. Wood, a distinguished American scientist to visit Blondlot's laboratory and inspect the experiment. Wood made the trip and found that the claim for N-rays was totally false. His own account of how he detected this fraud makes a very interesting reading even for the layman.

The temptation to make spectacular but fraudulant claims comes more strongly in the present times than in the relatively placid times of the turn of this century. This is because a scientist is judged by his performance much more stringently today than in the last century. Awards, peer support, promotions, project grants are all linked with performance. Thus if Mr. X has made a stupendous discovery he stands to attract a lot of financial support as well as power in the scientific circles. So there is every incentive for him to rush out and make premature announcements. In spite of these temptations science has remained relatively clean mainly because a scientific fraud is detected sooner than later. However, such cases as do turn up from time to time need to be widely reported to the public.

Another related area where investigative journalism can do a lot is in testing the claims of UFOs as extra-terrestrial spacecrafts. The common man gets excited by the suggestion that these are spaceships from some other civilizations beyond our Earth. Philip Klass, a journalist from Washington DC has written a book entitled 'UFOs Explained' in which he has given absorbing details of investigative journalism which removed the mystery around several such claims. He has also shown how the so called photographic evidence can be faked. Indeed, in some cases the UFO sighting has been turned (fraudulantly) to material gains.

Debunking miracles and fighting superstitions

India has a special problem of its own. The so called holy men who take advantage of the gullible by producing miracles apparently defying science can wield considerable evil influence on individuals and the society. Scientists and

magicians together can play a valuable role in debunking such cases. And the journalists can get a good story out of it.

The nearest to this type of situation arose in the West with the advent of Uri Geller who claimed to have supernatural mental powers by which he could bend spoons at a distance. The fact that even scientists were initially fooled by him and that it took a magician (James Randi) to demonstrate the secret illustrates that considerable subtlety is involved in these deceptions and the claims have to be probed very carefully.

India is a curious mixture of scientific advance and traditional superstitions. Superstitions are deeply ingrained and cannot be eliminated overnight. They cannot be removed by dictat but can be countered by rational arguments. Take astrology, for example. Scientists have tested astrology in many different ways and found it devoid of any scientific basis. Yet, to convince the believer that this is the case is not easy. Patience is needed. And information, which science journalism can provide.

Technological disasters and boons

With high technology entering in every field there are disasters also. The space shuttle Challenger exploded on take off in January 1986. The nuclear reactors in the Three Mile Island in the USA and in Chernobyl in Russia developed malfunctions that led to leakage of damaging radiation. The Bhopal gas tragedy of 1984 is still green in our memory. Sophisticated aircrafts crash or rockets fail to take off or railway accidents occur due to signalling faults. Potent medicines may turn out to have damaging side effects….

The list is long. Whenever such a disaster happens there is a popular reaction against science. Argue the critics, "Look this is what happens when you go in for science and technology. Abandon it all (they continue) and go back to the simple days of the last century."

This is where technical experts and journalists need to get together. It may not be possible to analyse and diagnose what went wrong immediately. But openness fears. When the cause has been found out it will become clear what corrective action or precaution is needed for the future. In most cases it will also turn out that the initial panic against science and technology was akin to throwing the baby out along with the bath water.

There are interesting and informative articles written on most of these disasters. The problem is how to give them as wide a circulation as possible. A valuable contribution science journalism can make to science and technology is to mitigate fears of the irrational type, discuss what went wrong and point to where the fault lay. This may not be easy since there may be vested interests keen to suppress the truth.

Science dissemination at the popular level also should emphasise the positive aspects of science and technology. There are several ways of doing it. Take medicine, for example. Max Perutz in his book 'Is Science Necessary' has given a list of highly creative persons in the arts and sciences who died young – in the days

when science was yet to provide remedies that could have cured them – remedies that we take for granted today. Today science has provided quick channels of communication that are pressed into operation whenever natural disasters like cyclone, volcanic eruptions, earthquakes, etc. call for immediate help.

The journalist can highlight these positive aspects of science and technology besides the negative ones I mentioned earlier. In making any forward planning these inputs should form essential ingredients. In our country they are at best peripheral largely because science and technology have not seeped into the planners' minds to the extent it should have. One still notices two cultures – with the scientific one kept in a closed box to be opened on some purely ceremonial occasions.

The status of science journalism today

Let us first consider the advanced countries of the West. Writing about science journalism in his book 'The Wisdom of Science', R. Hanbury Brown has moaned that "Although advances in science and technology have given us an unparalleled ability to communicate with one another by radio, television and vast quantities of print, these so-called 'media' are seldom used to tell us anything about science…." He goes on to say:

"As far as journalism is concerned, it would prefer science to go away; of the 1750 daily papers published in the USA only 50 employ full-time science writers. The reason is, of course, that the popular media prefer topics that are more sensational and entertaining, and so they avoid science; they do this not only because they think science will bore their customers stiff, but also because it is difficult to find people who can put it over to the public successfully. However, there is some light at end of the tunnel. In recent years there has been a marked increase in the number of programmes and semi-popular magazines devoted to science, particularly in the USA, which suggests that, maybe, the popular media have underestimated the market."

Compared to the West, the situation in India is even more dismal. As mentioned by Hanbury Brown, the 'market economy' operates here too. And so astrological forecasts appear regularly in our newspapers but science and technology are touched if at all, only with a bargepole.

In a recent survey conducted by the Energy and Environment Group and the National Council for Science and Technology Communication (NCSTC) the fraction of space devoted to science coverage in the National newspapers (over the 6-month period July-December 1989) was found to be in the range of 2.1% to 6.56% of the total reading matter exclusive of advertisements.

Even in these reports on science it is not known how much was of indigenous origin and how much taken over from foreign sources.

Many reports in our newspapers come from the New York Times, the Nature – Times Science Reports, and other news items or articles in the western media.

To provide our own sources of scientific news, the NCSTC launched 'Srote' – a publication that has science coverage compiled and prepared in India. This experiment was launched in 1988 and in the form of a monthly resource letter.

Newspapers and radio stations, etc. were invited to subscribe. Those that did were put on the mailing list. It contains science items that could be published in newspapers, and being in 'ready made' form removed the editors' difficulties of locating sources. What was the response?

Even after over a decade, the newsletter has not picked up as expected. The reasons for the apathy were mainly as follows (as discerned from the feedbacks received from newspaper editors, proprietors, etc.).

First, being a monthly, the items intended to be rated from a 'news-value' point of view. Second, the articles were longer than what the newspapers would like to have. Further, some newspapers would have liked the articles 'jazzed up' to make them more exciting or dramatised if not sensational.

To get round these difficulties 'Srote' was made a weekly with shorter crisper articles. The total number of pages per month is still the same; but the response has been much better. However, 'Srote' editors point out that many clippings are used by newspapers, etc. without acknowledgment of source let alone the payment of the modest fee for it. Thus the extent of unauthorized use of 'Srote' articles may even be larger.

The list of newspapers using the facility has over 100 names, but they are largely from the Hindi belt in the north.

In fact, science coverage in Hindi newspapers is claimed to be better than in the English ones. Whatever the present situation, the 'Srote' experiment should be continued further in view of its impact.

Another silver lining is the regular weekly publication of science supplements by leading newspapers in different languages.

Here I feel our scientists can contribute effectively in many ways – by writing articles on the latest developments, by giving interviews on their work or even by helping out in answering readers' queries.

Concluding remarks

This last point needs to be underscored heavily. In modern times the scientists themselves, with the large public funds supporting them, owe it to the public to inform them on what they are doing. By remaining in their ivory towers they will only help foster a growing feeling that science is a luxury that we cannot afford.

Rather, it is the other way round! Science is something that we cannot afford to abandon or leave to others. I have already pleaded strongly why the society needs to be well informed about science and technology.

To make the correct decisions about the country's development, to employ the right strategy with regard to the controlled use of the rapidly growing science and technology and to nurture the vital spark of scientific creativity, the scientists as a body have to keep the public well informed about the vital issues.

And the media should help scientists in this crusade. Newspapers play a vital role in spreading information and opinion in times of stress.

In the present age of science they should not treat science journalism as quiet backwaters. They should look upon it as an ocean vibrant with waves and tides that affect our destiny.

Source: Indian Journal of Science Communication, January-June 2002

Chapter 14

Popularization of Science in Brazil: Getting onto the Public Agenda

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Abstract The importance the Brazilian government has given in the last few years to the dissemination of science points out the necessity of a more discerning analysis about the establishment of this subject on the public agenda and the related public policies undertaken. This work tries to contribute to the debate as an inquiry about the policies to popularize and disseminate Science and Technology (S&T) established by the Science and Technology Popularization and Dissemination Department, which was created in 2004. In order to do so, theoretical references from Public Policy Analysis, the Studies of Science, Technology and Society (SSTS), and Public Communication of Science are used. Furthermore, we analyze some of the results from research on Science and Technology Understanding carried out in Brazil in 2006. As a final point, this associated approach aims at identifying some of the limiting factors related to science dissemination actions in Brazil.

Introduction

The growing influence of Science and Technology (S&T) on different dimensions of modern life makes the understanding of scientific technological questions more and more indispensable for the exercise of citizenship. A policy of science popularization, aimed at broadening the individual understanding of the world we live in, may stimulate public participation in choices and directives with regard to science and technology. Consequently, it may also contribute to the inclusion of the interests of social groups which traditionally have been excluded from the benefits the scientific and technological development can bring about. In this way, actions to promote the popularization of science can also be understood as strategies for stimulating social inclusion.

However, this theoretical perspective, despite having a reasonable logical sequence, is not so easily verifiable and applicable in the concrete practices of policies aimed at the popularization of S&T. As this paper will illustrate, the popularization of science within an approach based on Studies of Science, Technology and Society (SSTS) and, in particular with a focus on social inclusion,

involves components which go far beyond broadening public understanding of S&T.

Our discussion of the relation between the popularization of S&T and inclusion is centered on the actions of the Department of Dissemination and Popularization of Science and Technology (DEPDI) together with the Secretary of Science and Technology for Social Inclusion (Secis) of the Ministry of Science and Technology (MCT). We will analyze these actions through the theoretical references provided by Policy Analysis, SSTS and studies on Science Communication. We will also include some results with regard to the most recent national study, "Public perception of Science and Technology", carried out in Brazil (2006).

Science popularization onto the Brazilian public agenda

In order to understand the aspects related to the inclusion of the issue of science popularization into the Brazilian political agenda, we use the reference of Public Policy Analysis (PPA), given that it is useful to explain the role of the actors involved and the interests and values which shape the policies. Public Policy Analysis also incorporates a prospective orientation, being capable of providing elements for the improvement and reformulation of public policy (14).

According to Deubel, public policies (PPs) can be understood as action programs that represent the concrete realization of State decisions in the sense of inducing change in society. Public policies play a role in the construction of a new representation of problems that is capable of favoring the establishment of socio-political conditions for their resolution (14).

The inclusion of a issue into the political or public agenda occurs when the government gives this matter priority as a public problem and considers it able to be translated into a public policy. The problems making up the future agenda are chosen by individuals or groups who have enough power to influence governmental decisions with regard to the agenda's configuration (13). With this consideration in mind, can we affirm that the topic has really entered the government's agenda and has become the focus of public policies? Should we have enough elements in order to answer this question affirmatively, others will be raised. In what way did the topic enter the political agenda? What are the views on the scientific popularization of S&T that guide current policies formulated and implemented by DEPDI?

To start with, there are two concrete facts that make us believe science popularization is present in the public agenda of the current government. Firstly, the establishment of a formal structure within the government to deal with the matter – DEPDI – can be understood as a confirmation that the matter has become accepted as a problem incorporated in the agenda of the current government. Secondly, the inclusion of "Popularization of S&T and Improvement in Science Teaching" in the "S&T for Social Development" line of action of the 2007/2010 Ministry of Science and Technology Action Plan, which presents the directives of

S&T Innovation policy in Brazil. We base our affirmation on Deubel (3) when he relates the existence of a public policy to state-run institutions that take on, totally or partially, the responsibility of reaching determined objectives.

Most authors that use the PPA reference divide the public policy elaboration process into four basic stages which make up what they call policy cycle: i) Agenda Setting (entrance of the problem onto the political agenda); ii) Formulation; iii) Implementation (of decisions); iv) Evaluation. These stages should not be thought of in a static manner, for they make up part of a process (continuum); it is for this reason that they are also called public policy elaboration moments. Our objective is to contribute with a preliminary analysis of the first two stages of public policies directed at the communication and popularization of S&T.

The identification/definition of a problem and its entrance onto the public agenda is the stage known as agenda setting. This process, according to Deubel (3), highlights that not all problems enter the public agenda. They are subjected to mechanisms of exclusion and inclusion. According to Deubel, a formal agenda and an informal (hidden) agenda exist and the problems that appear publicly on the agenda of an institution as the target of its actions are not always the tasks with which the institution really works.

Since its foundation in 2004, DEPDI has acted within the governmental structure and has been able to implement some concrete actions. The tasks formally taken on by this department include: formulating policies and implementing programs of S&T popularization (promoting National S&T Week, signing agreements with TV and radio stations in order to develop programs on science communication); collaborating with science teaching in schools, in partnership with the Ministry of Education (at a national level) and the Secretaries of Education (at a state level); supporting science centers and museums; supporting science communication events (including the training of science communicators).

Before 2004 governmental initiatives and programs which focused on the problem of lack of knowledge of S&T among the Brazilian citizens were not configured as general public policies or nationally articulated programs. The actions were limited to the creation of financing possibilities through a small number of measures addressed to science centers and museums and a small number of incentives for science education through the Ministry of Education. Even after the creation of DEPDI, the public policies in this area continued to be widespread. In an article published in 2006, the then director of the Department, Ildeu de Castro Moreira, spoke of “proposals for the formulation of a science popularization policy” and “general directives for a public policy of science popularization”. These words demonstrate the constructive nature in which policies related to the topic are still found.

In the same article, the author draws attention on the fact that public policies related to diffusion and popularization are included in the directives of the Ministry of Science and Technology’s Secretary of Science and Technology for Social

Inclusion (Secis), as indicated by the title of the article - "The Popularization of S&T as an Element of Social Inclusion".

> One of the aspects of social inclusion is to make it possible for every Brazilian to have the opportunity to acquire basic knowledge about science and its workings, thus giving this person the ability to understand his or her surroundings, broaden his or her opportunities in the job market and act politically with an understanding of cause. (10)

Moreira also signals that the insertion of DEPDI within Secis and the current administration's political prioritization of social inclusion cause the popularization of S&T to become an "important line of action". Thus, the Department's allocation and its director's discourse show that public policies related to the popularization of S&T have been conceived within a perspective of social inclusion. These choices are relevant, for they indicate a posture in terms of insertion of the matter on the public agenda and social construction of the problem.

Public policies on science popularization: Elements with regard to the social construction of the problem

According to Sánchez, the understanding of the subjectivity of the definition of a problem that will be the focus of a public policy has materialized in the last two decades with the development of Public Policy Analysis within Political Science. Before this time, the problem was considered as an objective entity, and it was not even recognized as a stage in the political cycle. Upon admitting the lack of knowledge that the majority of the Brazilian population has with regard to S&T as a problem that has penetrated the public agenda, we realize that this insertion could have taken place through other ministries. The link to the Ministry of Science and Technology indicates that the acknowledgement of this problem probably came from policy makers in the area of science and technology and members of the scientific community with a "sensitive view" of the question. The identification of these actors is important; for it is through their conceptions, how they perceive and what cause and effect relationships they establish that the representation of the problem will be constructed.

Deubel (3) points out that, before entering the political agenda, a situation should be recognized as a problem by an individual or social group which has ability and interest. This group will then work to define the problem and express it in adapted language in order to make it acquire a public dimension. Within this scenario, the media, academic and scientific circles, and political actors all have a key role in the definition and spreading.

Thus, some actors end up carrying out the task of mediation between society and the State for the creation of the public agenda. These actors are public mediators, comprising parties and their representatives; social mediators, comprising private representatives, such as intellectuals and scientists, that have legitimacy because of their strategic position or personal distinction; and administrative mediators,

made up basically of civil servants or other professionals that hold positions within the State apparatus. These mediators are the main actors responsible for the definition of the problems that make up the public agenda.

Using the aforementioned theoretical reference to analyze S&T popularization policies, Moreira, in the same article, notes the "challenge of social inclusion" in a society that "has accumulated an enormous set of social inequalities", creating difficulties for the "appropriation of scientific and technological knowledge" by the population. Moreira also makes several references to Brazil's educational problem, pointing to formal scientific education in Brazil as "dismal". Interviewed in August 2006, Moreira stated that "one of the greatest problems of the country is its education" and that "science popularization would be one of its alternatives to better the education" (11).

This link between the needs of social inclusion, an increase in the level of schooling and the popularization of science allows for the verification of the effects created by social inequality and low levels of education, as shown by the data of the 2006 S&T Public Perception Poll, with regard to access to scientific technical knowledge and information. A good example of this is the fact that the poorest have a lower interest in S&T.

In another passage of the interview, Moreira explains the relationship established between the popularization of S&T, improvement in education and social inclusion. To him, a broader knowledge of S&T, spurred by spreading and popularization policies, would help to promote a type of "school renovation", improving the quality of teaching. The virtuous cycle would be closed by better quality teaching which stimulates social inclusion.

The contextualization of the need to popularize S&T in Brazil within a "global view" of social exclusion and poor quality education can, in principle, point to an adequate direction. In trying to establish a causal relationship among these "three issues" - exclusion, poor quality education and the lack of knowledge about S&T – we noted that the lack of knowledge about S&T is taken as a consequence of the condition of socio-economic and educational exclusion which a large part of the Brazilian population has to face. We could thus think of the question of popularization of science and technology as a problem that has its origin in two other permanent "larger problems" on the public agenda.

Other data corroborate this thesis. Thirty-seven percent of the people interviewed stated that they do not understand the matter (S&T), which can lead to a lack of interest. Thirty-two percent declared that they do not look for information on the matter because they do not understand it.

But what other actions and relations could a S&T popularization public policy establish with other policies to improve education and the eradication of social inequalities? It seems that in order to construct policies which allow for positive changes in this global setting, the adoption of a critical posture on the understanding of education and the diffusion and popularization of S&T and it objectives would be necessary.

Some concepts

In order to analyze science popularization policies, it is important to understand some conceptual models and relations that involve the problem of the so-called public communication of science, understood as a fundamental aspect of popularization. In order to do this, we will begin by referring to the idea of the three levels of ignorance involving the public communication of science as proposed by Leite (6) and attempting to relate them to the results of the S&T Public Perception Poll (12). For Leite, the problem of public communication of science involves three levels of ignorance:

1. Base ignorance, or the lack of fundamental concepts about S&T that should make up the basic education of individuals. This point is intimately related to the problem of formal and non-formal education.
2. Ignorance about what is happening, or a lack of information about current matters of science that require constant accompaniment. In this case, we can mention data from the poll which show that 84% of the interviewees declared they were not aware of the research institutions existing in Brazil. Among the 16% who declared awareness, 47% of them mentioned public and mixed entities (such as the Oswaldo Cruz Foundation/FIOCRUZ) or Universities/Colleges (46%), with the University of São Paulo (USP) and the University of Campinas (UNICAMP) being the most frequently cited. Eighty-six percent also declared they did not know any scientist. It is important to point out that these institutions are the ones which appear the most in the media, thus explaining their recognition by the population. This data not only points out the population's ignorance in relation to what is taking place in S&T, but it also shows the difficulty of the inclusion of this population in the socalled scientific culture. The institutions doing science in Brazil – as well as their workers (the scientists) – are clearly far from the reality of the majority of the population.
3. Ignorance of the implications, which involves an inability to contextualize scientific matters in their political, legal, ethical and social dimensions. An interesting piece of data from the Public Perception Poll (12) that can be related to this dimension of the problem was that 32% ignored (or preferred not to answer about) what determines the direction of S&T.

Still with regard to the data of the 2006 Public Perception Poll, it was revealed that 58% of the population is uninterested or has little interest in S&T. This lack of interest in the topic from more than half of the interviewees becomes even more disturbing when understood as the first step that may or may not lead to a critical understanding of the relation between ST&S and the possibility of public participation. The creation of conditions for social participation in the processes of decision-making with regard to S&T depends on the existence of an educational system which favors the development of cognitive abilities and

promotes a change of view with regard to the nature of the scientific technological phenomenon, as well as its products (7).

Models of public communication of S&T

Within the terminology encompassing the public communication of science, the concepts of popularization and, to a greater extent, vulgarization have been generally used in association with the so-called scientific knowledge deficit model and the idea of scientific illiteracy. In this model, the average public, which lacks knowledge about S&T, should receive this content in the simplest and most easily assimilated way possible. It relates to a view of science as a motor of progress, as a way of knowledge that is linear and independent from the social surroundings. The fact that 47% of the interviewees in the research on public perception (2006) see scientists as people who contribute to the scientific and technological development of the country and that 33% see them as contributing to solve the problems of the people, both help to maintain an idea of science as the engine of progress. Furthermore, it is important to say that the other 60% of the interviewed see scientists as "intelligent people who do useful things for humanity".

In this regard, the perspectives of the popularization of S&T are linked to the broadening of public understanding and knowledge about the benefits brought about by the scientific technological activity. The deficit model, which was predominant in the first science popularization policies, privileges the scientist and positions science communication as having only one direction – from the specialist to the lay public. This is based on the superiority of scientific knowledge over tradition and on the public's limited ability to understand and interpret S&T issues.

This limited view of the public communication of S&T was subject to criticism, especially coming from a group linked to STS Studies and more critical segments within science communication itself. The criticism related to the simple deficit model has ended up leading to changes in the science popularization models that have been adopted in public policies throughout the world. Other models have gained ground, such as the complex deficit model and the democratic model. In the complex model, popularization has the broader objective of promoting a greater understanding and valuing of scientific technological activities, in addition to broadening the capacity of public participation. However, a unidirectional view of communication and of science as the true and superior way of knowledge still prevails.

Finally, the democratic model has emerged as the most recent science popularization model. It seeks to spur the participation of diverse social actors in the decisions and resolutions of conflicts surrounding S&T. This model starts from a view of scientific knowledge as partial, provisional and controversial. We can note the influence of criticisms and reflections promoted by STS Studies in this model. Its justification is mainly political – in other words, in a democracy everyone has the right to decide about issues that affect their life (8).

When we observe S&T popularization policies in place in Brazil, we notice that the importance of these conceptual differences is not unknown. However, when incorporating them into political actions, there seems to be a gap that is difficult to bridge. The policies in the area of S&T spreading and popularization still seem to be strongly influenced by the idea that the lack of public understanding about S&T can be cured by exposing the public to more enchantments of science and technology and that this access should lead to social inclusion. Only few initiatives which come close to the ambitions of the democratic model are truly linked to a proposal of broadening public participation in science.

The importance of the SSTS field insertion

The Studies of Science, Technology and Society (SSTS), begun in the 1950s, consist of an interdisciplinary field with heterogeneous approaches. Their objective is to understand the relations between science, technology and society or to understand science and technology through their social context. The contributions from this field, namely from what is referred to as STS education, aggregate interesting methodological proposals in order to comprehend and understand the science-technology society relations within the context of formal and non-formal education. These methodologies propose a critical/reflective outlook on S&T, which goes beyond the understanding of concepts and benefits associated with S&T. The conventional form of education has been questioned by STS education because of its contents and organization, as well as because of the teaching methodologies used.

The Studies of Science, Technology and Society point to public participation in decisions about and the evaluation of the development of science and technology. In turn, public participation points to the need for education that is coherent with the presuppositions of those studies. Considering the relation between science, technology and society implies outlining an education consistent with this perspective. In other words, it means education which does not present S&T as neutral. Rather S&T is presented as conditioned by values and interests and, for this reason, open to questioning and permeated by choices (4).

STS education introduces related programs and subjects in the different areas of teaching, thus guiding students to rethink the image of S&T within society. Scientific and technological knowledge was viewed until the mid-20th Century as a path to the redemption of humanity's evils. However, the awareness of not having a linear relation between S&T and the social well-being was the stimulating factor in the emergence of these questions (7). This perception was the basis firstly to question what paths science and technology are taking at national level so that the citizens may later participate in policy formulation and, secondly, to demand that the benefits from science and technology not be concentrated, but rather shared.

Precisely as those issues and the public agenda involve a social construction process which should consider the interests of all the actors, also the paths of

scientific and technological development are socially negotiated. In that sense, the formulation of public policies for science popularization aligned with the expectations of the democratic model could be aided by reflexive and practical contributions from Science, Technology and Society Studies.

Despite suggesting the need for a partnership between Education and Popularization, the concrete actions of DEPDI are based on a model in which the dissemination of S&T operates primarily as a support mechanism to improve the quality of science teaching. As we tried to show, the critics of the STS field and STS Education put the issue of knowledge democratization within a context of citizen participation and development of a critical and contextualized understanding of science. Thus, the scientific content should be democratized from new methodological approaches.

Specifically, among the public policy initiatives of science popularization in Brazil, the implementation of a National Week of S&T, the Mathematics Olympics and the establishment of science centers and museums were those that received more support. Other attempts, such as expanding partnerships with TV and radio stations for the creation of programs of dissemination, also obtained some investments and results, but still unsatisfactorily.

As demonstrated by the detailed proposals contained in the fourth strategic priority of the Action Plan for 2007/2010 from the Ministry of Science and Technology, called "S&T for Social Development", the support to this type of activities will be apparently maintained within future popularization policies. This is demonstrated by the estimated allocation of resources: 20% to the "Support of Dissemination Projects and Events and Science and Technology Education", 20% to "Support to the Establishment and Development of S&T Centers and Museums", 24% to "Digital Multimedia Content for Science Education and Popularization of S&T on the Internet," and the largest share, 36%, to the "Olympics of Mathematics of the Brazilian Public Schools."

It is important to note that, out of the total proposed expenditure for the Action Plan implementation, only 2% is destined to the fourth priority, which is embedded in the line of action "Popularization of Science, Technology and Innovation and Improvement of Science Education". On the one hand, the low estimates of resources demonstrates that despite the emergence of the popularization theme and its inclusion on the public agenda, this issue is still far from a priority. Moreover, the allocation of resources to the scheme for popularization and education improvement appears as the continuation of a policy to support popularization activities based on a model implementing science promotion through events; creation of visitor attractions, and a technical upgrading in science teaching.

Inasmuch this work suggests the need for integrating the critical vision of Studies of Science, Technology and Society, highlighting the contribution from STS Education, we believe that public policies based on the actions above are not sufficient to promote public participation and inclusion, consistently with the democratic model of science popularization. These targets involve a concern

with the integration of STS education at various levels of formal education and a training project, addressed not only to teachers and students but also to professionals who work extensively on popularization. These professionals, involved in the development and maintenance of projects such as science museums, would be rewarded with the critical and methodological contribution from the STS field, thus being able to promote a kind of popularization targeted on citizens and critics participation, much less focused on "learning or interacting" with scientific concepts. The popularization of methodologies based on what we refer to as "funny learning and enchantment with science" - traditionally used in science museums around the world - may be sufficient to act against the "ignorance of basics," but it is still inadequate to promote a proper understanding of the "ignorance of the context and its implications" (6), mainly in the scenario of economic inequity and educational deficits in countries such as Brazil.

Final considerations

The issue of S&T popularization has gained momentum on the public agenda in central as well as in peripheral countries. In the case of Brazil, this policy entered the agenda in a way explicitly linked to the problem of social inclusion. In this article we attempt at showing that in order to act along this path – to include and widen public participation –S&T popularization actions should be thought of and implemented taking into account the contributions from Science, Technology and Society Studies and a critical view of public science communication. The objective of this union is to foster an understanding of S&T in its economic, cultural and political dimensions. In this analysis, SSTS approaches constitute an essential reference for public policy formulation and implementation in the S&T popularization area, thus keeping with a democratic model of public communication and with the objectives of social inclusion.

The improvement of the Brazilian policy of S&T popularization therefore depends on joint and consistent actions from DEPDI and the Ministry of Education, with the objective of introducing STS education into the curriculum of the various levels of education. For this reason, the training of professionals to work with STS education in formal and informal settings appears to be an urgent measure.

Even though the current proposals and actions of DEPDI prove to be fundamentally related to offering support to formal education, they seem to seek a type of technical and methodological modernization of formal education (use of the Internet, videos, etc.) focused on creating places where to promote occasions of contact with S&T as well as admiration of science in itself (Science Museums, National Week of S&T, etc.). Following our analysis, these public policies would need to be complemented by more structured measures, such as those mentioned above, within the system of formal education and with professional training

actions on popularization aligned with the perspective of Science, Technology and Society Studies and social inclusion.

Our analysis of the early stages – agenda setting and formulation – of the science popularization public policies under way in Brazil reveals a deficiency in the outlining of the issue of popularization and, consequently, in the actions adopted. As discussed, this deficiency derives from, among other factors, a non-appropriation of the contributions of Science, Technology and Society Studies, especially STS education, in order to think about the relation between science, technology and social inclusion.

Translated by Robert Gartner

References

R.P. Dagnino, Enfoques sobre a relação Ciência, Tecnologia e Sociedade: neutralidade e determinismo, in DataGramaZero – Revista de Ciência da Informação 3(6), 2002. Available at http://www.dgz.org.br/dez02/Art_02. Accessed on 08/11/2007.

R.P. Dagnino and H. Thomas, Introdução, in: R.P. Dagnino and H. Thomas (org.), Panorama dos estudos sobre ciência, tecnologia e sociedade na América Latina, Taubaté, Cabral (2002).

A.R. Deubel, Políticas Públicas: Formulación, Implementación e Evaluación, Bogota, Ediciones Aurora (2006).

L. Fraga, O curso de graduação da Faculdade de Engenharia de Alimentos da Unicamp: Uma análise a partir da Educação em Ciência, Tecnologia e Sociedade, Master's Thesis defended at DPCT/IG/UNICAMP. Campinas/SP (2007).

Instituto Brasileiro de Geografia e Estatística (IBGE), in http://www.ibge.gov.br.

M. Leite, Contribuição do Jornalismo Científico ao desenvolvimento científico brasileiro, communication presented at roundtable entitled "A população informada: divulgação científica", included in the National Conference of Science, Technology and Innovation, in Brasilia, on 20/09/2001.

I.V. Linsingen, CTS na educação tecnológica: tensões e desafios (2006). Available at www.ige.unicamp.br/gapi/Irlan%20CTS.pdf. Accessed on 20/10/2007. (8) M. Lozano, Programas y experiencias en popularización de la ciencia y la tecnología. Panorámica desde los países del Convenio Andres Bello, Bogota, Convenio Andres Bello (2005).

MCT/Departamento de Difusão e Popularização da C&T/SECIS, in http://www.mct.gov.br/index.php/content/view/50875.html. M. Tait Lima, E. Felix das Neves, R. Dagnino 8

I. de Castro Moreira, A inclusão social e a popularização da ciência e tecnologia no Brasil, Revista Inclusão Social – IBICT, vol. 1 n 2 (2006).

I. de Castro Moreira, Entrevista para Boletim UFMG, n. 1541- year 32, 28/07/2006 (2006).

S&T Public Perception Poll In Brazil (Pesquisa Percepção Pública C&T No Brasil) (2007). Available at http://www.mct.gov.br/index.php/content/view/50877.html. Accessed on 13/10/2007.

P.M. Sánchez (org.), Análisis de Políticas Públicas, Granada, Ed. Universidad de Granada (2006).

A.V. Velásquez, El estado y las políticas públicas, Bogota, Almudena Editores (1999).

C. Vogt (org.), Cultura Científica: Desafios, São Paulo, Edusp/Fapesp (2006).

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Chapter 15

KASISH: An Approach for Science Communication for Emerging Economies

P. C. Vyas

Introduction

The first Prime Minister of India Pt. Jawaher Lal Nehru constantly had been saying that people of India must acquire a scientific temper so that they can have their thoughts and actions in scientific manner to become better citizens of tomorrow. The importance of science and technology (S&T) in every aspect of our lives has been restated many a times in important S&T resolutions came into effect after India's independence. The constitution of India made a special provision as fundamental duty of its citizens "to develop the scientific temper, humanism and the spirit of enquiry", under part IV A , Article 51 A (h).

Right to education and right to scientific information: There is growing realization all over the world that science can change the lives of common people to uplift their standard of living and thinking. The World Declaration of Science states: "the use of scientific knowledge is part of the right to education and right to scientific information belonging to all for human development and creating of endogenous scientific capacity" for peaceful co-existence. The scientific literacy (SL) and Public communication are becoming increasingly important globally. Empowering people to enable them to make personal and collective decisions with rationality and logic is vital to sustain democracy.

Importance of India-Brazil cooperation: The recent efforts of both India and Brazil to strengthen its scientific base attracted international attention and these efforts are being considered as an example of to how developing countries could move out from the status of underdevelopment, poverty, and international dependency to economic growth, better living standards, and self-reliance. The South-South cooperation and IBSA had emerged as a viable development strategy in the new millennium with the emerging countries such as India, Brazil, and South Africa (IBSA) in different continents with development of new markets, natural and human capital, technologies and expertise. Brasilia Declaration (6th June 2003) recalls the role of S&T in shaping the future societies in these three countries, particularly by providing tools for reducing poverty, promoting social inclusion and contributing to the attainment of the UN Millennium Development

Goals. The IBSA Dialogue Forum includes co-operation in a broad range of areas. The priority areas for cooperation under MOU on S&T (2010) are following:

1. Biotechnology
2. Nanotechnology
3. Health sciences (TB, Malaria, HIV/AIDS)
4. Indigenous Knowledge
5. Alternative and renewable energies
6. Oceanography and Antarctic research
7. Information and communication technologies.

More recently MOU has been entered on Biofuels under IBSA forum (13th septmber 2006).

Importance of PCST in IBSA dialogue: Building scientifically literate society in these countries can provide support and strengthen bilateral relations. Efforts are being made for co-operation in the fields of S&T in future. Although, their exist vide ranging expertise in science communication education and research in India and Brazil, it has to be included in the priority areas under the S&T cooperation between two countries. Both the countries attach importance to the promotion of science and harnessing technology as growth engine for economic development and creating a knowledge society. A fresh outlook is required in view of Brazil which will host PSCT conference in 2014.

Emergence of PCST: The area of teaching, research and practice in science communicators is emerging as new field of study in science. The first PCST Network conference was held in Poitiers in France in 1986. The 11th PCST-2010, "Science Communication without Frontiers" was held in India from December 06-10, 2010, which was attenended by scientists and science communicators form 66 countries. The Indian participants and Brazilian scientists led by Prof. Maria Ines Nogueira and her collegues and other deligates of several countries and leaders of PCST Network discussed informally the multifaceted aspects of science communication during and after the conferance and explored possibility of India-Brazil co-operation on the above subject.

Interdisciplinary Symposium & Workshop on Public Communication of Science, Technology and Culture (Sc-T-C&S): Concepts, actions and local-global implications: It is a product of these deliberations. The workshop intends to lay down the framework of a future trans-disciplinary postgraduate programme in Public Communication of Science, Technology and Culture involving the University of São Paulo, Colleges, Museums and Research Institutes. This opportunity should be sized to convince IBSA forum to include science communication and science education in priority disciplines, as the SL and PCST and "Science for All" (SFA) have been recognized as cornerstones for world movement for the attainment of UN Millennium Development Goals. Accordingly, creation and building of endogenous capacities in the field of S&T

must become national priority for both developed and developing nations, more especially for emerging economies like India and Brazil.

Capacity Building in Science and technology through S&T Education: During Post-Sputnik science education reforms capacity building in S&T on the lines of developed countries was undertaken by developing countries. The object of these reforms was to produce trained manpower for research and development in frontal area of S&T. But in India in 1964-66, Kothari Commission Report stressed: "Science has added new dimension to education and its role in the life of the nation, but central to all this is the quality of education. If science is poorly taught and badly learnt, it is little more than burdening the mind with dead information and it could degenerate even turn into a new superstition".

Third World Resurgence in Science: Three major goals of STE were identified in the report viz:

1. Prepare Excellent Scientists
2. Training of teachers in new frontiers of knowledge
3. Produce scientific literate society.

The building of endogenous capacity for scientific knowledge through scientifically literate society received attention in this context for the first time. It was acknowledged that not only the attitude of those who are creating scientific knowledge, but the attitude of those who are taking benefits of science is equally important. However, it impacted the thinking of scientists and educators equally in third world countries and brought scientists, educators and teachers together at all levels on a common platform of (PCST).

What is KASISH approach?

It lays emphesis on all aspects of knowledge creation, attitude formation, and skill development, adoption of innovations, reflections of scientific temper and technological temper for scientifically literate human development. "KASISH" can be understood in terms of; K = Knowledge (Basics of PCST) and its outcome A = Attitude, S = Skills, I = Innovation, S = Scientific temper and H = Human development through PCST, It is all inclusive model based on content and processes of S&T development and takes care of all situational models such as deficit, contextual, and lay expertise models.

Knowledge

A**bout PCST and its basic principle:** Popularization of science endeavours to imaging scientific ideas in such a way that every one (especially non-scientists) can grasp fundamental concepts and have an idea of what science in essence is (Cornelis 1998). The Process consists of action that specialist in science needs diffusing it to broader population. It changes the attitudes amongst the population and in its public culture which makes science interesting to them. It integrates

public support for scientific research and development. The other objectives of science popularization interlinked to each other are to:

1. Provide generalized and simplified concepts of science in a language to be understood by all
2. to Increase scientific awareness and understanding
3. Encouraging inquisitiveness and creativity.

The outcomes of these efforts are creation of awareness of public about science and scientific research and new technologies, their benefits and generation of scientific and technological temper (S&TT) in general public. It is necessary to demystify myths and tackle superstitions. Futuristically, in today's globalized world, it is a tool to bridge the growing gap between society and world of science.

A paradigm shift is needed in objectives of science as progress engine in knowledge society in which scientist not only create science but scientists must communicate science to provide insight to common men to understand that how world is functioning and impacting his life. So that, public is able to understand the role of science and technology in disaster or peace**.**

Objectives of Science Communication: Translating ideas and concepts that are often extremely complex and far distant from common man. Creating tools to interest of public without betraying the scientific truth. Scientists must communicate science because it influences the society and empowers it to decide on issues and prepares for making informed choices for selecting development paradigms. Both scientific literacy and lifelong learning in S&T for all is agenda for future science communication in the world.

Core issues for People friendly science communication plan: (a) Bridging mistrust and gap in understanding of science and traditional knowledge; (b) Understanding the role of social, cultural and economic and demographic profile of society in relation to S&T development and its value for sustainable development; (c) Role of media and media skills in distribution, dissemination, argument reporting and urgency for science popularization in view of diminished attraction among meritorious students in sciences due to ineffective science teaching in schools; (d) In many schools science teaching is being closed for want of teachers and infrastructure facilities, whereas science departments in universities and colleges are suffering from flight of talented students elsewhere; (e) Integration of Education for All (EFA) with Science Education for all (SEFA) is must for retaining young talent in educational milieu of emergent economies; (f) Importance of information and communication technology and creation of virtual facilities for PCST programmes have emerged as powerful and effective medium; (g) the use of multi-media and essentiality of multitasking engagements both media literacy and digital literacy have been recognized as major functionalities of PCST.

National Policy Framework for PCST: A policy framework for PCST is essential pedagogical tool for enhancing budgetary support and augmenting facilities for

PCST, as well as, for improving science teaching from K-1-12 at school level. There exists a framework on popularization of S&T in Brazil also. It is based on the suggestions made during the Workshop on the Popularization of Science and Technology held in Rio de Janeiro from February 2 to 5, 2004. The policies, strategies, and priorities set by COMCYT can be used under IBSA dialogue for designing the New Framework.

Issues and challenges: The conceptualization and contextualization of popularization of science and technology as " the system of measures aimed at the dissemination, appropriation, and valuing of science and technology goods, which include critical thought, ideas and values, the history and sociology of scientific knowledge, how science is being practiced, and the results of scientific research and technological development". All these considerations are relevant for emerging economies including India and Brazil. However, some fresh thinking is needed because several dilemmas and challenges as focused by Hernan Chaimovich. These issues are: need to balance the scientist's freedom and society's need for knowledge, the tension between the individual pleasures of creation and the objective conditions of the restructuring wherein the scientist works, searching alternatives between a centralized generation of science and technology and correcting regional imbalances and also establishing relationship between science, technology and innovation and ethical values. All these issues are also relevant for India and other Asian countries from the point of view of scientific inclusion and integration.

Do we still need science popularization in India after 60 years of scientific pursuits?: The answer to the question is yes. Unfortunately many Indian professionals equate scientific acumen with technological expertise. A deep knowledge in specific scientific discipline like science communication coupled with textured experience in an environment conducive to scientific thought and discourse is key to long term success in this area and can offer solutions to issues mentioned above.

S=Scientific Attitude or Scientific Outlook

Major outcomes of effective science communication in society: The major outcomes of effective Science communication in society is scientific attitude or scientific outlook. The first Prime Minister of India Pt. Jawaharlal Nehru always stressed the importance of scientific approach towards problems of people and their role in nation building. He said on many occasions "science has brought all mighty changes and not all of them have been good for humanity. But the most vital and hopeful of the changes that it has brought about has been development of scientific outlook in men".. He was most powerful and effective science communicator and an advocate of scientific outlook in men and gave conceptualization of scientific temper for a society and supporter of international cooperation. The Scientific Policy Resolution of March 4, 1958 passed under him by parliament has been a guiding principle for development of science and technology in the country. Many strides made by India in the field of atomic energy, agriculture, space and

pharm became possible due to gigantic development of infra-structure for S&T under DST and CSIR and chain of National Laboratories devoted to variety of scientific purposes established during sixties as envisioned by him. Science 1958 there has been continuous efforts to popularize science in India by government and non-government agencies to infuse scientific outlook and temper in Indian society. The Government of India established the National Council for Science and Technology Communication (NCSTC) in 1982 as an apex body in pursuance of the objectives for taking science to the people,

Pt. Jawaharlal Nehru believed in vibrant education i.e. education as per needs and aspirations of people. In the present context we need Effective and Vibrant Science Communication directed towards changing the outlook of men. The Knowledge producers (researchers i.e. scientists) and Knowledge users are required to align their attitude toward science and its application. Attitudes and mind sets of Scientists as knowledge producers and users as science communicators or science journalists and science teachers requires In- phasing of Scientific attitudes (SA) of all stakeholders to construct a scientifically literate society by Effective Vibrant Science Communication (EVSC).

Building S&T capacity for welfare of people: We have moved from the capital-intensive industrial base (CIIB) to knowledge intensive information base(KIIB) and It has to be appreciated by all. Many greatest strides have been made in electronics, and biotechnology. Nanotechnology, Electronics has essentially transformed the global scene in the last seventy years, whether it is microprocessor, fiber optics, satellites, television, telephones, computer information or medical instruments These developments have opened up whole new set of opportunities . The scientists are required to work on. the scientific empowerment of people for Quality of life. The Board of the Inter Academy Council (IAC), 2001, decided that its highest priority among a host of priorities, importance would be given to Provide S&T education at all levels, strengthen links between scientists , engineers sociologists, political scientists and policy maker to design science communication to encourage innovation in disseminating the results of research and in turning them into new products and services that address local needs. There is urgent need to foster public-private partnerships that involve academia to define the protection of public goods and define the boundaries of the public/ private interface for building indigenous S&T capacity around the globe, while Building centers of excellence in basic sciences.

Social Activism and science communication: There is growing realization science and technology alone cannot promote socially equitable development. But at the same time it is a fact that development is is not possible without an adequate science and technology development. Thus, while considering the consolidation for excellence in our science and technology education and education in science communication, Because there is no sustainable future if a country nation's science system is are not related to its innovation system , adding value to export products, solving the serious income distribution problems and

providing common and equable access to health and education of equal quality to all citizens. Science communication by social activists is another area to be considered as recognizable societal form of PCST. The artistic tool and methods of communication in the field of entertainment media i.e. cultural forms of science communication have become more relevant, sometimes more powerful than print and electronic media and also science museums and science centers etc.

Mass mobilization for public understanding of science: Public participation for understanding of science in india got into the roots after in 1962 with the formation of Kerla Satra Sahitya Parishad (KSSP). In subsequent years it laid foundation of 'People's Science Movement (PSM)'- which later transformed into All India Peoples Science Network (AIPSN). The PSM which was constituted by a hand full of organizations from different states of India organizing 'Jan Vigyan Jatha' (Peoples' Science Campaign) in association with the National Council for Science & Technology Communication (NCSTC). The strong national science movement that emerged as a result of 'Bharat Jan Vigyan Jatha (National Peoples' Science Procession)' gave birth to many regional and national campaigns in India later.

Skills for science communication (SCS)

The public representation of science is the result of a combination of a great multiplicity and variety of factors, the origins of which are difficult to trace. These have very wide applicability: (i) It extends from writing articles in scientific journals; (ii) Public speaking; (iii) Writing for conferences and newspapers; (iv) Giving talks to students in school, college and universities; (v) Presenting on radio or TV or interacting through digital media or communication; (vi) Through performing arts, etc.

The researching knowledge of existing literature on the related subjects and issues, interaction with scientists and media persons, linguistic skills are essential for setting skills for SCs. The "scenario approach",requires the researcher to be trained and is put into a number of situations in which he will be expected to communicate with lay, but intelligent, audiences. The communicator has to play both the roles, i.e. as researcher and communicator. Because in both the roles one is required to play a part in formulating what goes out to the media, to ensure accuracy and to highlight the relevance, novelty, etc. In this context, it is important to understand how people relate to science. It is a fundamental premise for using the "uses and gratifications" approach for science communication theory.

Skills for media coverage: Writing press release, media interviews are basic skills to answer a few very basic questions: who, what, where, why, when and how of SCS. The media interview introduces you to the various forms and uses of the media in which scientists and non-scientists may be involved for clear focus on key points and anticipating questioning from non-scientists, policy-makers,

interest groups, community groups, business representatives, and members of the general public.

Framework of skills: Some of the professional skills are: background, experience in public engagement, writing skills, understanding the concepts of science and technology in everyday life and methods of science, and scientific outlook towards human problems and contemporary issues and interaction with media, scientists and non-scientists, public engagement with science and technology policies, their implementation, etc., and knowledge of media and public communication of science are some important elements which can constitute a framework of skills for science communication. The application of ICT in media communication has increased manifold, public science on the web, training in digital media, critical viewing selected science websites and TV programmes and application of electronic media to identify elements of good and bad practices are essential components.

New Set of interpersonal skills: We are living in world of democracy where people's will is supreme. The understanding of cultural and social issues in relation to presentation and broader outlook on science relationship between society, science and spirituality and religion is also necessary for SCS. The Gandhian principles of truth and non-violence have emerged as strong tools for conflict resolution. Therefore in coming times an understanding of peace education and conflict resolution is further necessary in context of values in science, cultural and societal development in relation to S&T development. In the current political climate of science and society interaction, there will be a demand for a new set of interpersonal skills to devise (EVSC) and SCS skills to meet the evolutionary Challenges in the world.

Integration, inclusion & innovation

Various factors and agents with different roles and functions are involved in good understanding of scientific concepts and methods used in popularization of science. Therefore, an integrated actions by knowledge producers, such as scientists, Researchers, and intellectuals and knowledge disseminators, such as science journalists, Publicists. Musicologists, Science teachers, Audio-video specialists and knowledge users and communities of scientific, cultural and social institutions are needed.

Selection of Science contents: The effective efforts to popularize science by EVSC must consider both the necessary tools and the content and subjects of the popularization activities. Thus, they must take into account the Interest Expectation of Audience (IAE). Guidelines can be developed through preferences of audience identified through research designs constructed for investigating content module for Science for all e.g. Harnessing of Technology for welfare of people ,Water Resources, Population Growth, World Hunger, Energy security, Environment, global warming and climate change, Sustainable development, Terrorist Activity,

Extinction and biodiversity, Hazardous Substances, Human Health, Air Quality, Degeneration in agriculture and pesticides, biotechnology and nanotechnology are few examples. The pre determination of IEA can enhance TRP (television response Potential) leading to HRPFSL

Inclusion: The Promotion of the integration of other forms of cultural expression and artistic creation in communication of science and technology Constitutes the inclusive elements for the creation of content and the standardization and organization of information for different audiences. The all inclusive process of science communication is to ensure that information reaches to unreached and mechanisms are created to ensure quality and ethics in the dissemination of science and technology The monitoring and designed evaluation Systems with reference to Various agents involved in popularizing science, each with different roles and functions, and the need for different types of training and incentives are identified for these purposes.

Innovation: Certain government, nongovernment and voluntary agencies have been experimenting with programmes predominately with the involvement of school children. They have developed many new ways of science communication, e.g. performing and folk arts forms, joy of learning with plays and toys, discussion forums, science clubs, seminars, explaining and exploring miracles and mysteries, children science congress, nature watch and excursions, slide shows, planetarium, exhibitions, science parks, etc. In India, NCSTC-net work (330 has been organizing, National teachers Science congress and National Children's science congress regularly since 1994.It has organized several other programmes such as year of Scientific awareness 2004, Appreciating physics in daily life-2005, Planet earth programme-2008-09, Science express-2007-08, International astronomy year -2010 etc.

Science policy for innovation: The encouragement of innovation in disseminating the results of research and in turning them into new products and services that address local needs is an important area that should be included in science policy .Many TV channels regularly include science programmes on astronomical events and contemporary issues for their audiences. The impact of discovery channel, backyard science, save planet earth etc. has been tremendous.

Public-Private-Partnership (PPP) models: In India, EMRC, EDUSET, Saksat has emerged as important tools for learning science. But these efforts can help augment technical man power but their use is simultaneously oriented to create scientifically literate society also. There has to be a trilateral effort at the national and global level in this regard. Besides governmental efforts. The involvement of PPP in this area, community radio, FM-radio and TV channels and cable-net work at local level can be more effective. The involvement of trade, industry and business in designing new services and products as business enterprise could help in innovations. The market for video games, Multimedia products, websites for learning languages, self learning in Science subjects through CD-Rom, websites, on-line learning are being used as market products. We have science

and technology development at the universities and national laboratories. But we don't have innovation at the industrial enterprises. It is a common paradox for many developing countries. We need to formulate sound and proper industrial and trade policies for it and role of industry in improving the quality of science education and communication. Civil Societies formed by scientists, Industrialists, media industry, media persons, artists and singers can bear fruits like " All for Education movement" started in Brazil by civil society. We can visualize Such initiatives for synergizing the goals of "Education for all " and universalization of secondary education for integrating with the goals of "Science Education for All".

Scientific Temper: Our first Prime Minister Pt. Jawaharlal Nehru persistently wanted people of India to acquire scientific temper so that they could conduct their thoughts and actions in scientific manner to become better scientists and citizens of tomorrow.

What is Sientific Temper?

In the Presidential address to the Indian Science Congress session held in Delhi in 1947, he pointed out the importance of approach of science to our national problems in terms of India's future. An extract from the speech to quote, "I do believe firmly that only right approach to world problems and to our national problems is the approach of science, that is to say, of the spirit and methods of science".

Technology Temper: Technological temper like scientific temper is a social attribute reflecting the inner urge, individual and collective for innovativeness and skill temperament and abiding faith in application of science and technology that all problems have solutions. That is why technology is defined as practical and application aspect of science. The synergies between S & T can be taken as capacity to convert concepts into technology and vice-versa. Technological temper is essential for creation of technology friendly environment amongst the masses. Scientific temper is essential for harmony and peace in society .Because It contributes to human development also, In truest sense of the word "KASISH" can be used an Indian term appropriate to science and technology temper including the processes and outcomes taken together. The meaning of "KASISH" is deep intense desire or passion for an ultimate fulfillment of objective. It is used in romantic Urdu poetry to express intense love or attraction, commitment and dedication.

Human resources development in science communication. The Education and Training for Science communication can be conceptualized for formal and non-formal sectors. The objectives of formal Education in science communication are to produce professionals for research and education in the field. The other aspect of formal education is to provide technical manpower for science communication and management of education through science museums, science centers, science exhibition and fares, media personals for print and electronic media. The third

aspect which has not been receiving attention is improving the quality of science education in schools. A good science teacher has to be good science communicator. For this some elements of education in science communication can be incorporated in teacher education or teachers training in the art of science communication. At present the first dimension is receiving attention and postgraduate degree courses and diploma courses are being run by universities and colleges in India by more than 30 institutions of higher education. Vigyan Prasar is running short term courses on some specialized aspects. Eventually science communication will become part of university education after it is recognized as priority area in XII plan.

Non- formal education: the non-formal science and the role of media (print and electronic), voluntary associations and societies, science museums, science centers. Science clubs and societies, science cafes, science parlors, cyber cafes and exhibition and fares by which one learns science are important. According to Miller (1996) scientific literacy is just over 10 % in population of 14 industrialized nations of world. In India scientific literacy is 3 % according to Manoj. It can be increased at faster rate if the school going population can be involved in learning science according to goals for Science education for all as discussed earlier. The establishment of school science societies or science clubs in each school offers an opportunity to bring together younger generation and community in a joint enterprise for learning scientific knowledge and information.

The core activities of school science societies will consist of following objectives identified in view of practical experience through VDS: (a) spreading of science literacy, (b) Provide a forum to teachers to engage themselves in science Popularization, (c) Organize interactions of scientists and technologists with stake Holders, (d) Involve parents, teachers and children in learning science by doing through activities such as projects, exhibitions, fairs, rallies, so as develop schools as centers of lifelong KASISH for S&T temper.

Why we need Vaigyanik Drishtikon or Science Societies?: Schools can be a collective and co-operative platforms for all stake holders to reap the benefits of SEFA as discussed above. The Vaigyanik Drishtikon Society has been bringing out a fortnightly newspaper Vaigyanik Drishtikon for more than a decade to disseminate recent scientific knowledge, concepts, and developments and fill in the knowledge gap among all stakeholders. Vaigyanik Drishtikon Society has undertaken several activities for the fulfillment of training needs, including the training of teachers. The list of activities undertaken by VDS illustrates the roadmap for science societies and their importance for the fulfillment of mission PCST. VDS was partner in organization of 11th PCST-2010 India, and covered the daily proceedings by its media team through a daily newsletter. It also covered international conference "on hands on science, Ahmedabad, India. It has been covering National Teachers' Science Congress, National Children's Science Congress and many other events at national and international level. It has organised workshops for teachers, media persons, students and non-science persons,

administrators, policymakers and public representatives on varied subjects to popularize S&T, such as, science journalism and science writing, Bio-safety awareness and capacity building, environment issues, science communication through digital media, theater workshop for schools, miracles, origami, science popularization, master resource person training programme, resource person trainings for children's science congress, and recreating interest & excitement in basic sciences in collaboration with NCSTC, DST, Govt. of India. Currently, a programme Mobile Planetarium for Astronomy popularization in schools is going on throughout the state of Rajasthan.

References

Science Policy Resolution, Govt. of India (1958).

Technology Policy Statement, Govt. of India (1983).

S&T Policy 2003. mht.

Verkey M. J. Current Science, vol. 7 No. 9 (2000)

UNESCO. 1999. "Science for the Twenty-First Century.";Text adopted by the World Conference on Science; http://www.unesco.org/science/wcs/eng/declaration_e.htm

6.Lechini Sledys "middle power", Nacla report on hemisphere (2007)pp 28-32; Emerging powers IBSA www.wilson center.org 12 may (2011)

IBSA website htpp://www.ibsa trilateral.org; Amy bratzal www.coha.org ; WWW.ibsa news.com (2011)

IBSA dialogue forum. En.wikepedia.org:www.ipe.undp.org (2010)

Patairiya Manoj, Science communication in India, British Association for advancement of science festival , Gasgow (2001), CREEN Channel.: Science Journalism in India, mkp @nic.in/ Jour. net. International conference on professional education for media, New Castle, Australia ,Feb.2-5 (2004)

Report of workshop on popularization of S&T, Rio de Janeiro, Brazil, Feb. 2=5, (2004):Popularization of science:getting on to public agenda, but how, Mercia Tait Lima , Ednalva, Felix das Neves, Renato Dagino, J. com. (04) 2008./http:// J.com.sissa.it./ communication of science: Review of literature, Michael F. Weigold (2001). Htpp:// scx. Sagpub.com/cgi/content/ abstract/23/2/164./ science and technology in Brazil, a new policy for global world. Vol.1. (1995), Simm Schwartzman, science communication Vol.23 No. 2 (2001) 164-199.

.PCST—8 (Barcelona 2004) Proccedings http://www.upf. Edu/cms/cms/pcst.pdf..

Pierre Fayard, Paola Catapano and Bruce Lewenstein The International Public Communication of Science and Technology Network A brief historical overview ,, www.upf.edu /pcst academy.org.

PCST-11= India December 06-10; www. Dst.gov.in ; PCST-2010.0rg: mkp@nic.in: Richa Malhotra, Report of PCST -11, richamalhotra@ gmail,com, Current Science vol. 100, No.5, (2011).

Public communication of science & technology Bruce , V. Lewenstein, web. Htm./www.pcstacademy. org/PCST-8, Barcelona (2004)/Popularization, History of modern science, oxford university press(2003), models of science communication, b.lewenstein@ cornell.edu. (2010)

(a) Denis A Ausiello, J. clinical investigation, 117, ,3128 (2007)(b) Science literacy for all AAAS project 2071; Benchmarks for Scientific Literacy, Oxford Univ.Press (1993). (c) http://www. scientificliteracy.org/

(a) Every Child a Scientist: Achieving Scientific Literacy for All http://stills.nap.edu/readingroom/ books/evchild/(b) Kothari commission report India (64-66)

ESConet the European Science Communication network) is part of enabling the vision of Europe's vision for Science and Society to become reality http://www.caas.unizg.hr/

(a) Inter Academy council science for better future (2003), secretariat@iacknow.ne., (b) mohamad H. A Hassan, Thirld world Science No. 1 (2000) , (c) ISWA . http://www.iswaindia.com/

N. K. Sehgal , Art of science communication, J comcom, (2004). Verkey, Viastas in science communication., J. Science communication Vol. 1, No. 1. (2009) 10-21.

Vyas P. C. "KASISH" school science societies(257), HSCI2009 (hands on science for All: quest for excellence) oct.27-31 2009 ,Ahmedabad India NCST: ISBN 978-989-95095-5-9;http://wwwhsci.info

OECD report, Instrument design: A Framework for assessing Scientific Literacy, (1998).

Geoff Rogers, James J. Watters, Kay Gibson, Mara Alagic and Connie Haack;

Global perspectives of Science education, Australian Science Education Research Association Conference 9-12, July, (2003).

UN millennium Development goals (MDG) (2000).www.un.org, www.undp.org/basics

(Science Education seminar, INSA-May (2002), Science education workshop INSA Oct. (2002). www. insaindia.

STME for human development (CASTME-UNESCO-HBCSE) portal .unesco.org/ 2001.

Vyas P. C., Science of Assessment for Quality Education, COBSE Conference Report Goa, (17-19 January (2006).

Quality science education reforms. COBSE conference , Rishikash Haridwar (2007)

Vyas P. C., Curriculum vs Designs. Towards Universalizing Secondary education, COBSE Conference Report Trivendrum , kerala (2005)

Vyas P. C., Universalization of secondary education COBSE Conference Ajmer, Oct. 19-20, (2010).

Shukla Rajesh, India Science Report, National Council of Applied Economic Research (2005)

NCSTC http://www.dst.gov.in/ www.Green Channel India./ National Institute of science communication and information Recourses (NISCAIR) India (2009)

ESConet (the European Science Communication network. http://www.caas.unizg.hr/

Policies in Development volume 1: Knowledge Flows, Innovation, and Learning in Developing Countries A Project for the Global Inclusion Program of the Rockefeller Foundation June 2003

Adeoti, J. (2002). Building technological capability in the less developed countries: the role of national systems of innovation. Science and Public Policy, April 2002.

Albuquerque,E.(1999).Scientific Infrastructure and the catching up process,http://www.dii.uchile.cl/~lacea99/papers/102.

Hernan chaimovich, Brazil science and technology: some dilemmas and challenges. full professor at the

Chemistry Institute of the University of São Paulo. universityScience and Technology. 323-332. Pdf. 39.

Pursuit and Promotion of science, (looking Ahead) chapter-38 Planning commission India/Scientific outlook Mainstream weekly(India) 2010

Chapter 16

Science Centers for Education and Socio-cultural Inclusion

Dirce Pranzetti, Maria Cecilia Tolosa, Marcos Matsukuma, Adenilson Matos do Nascimento, Norton Felipe, Maria Ines Nogueira

Science is made by man for man (Fourez, 1997), a statement that requires reflections on how humankind is developing actions to assure that man is getting benefits from science and technology, by least understanding its basic principles, which are part of daily activities.

In the last decade Brazil has experienced a boom on the amount of governmental institution's announcements of grants to develop programmes to socio-cultural inclusion in science and technology, however, they are still insufficient to cope with the need of this large and diverse country in all levels, we might think, of comparison.

The Estação Ciência (Science Station), a center for scientific, technological and cultural public understanding at the Provost of Culture and Extension in the University of São Paulo, was created by the Brazilian National Council of Science & Technology in 1987. It was renovated from an old fabric plant with 3,000 m² building to an area of about 4,600 m², under leadership of an inspiring scientist Crodowaldo Pavan. Soon it was moved under the administrative control of the University of Sao Paulo (1990)

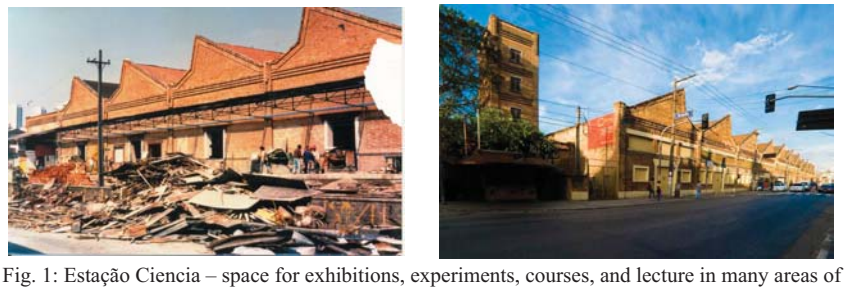


Fig. 1: Estação Ciencia – space for exhibitions, experiments, courses, and lecture in many areas of science, technology and culture.

It experienced a continuous renovation and updating, with permanent, temporary and itinerant exhibitions. In an innovative effort in education, it also has developed programmes to improve formal education in partnership with public schools, and informal programmes. The teachers' visits to the Science Center are

part of a project of the school. The teachers, as much as possible, come first, get acquainted to the themes exposed by lectures and interactions under supervision and dialogue, then they plan the visits at their school. This is how they become partners, helping to deal with the kids in inculcating right kind of behavior and imparting scientific contents, while visiting exhibitions. It has given excellent results in partnership with the public school system also excellent return in terms of optimization of resources.

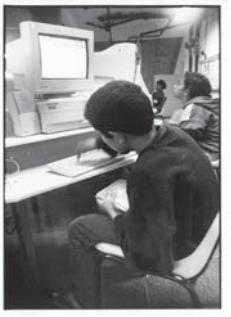
It has interactive programmes through the internet or local spots, such as beautiful curtains on time, depicting evolution of the city, landscape uses, different behaviors. Over the years, it was digitalized (M. Matsukuma layout and program, fotos Renato Cury, texts of Isabella Cunha Gonçalves and Rodrigo da Silva)

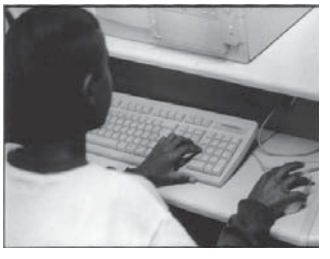
In addition, the center has much more to share, demonstrate, and deliver. Some of the important activities are summarized here:

Project Clicar

The location of the Estação Ciencia is a place that attracts many poor people as well. It emerged as a neighborhood of Lapa, a commercial center, next to the train and bus terminals, near the district food market and shopping center. Its surroundings represent, to all, urban space for informal jobs and access to leisure and better conditions, but for some it is for survival.

The project clicar started as a programme for children at risks, some of them are homeless. Kids come to the science center on their own or sometime recommended by someone. That was an opportunity to interfere by non formal education. After observations, analysis and dialogues, an understanding of the situation led to a proposal for some actions to change the scenario. The construction of a project with a special methodology and development of educative actions on how to reach the kids through educators and trainees, organization of physical space with computer and internet access, books, games, toys, equipments of multimedia and pedagogic materials, etc., were provided, besides establishment partnerships. Therefore, children now involve themselves in digital games under supervision of specialists, who stimulate their curiosity, participation and desire to change their lives. The kids also, participate in monitored visits to exhibitions of the Science Center, as well as other educational institutions (theatre, dance). Weekly session of movies with right to popcorn is scheduled. The kids enjoy the project; some of them become tutors of the new comers.

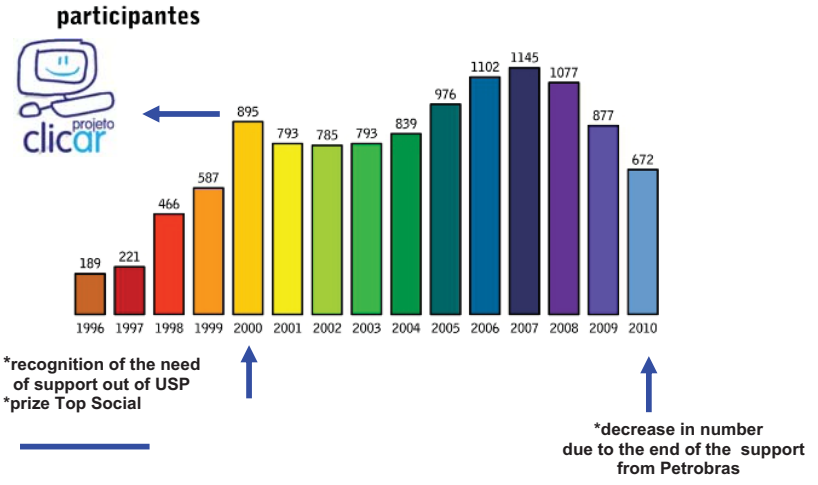
Finding suitable conditions. *Finding sutitable space*

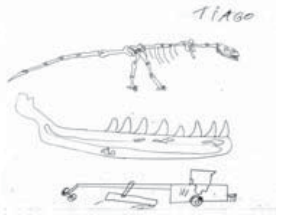




Project Clicar – a space of respect, social education and inclusion

www.projetoclicar.org.br/ www.projetoclicar.blogspot.com





In honor and memory: Tiago, who loves to study and draw dinosaurs Amelia Imperio Hamburger, who loves to awake minds, warm hearts.

Clicar Project: Imagined, created and settled by Prof. Ernst W. Hamburger, Dirce M. F. Pranzetti, Maria Cecília Toloza and undergraduate trainees form the University of São Paulo.

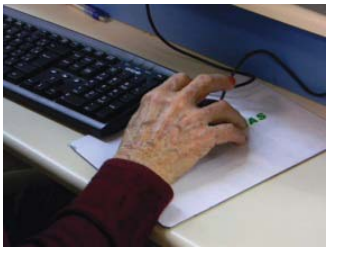
Project Clicar, 3aI (Senior citizens)

Concerning the children, their profile and the environment nearby Estação Ciencia, is changing with the arrival of new technologies, internet, collaborative and virtual spaces. It is therefore necessary to re-evaluate the project in a broad sense.

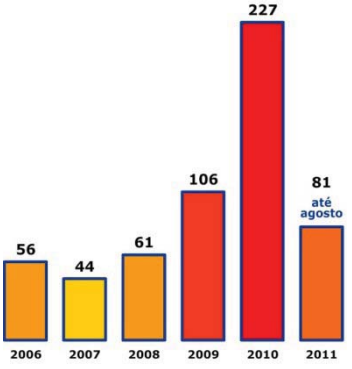
However, in today's fast food-feelings-life condition, a new group emerged, those of excluded people from these uses, facilities of new technology. The senior citizens, who are willing to get acquainted, but nearby conditions do not make things easy to them.

In this context, a new project was added in 2006 to the concept of Clicar, aggregating the third age, senior citizens, by using same space, installations, equipments and professionals. Although, specific methodology and procedure were developed to benefit them.





They come to the science center twice a week to follow a scheduled protocol comprising lectures and exercises, including understanding computers' basics and then the internet.



Number of applications per year from 2006 to 2011.

The activity attracts so many applications and two new groups were opened, as depicted here, and the number of participants has been increasing. They get much more than just computer and internet access, they get friends-partnerships, recovery of self-esteem and confidence, besides being instrumented to better interact with this mutating world.

Nucleus to scenic arts: Theatre

The Estação Ciencia has a nucleus to scenic arts, which develops and adapts scientific knowledge into plays, in a special way to communicate scientific information with cultural, folkloric aspects to people in general, aiming to improve their awareness on specific subjects.

The writer, director and actor Adenilson Mattos do Nascimento (Caue) works with a team in this process of making apparently complicated issues in interesting, digestible, but efficient understanding and awareness.

This is a very proficuous nucleus which has come up in a few years and has developed many plays presented at Estação Ciencia for different publics and also in other similar institutions or during events. It motivated other groups in the same direction. Nowadays, there is a national event named "Science in Scene"

every two years congregating theater groups with similar objective from different regions of the country. This special language, has been improved and is gathering momentum at different levels: to play, to develop and to assist.

The interest showed by senior citizens led to the elaboration of yet another special project at Estação Ciencia in 2007 aiming to include them in the activities, named: Only with Experience- for people over sixty. It is now in its third version, the interesting aspects observed with the activity and participants stimulated a master science project. Therefore, a methodology was proposed with focus on theater, dance, and circus with the objective to improve self-esteem, to put value in the personal history, promote social interaction, but most important is the opportunity to practice and understand the magic of theater for science communication.

Dance

Voice practice

Interpretation

Capoeira

The participants have to be engaged in workshops on theatre work; the body in poetic actions comes from a triple dialogue with conscience, presence and movement, based on techniques of consciousness (Klaus Viana), tact and improvisation (Steve Paxton). So, they study a reference list, have lectures, aiming to develop and present a play.

It seems they enjoy a lot. Six plays were already taken to the stage.

Only with experience
Art is a form of feeling that I am alive.
While I am accepted in a play I want to be there.
Marilene Anderson Diaro

www.teatroterceiraidade.blçogspot.com/ teatrec@eciencia.usp.br

Chapter 17

Science and Technology Communication Studies in India: Policies and Experiences

Manoj K. Patairiya

Abstract Mass media play a vital role in enhancing scientific literacy and scientific awareness among masses in an informal and interesting manner, as it has wider and deeper reach to the society. The science coverage in mass media is, however, abysmally low, due to various reasons and lack of suitably trained science communicators, writers and journalists being one of them. A science communicator/writer/journalist has an important role to play to develop a scientifically informed and attitudinally rational society, by way of interpretation of scientific knowledge and scientific concepts to the public through the use of mass media, be it print, broadcast, folk, interactive or digital. Even the newspapers, radio and TV seem to be inclined to devote space and time to S&T, but it has been found to be rather difficult to get enough science communicators, especially in regional languages. Incidentally, India has 22 regional languages recognized by Constitution of India. To fill this void, a unique programme for developing suitably trained manpower was launched by the India's National Council for Science & Technology Communication that includes developing human resources in S&T communication at various levels. The present paper while giving an account of such initiatives, presents an elaborated study of the programme, with appropriate inferences and futuristic approach.

Introduction

Science and Technology have made enormous strides the world over, not only in pure but also in applied sciences. We realize that communication of science holds the key to the real treasure of scientific knowledge; only which could carry the benefits of scientific developments to the common man. It is believed that most of the problems faced by mankind could be solved through science and by developing scientific attitude. Over the years, there has been a remarkable increase in science communication activities using different innovative modes of communication. Several newspapers and magazines have started science pages or columns. A variety of programmes are available on radio and television. Some voluntary agencies are actively taking science to the people through folk forms,

street play, theatre, puppetry and skits, etc. Print and electronic media have certain limits, but illiterates can also be enlightened through folk medium, as it offers two-way communication and is cost effective. Science exhibitions, science fairs, slide show, lecture, demonstration, planetariums, museums, science train are also part of ongoing S&T communication activities. A variety of popular science software has been produced. A number of potential science communicators are being trained. However, there is an urgent need to develop an army of trained science communicators to put in every effort to make S&T communication activities more effective and meaningful both in terms of quality and quantity. For instance, science coverage in print media is 3.4%, TV 2.18% and radio 5.84%, which is abysmally low that we intend to increase to 10%. Realizing the need of a large number of human resources in the form of trained manpower equipped with sound knowledge and skills in various aspects of science communication, for taking up science communication activities at micro and macro levels, academic courses in science communication were conceptualized and introduced in various universities and institutions some two decades ago, which have now became a prominent source of highly educated and motivated science communicators in the country.

Observations

Science communication courses in India are mainly available at the following 8 levels:

1. **Short Term Courses:**
   These courses are available for 5 to 15 day's duration. The participants are science activists and enthusiasts, whether students of science at higher level or not. A series of training/ orientation workshops of promising writers, illustrators, scientists and media persons at local/ regional level was conceived, formulated and being implemented by the author across the country in order to enhancing science coverage in mass media, especially in vernaculars. The participants during the workshops in consultation with the subject experts under the guidance of resource persons and eminent writers develop some scripts on a popular science topic. The scripts are then handed over to the press/ media persons for inclusion in their respective periodical/ programme. The team developed by such a way works regularly for a year and as per expectations a chain reaction in the field of science journalism is taking place and a new generation of promising science writers is coming up. The main feature of this programme is, that we do not leave the trainees alone after completion of the workshop; we try to associate them with some local/ regional newspapers/ magazines; so that they can contribute regularly and fine tune their writing ability. Selected promising writers are encouraged to write for state level media in the second phase. After that, the same process would be repeated and potential writers are encouraged to contribute to the national

level media as well. As a final outcome, it is expected that a large number of science communicators would come up and be able to bridge the gap between scientific knowledge and masses. Study and resource material on various aspects of science communication/ script writing/ journalism was prepared and uses extensively in the programme. Detailed methodology was developed, trained resource persons were identified and locations were selected for the purpose and guidelines were framed for successfully running the programme across the length and width of the country. As a result, over 350 such courses have been organized covering 350 districts out of 550 districts of the country and training over 10000 potential science communicators.

2. **Advanced Training**
   Advanced level workshops for earlier participants, who have shown outstanding performance, by way of contributing in mass media, are organized in various states/ regions. Special training programmes were undertaken to develop specialized science writers for various mass media/formats/target audiences/scientific disciplines, including science writing for folk media, electronic media, digital media and print media. That apart, workshops for working journalists, science fiction writing, science plays, science poems, science reporting, environmental journalism are organized from time to time to develop science communication using literary genre. National workshops for training of master resource persons are also organized at different intervals, which also review and address various issues.
3. **Medium Term Courses**
   These courses are of 1 to 6 month's duration; usually for those who want to improve and further fine-tune their science communication skills. Such courses are available as certificate, semester, informal courses in various universities and institutions. Some organizations also offer part time courses to accommodate working journalists. Such courses were proved to be useful especially to professionals already engaged in mainstream reporting/ journalism.
4. **Long Term Courses**
   Masters' courses leading to M.Sc./ M.Sc.(Tech.) in S&T Communication for 2 years' duration (4 semesters, with one semester on project/field work) were introduced in various universities with an initiative of the National Council for Science & Technology Communication.
5. **Correspondence Courses**
   One year training courses in science journalism/ science communication through distance learning were introduced in various institutions and universities, especially for those, who are working and are not able to spare time. Students from within and outside the country have joined the course. The study material in 5 modules is provided for the course, contact classes are organized at different locations in India and virtual interactive contact programmes are also organized with a provision of online examinations.

6. **Web Enabled Online Course**
   The world's first full-fledged online course is offered in science journalism through Internet to attract more students from across the country and from overseas as well. The duration of the each batch is one year and each batch is able to attract some 100 students from all over the world.
7. **Special Papers**
   Special/ optional papers on science journalism/ environmental journalism/ science communication as part of graduate and postgraduate courses in journalism and mass communication in various universities were introduced. The objective behind this intervention is to take advantage of a vast pool of students who have already taken up mass communication as their area of studies. The special paper course in science journalism offers an appreciation and orientation towards science journalism amongst such students who may eventually join mainstream mass media as science journalists. The efforts are being made to have many more such courses.
8. **Doctoral/ Postdoctoral Research/ Science Communication Chairs**
   Some universities have started offering Ph.D. in science communication and efforts are being made to have D.Sc. in science communication and establish science communication chairs in different central universities to foster research in emerging areas of science and technology communication.

Science communication courses in India

1. M.Sc. in Mass Communication in S&T, Lucknow University, Lucknow
2. M.Sc. (Tech) in Technology Communication, Indore University, Indore
3. M.Sc in Science & Technology Communication, Anna University, Chennai
4. Postgraduate Diploma in Science Journalism, Makhanlal Chaturvdi National University of Journalism & Communication, Bhopal
5. Diploma in Science Journalism, Madurai Kamraj University, Madirai
6. Diploma in Science Journalism, Pudduchery University, Pudduchery
7. Postgraduate Diploma in Science Communication through Distance Education, Devi Ahilya University, Indore
8. Diploma in Science Journalism through Distance Education, Indian Science Communication Society, Lucknow
9. Postgraduate Diploma in Science Communication, Indira Gandhi National Open University, New Delhi
10. Postgraduate Diploma in Science Communication, Kota Open University, Kota
11. Diploma in Science Communication, Cochin University of Science & Technology, Kochi
12. Diploma in Science Communication, St. Xavier College, Mumbai
13. Special Paper in Science Communication as part of PG Course in Journalism & Mass Communication, Rajasthan University, Jaipur

14. Special Paper in Science Journalism as part of PG Course in Journalism & Mass Communication, Purvanchal Unicersity, Jaunpur
15. Semester Course in Science Journalism as part of PG Course in Journalism & Mass Communication, Hyderabad University, Hyderabad
16. Semester Course in Science Communication as part of PG Course in Journalism & Mass Communication, Gandhi Gram Rural University, Gandhi Gram
17. Special Paper in Science Journalism as part of PG Course in Journalism & Mass Communication, Saurashtra University, Rajkot
18. Certificate Course in Science & Environment Journalism, Vishwa Bharti University, Shanti Niketan
19. Special Paper in Science Journalism as part of PG courses in Journalism & Mass Communication, Cotton College, Guwahati
20. Special Paper in Science Journalism as part of PG courses in Journalism & Mass Communication, Guwahati University, Guwahati
21. Special Paper in Science Communication as part of PG course in Journalism & Mass Communication, Banaras Hindu University, Varanasi
22. Diploma in Science Communication through Distance Education, K.K. Handique State Open University, Guwahati, Assam
23. Certificate Course in Science Communication & Media Practices, Indian Science News Association, Kolkata
24. Certificate Course in Science Communication & Media Practices, Science Association of Bengal, Kolkata
25. Certificate Course in Science Journalism, Vigyan Parishad, Allahabad
26. Certificate Course in Science Journalism, Jeevaniya Society, Lucknow
27. Certificate Course in Science Communication, Punjab Agricultural University, Ludhiana
28. Certificate Course in Science Communication through Television, Development & Educational Communication Unit, Space Applications Centre, ISRO, Ahmedabad
29. Diploma in Science Communication through Audio-Visual Media, C-DIT, Trivendrum
30. Ph.D. in Science & Technology Communication, Devi Ahilya University, Indore

Discussion & Analysis

S&T communication courses have been instrumental in developing trained manpower in this area in the country. Though the syllabi and contents are comparable with any such courses elsewhere in the world, special attention is drawn from the developing world's perspective, and more emphasis is given on "participatory model" instead of a "deficit model" or "linier model" of science communication being followed in most developed countries. Since, around 33%

population is still illiterate and 20% population lives below the poverty line, the conventional media practices of using print and electronic media may not help much and hence an important segment is devoted for alternate means of science communication using folk arts and interactive modes. The inherent purpose is to impart knowledge and skill of different aspects of science communication, besides inculcating a scientific temper into the minds of students, enabling them to eventually spread scientific awareness and scientific temper amongst masses. It emerged from the present study that in the countries, like India, science communication has many more added responsibilities, such as: i) spreading public awareness of S&T; ii) inculcating scientific and technological temper; iii) safeguarding public interests through effective science journalism; iv) empowering people with public negotiations, science advocacy, science politics and activism; and v) motivating talented youngsters towards higher studies and research in science.

Conclusion

The result and impact of this programme were overwhelming, as a number of science communicators with desired attributes are coming up. With the efforts put in over the years in systematically planning, organizing and conducting these academic training programmes, the science coverage in the media is significantly going up especially in local press. Several such writers are emerging, who can effectively write for folk forms, such as skits, plays, songs, fiction, stories, etc.; these contributions were brought out as popular science books. A countrywide survey on impact and outcome of the programme was conducted through a questionnaire. The survey shows that programme is going to be extremely useful and sustainable for local as well as regional media. Another study for exploring employment potential for students for these courses, involving course coordinators, students and representatives of media/ scientific organizations/ corporates clearly shows that there is ample scope and opportunities for placement. Most students are offered campus selection and are absorbed subsequently as public relations, editing, information, and media personnel in S&T/ media/ multinational/ foreign/ government/ non-government organizations. Though, the courses are designed to suit our present and future requirements, the modifications are required regularly to keep pace with changing market scenario in the fast advancing world.

References

Tyagi, B.K., S&T Communication Courses, *NCSTC Communications*, July 1993

Lewenstein, B., A Developing World Take on Science Literacy, *SciDevNet*, January 03

Patairiya, Manoj, Science Communication in South Asia: Challenges and Prospects, *Indian Journal of Science Communication,* **6** (1), July-December 2007

Clayton J. & Lublinski, Jan, Training on the Web, *Science Journalism in Europe*, Jan 2008

Chapter 18

Monitoring and Interdisciplinarity in Science Museums between Induction and Enhancement of Knowledge

Ruiz

Abstract The Science Center, Estação Ciência, Center for Science and Technology Popularization of the Provost of Culture and Extension of Universidade de São Paulo aims to promote and popularize science. Visitors of Estação Ciência are people with different levels of education, ages and professions. The science center collection is composed of experiments and exhibitions that contemplate various areas of knowledge. Mediation between visitors and exhibitions is done by explainers, graduate students of the University of São Paulo.

Besides an intellectual practice, the public communication of science is an empirical process of acquiring knowledge and developing new languages. As part of a public institution, the success of this process depends on the communication skills training of technicians, teachers, researchers and journalists, in a way that all of them should be capable of moving between formal and informal knowledge and also to enable a more efficient science diffusion process among the different levels of targeted social groups.

Internship at Estação Ciência is oriented to allow an integration of academic vision to visitors' culture and scientific knowledge needs. In many cases, such work requires restructuring of complex concepts into a more popular version - not least informative - communicated through cognitive exercises, interactions and dialogue within a valuable mutual teaching and learning process.

The contact between the public and the explainers has fundamental importance in this science center considering that the meaning and the significance of the exhibitions are jointly constructed by visitors and explainers. Therefore, mediation is fundamentally interaction with different social experiences which requires effective preparation to exercise very different competences and abilities.

Aiming a most effective science and society dialogue with special attention on governance and participatory procedures a pedagogic proposal for the Estação Ciência explainers training was written in 2001 and consisted of three fronts:

pedagogical training, specific training and cultural space. These fronts have common goals:

General objectives

- Advise students/ trainees in activities that will be developed in mediating knowledge
- Introduce the activities developed at Estação Ciência as a whole: the administrative, museological and educational dimensions.
- Discuss the specificity of non-formal education in science museums and its importance to formal education as well as the formation of citizens.

Specific objectives

- To provide to the interns a broad overview of the Estação Ciência services available to the visitors and of the exhibitions.
- To reinforce the principles of solidarity, companionship, cooperation among the staff.
- To encourage the dialogue among students from different areas of knowledge to exercise interdisciplinary approaches.

Since the beginning of the implementation of this proposal, the coordinators of the explainers have been worried about refining methodologies, organizing and promoting workshops and mini courses to improve both their specific curriculum contents and the alternative pedagogical approaches available, as well as health care and well-being procedures during the explanations.

Given the high turnover of explainers and the entry of a large number of new trainees along with the year, it became necessary to offer this training throughout the year by means of lectures, meetings and workshops that could suit both veterans and newly hired monitors.

The various forms of training include the monitors from all areas of activity present at Estação Ciência in order to stimulate interdisciplinary and integration between the academic and practical scientific knowledge and citizens' right to get reliable and accessible information.

For beginners this guidance is essential to expose them to an overview of the internship goals, the technical and the administrative activities. The dynamics of the coordinators, as a group, and notably given commitment of the institution with society, promote the integration of their acquired scientific content with the needs of audience apprenticeship. For the senior trainees, these moments promote reflection and evaluation of their own mediation practice, besides an opportunity for exchanging experiences about ways of presenting, teaching and interacting with the audience.

The choice of contents to be explored, its form and dynamics were built up over many years by the team of educators in an increasingly integrated way with other projects and collaborators of the institution until mid 2010.

We understand that all these efforts can help develop strategies for reducing the gap between science production and its popularization. Considering information as power, efficiently done scientific dissemination can increase society participation and awareness in political decisions concerning the direction of knowledge construction, science and the future of society.

As an outcome of this proposal the next stage of the project will be to understand how the mediators training unfolds in audience learning, specially whether the information accessed by the visitor, during a guided tour, were enough to induce, enhance and build some knowledge. A recommended technique to achieve those steps is the stimulated memory methodology. From this perspective the visitor response can assist the institution in the process of making decisions about collections, exhibitions, mediators training and the role of general staff.

The motivation for taking such a challenge is the belief that public spaces for education, such as Estação Ciência , should be properly managed by taking into account the interests of society, and the relevance of their contributions to improve quality of life, which significantly impact areas such as; health, education and citizenship awareness.

References

CAZELLI, S.;MARANDINO, M. e STUDART, D. C. Educação e Comunicação em Museus de Ciência: aspectos históricos, pesquisa e prática. In: GOUVÊA, G; MARANDINO, M. E LEAL, M. C. (org.) Educação e Museu: A Construção Social do Caráter Educativo dos Museus de Ciência. Rio de Janeiro: Access. 2003.

CRESTANA, S., CASTRO M. G. e PEREIRA, G. R. M. (orgs.). Centros e museus de ciência: visões e experiências subsídios para um programa nacional de popularização da ciência. São Paulo: Saraiva/Estação Ciência, 1998.

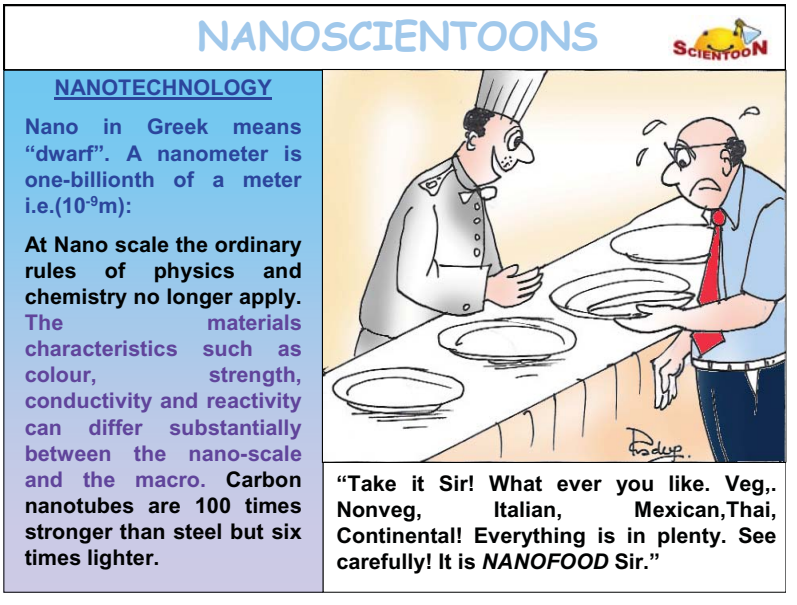
CRESTANA, S., HAMBURGER, E.,C SILVA, Dilma M e MASCARENHAS, Sérgio. Educação para a Ciência: Curso de Treinamento em Centros e Museus de Ciência. São Paulo: Livraria da Física, 2001.

CHASSOT, Attico. A ciência através do tempo. São Paulo: Moderna, 3ª ed., 1994.

Chapter 19

Scientoons and Scientoonics: A Novel way of Learning and Enjoying Science

Pradeep K. Srivastava



Abstract Science education and research is facing nowadays a tough challenge around the world. Many a times, the way it is being taught, it looks very technical, less interesting and sometimes even boring. Educationists around the world including USA are worried as students are opting for more lucrative career options in business, commerce and information communication technology. This trend is not a healthy one as no country can progress without the development in science. Nowadays most of the scientific researches have become interdisciplinary and many experts from different background have to work together. To communicate to such different experts from various disciplines, is a real challenge. Though science affects the life of each and every one of us, but when

> it comes to understanding and learning science, people are very much scared. It is the case with the students who also seem to be less interested in learning science. What has gone wrong and where did the scientist and all those who are teaching science fail? Science education is the field concerned with sharing science content and process with individuals not traditionally considered part of the scientific community is really great challenge. The target audience may be children, college students, or adults within the general public who may or may not have read science earlier.

Introduction

Science education is a comprehensive term that refers to the study of the teaching and learning of science in schools, colleges and universities. Topics in science education might include understanding how students learn science, how best to teach science, and how to improve learning outcomes by changing teaching methods and appropriate training of science instructors, within many modes, including classroom lectures, demonstrations, and laboratory activities. There is a constant need to update the skills of teachers engaged in teaching science, and so science education speaks volumes to foster the idea of finding alternate medium to attract people towards science.

The first person credited being employed as a science teacher in a British Public School left the job at Rugby in 1850 after establishing science to the curriculum. Sharp is said to have established a model for science to be taught throughout the British Public Schools. The next step came when the British Academy for the Advancement of Science (BAAS) published a report in 1867 (Layton, 1981). BAAS promoted teaching of "pure science" and training of the "scientific habit of mind." The progressive education movement of the time supported the ideology of mental training through the sciences.

In USA, Informal science education is the science teaching and learning that occurs outside the formal school curriculum in places such as museums, the media, and community-based programmes. The National Science Teachers' Association has created a position statement on Informal Science Education to define and encourage science learning in many contexts and throughout the lifespan. Research in informal science education is funded in the United States by the National Science Foundation. The Center for Advancement of Informal Science Education (CAISE) provides resources for the informal science education community. The practice of science education has been increasingly informed by research into science teaching and learning. Research in science education relies on a wide variety of methodologies, borrowed from many branches of science and engineering such as computer science, cognitive science, cognitive psychology and anthropology. Science education research aims to define or characterize what constitutes learning in science and how it is brought about.

History of cartooning

It is well said that a picture is worth thousand words. ***Cartoons*** are the combination of caricature and satire. ***Caricature*** means distorted drawing and ***satire*** means a humorous comment. A cartoon is a form of two-dimensional visual art. While the specific definition has been changed over the time, modern usage refers to a drawing or painting intended for satire caricature, or humour to the artistic style of such works. An artist who creates cartoons is called a cartoonist. A simple drawing showing the features of its subjects in a humorously exaggerated way, especially a satirical one in a newspaper or magazine

The term originated in the middle ages and first described a preparatory drawing for a piece of art, such as a painting, fresco, tapestry or stained glass window. In the 19th century, it came to refer to humorous illustrations in magazines and newspapers, and in the early 20th century and onward it referred to comic strips and animated films on television programmes. Humorous nonpolitical cartoons became popular with the development of the colour press, and in 1893 the first colour cartoon appeared in the New York *World.* In 1896 R. F. Outcault originated *The Yellow Kid,* a large single-panel cartoon with some use of dialogue in balloons, and throughout the 1990s humorous cartoons by such artists as T. S. Sullivant, James Swinnerton, Frederick B. Opper, and Edward W. Kemble began to appear regularly in major newspapers and journals. *The New Yorker* and the *Saturday Evening Post* were among the most notable American magazines to use outstanding single cartoon drawings. Humorous nonpolitical cartoons became popular with the development of the color press, and in 1893 the first color cartoon appeared in the New York *World.* In 1896 R. F. Outcault originated *The Yellow Kid,* a large single-panel cartoon with some use of dialogue in balloons, and throughout the 90s humorous cartoons by such artists as T.S. Sullivant, James Swinnerton, Frederick B. Opper, and Edward W. Kemble began to appear regularly in major newspapers and journals. *The New Yorker* and the *Saturday Evening Post* were among the most notable American magazines to use outstanding single cartoon drawings.

Genesis of scientoon

If the subject of the cartoon is science then they are called science cartoons. There are many good science cartoonists around the world. I was influenced by R.K. Laxman, a famous cartoonist in India, a Raman Magsaysay award winner, Sydney Harris of USA is a wonderful science cartoonist and his role in turning me to a scientoonist is vital.

As far as, I remember, drawing has been a gifted hobby to me. When I was kid, I used to draw anything in seconds. When I was studying in Govt. Model school in Rae Bareli, my home town, I made the drawing of Maharana Pratap (A great Indian Warrior) in Hindi (Official Indian language) during my exams. My teacher got very angry as he thought I had spent precious time in drawing the sketch

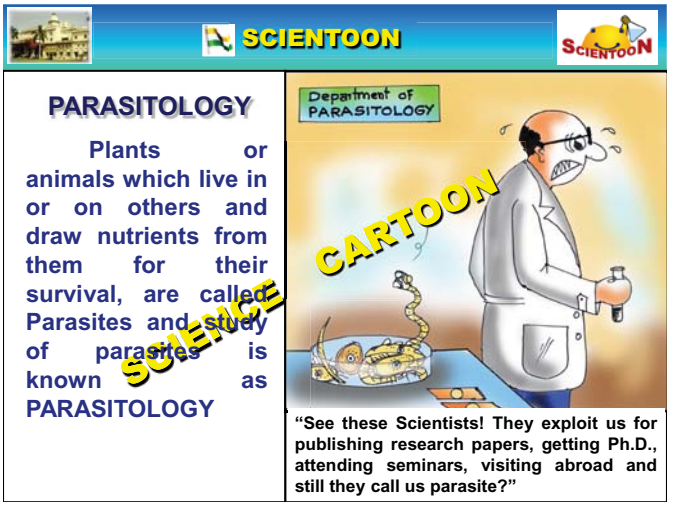
rather than attempting to answer the question. But when I told the truth that it took hardly 30 seconds, the teacher was amazed. He said "I'll give you 10 minutes to make the same drawing again, otherwise you will be severely punished". I finished the same in 28 seconds, and the probable punishment turned into lifelong reward.

I continued my drawings till B.Sc., as I had biology as one of the subjects, but after joining M.Sc. (Organic Chemistry), I stopped drawing and almost given it up. It was only in I984, I made first cartoon of my life, which was published in a local daily *"The Pioneer"*. The subject was political. After that, I developed interest and suddenly my old hobby was once again started flourishing. My cartoons got published in other local dailies like *Dainik Jagran, Sandhya Times, Anand Bazar Patrika* and magazines like *Lotpot, Grihshobha, Kadambini, Sun* and many more. I recall my first set of science cartoons published in *Science Reporter*, a popular science monthly of CSIR, New Delhi. *Science Reporter* continued publishing my science cartoons for several years giving me name, fame and honour. Such encouragement led to evolving the idea of scientoon. I could smell plenty of humour around me and I was able to fully utilize it to convert into science cartoons.

In 1988, while delivering a lecture "Development of Drugs and Pharmaceutical Industry in Developing Countries" in a conference held at National University of Singapore, Singapore, I used a few science cartoons to make my lecture more informative, interesting and impactful. I coined a new name for such cartoons - SCIENTOONS.

SCIENTOONS are the cartoons which are based on science, they not only make you smile and laugh but also provide information about new researches, subjects, data and concepts in a simple, understandable and interesting way.

The lecture was well received and enabled me win a SILVER MEDAL for the best lecture.



- Scientoons / cartoons have been published by reputed International bodies:
  - American Chemical Society, USA. (Chemtech)
  - International Union of Biochemistry, UK. (TIBS)
  - International Union of Pure & Applied Chemistry, Sweden.
- **Royal Swedish Academy** and **Swedish National Committee on Science & Technology (which awards NOBEL PRIZE in chemistry)** invited me to present a paper on the topic "SCIENTOONS" in the "32nd International Union of Pure and Applied Chemistry Congress "held at Stockholm, Sweden.
- **World Health Organization** has appreciated AIDS Education & Awareness to children through scientoons.
- **United Nations Environment Programme (UNEP)** has published report entitled "SCIENTOONS: Cartoons for Environmental Cause" in its Asia-Pacific News Letter.
- **UNESCO, FRANCE** has very much appreciated a original project based scientoons saying they could be useful to many sectors of UNESCO and showed interest to collaborate for exhibits, publications, training courses and seminars.
- **Dechema, Germany**, has invited me to deliver a lecture on the topic "SCIENTOONS - A Novel Tool to Create Environmental Awareness- A Key to Environment Mnagement in the an International Congress of Chemical Engineering and Biotechnology "held in China.
- **Council of Scientific & Industrial Research (CSIR),** India -Developing scientoons on safety aspects of chemical, biological labs, industry and fire safety. Member, Editorial - cum - Organizing Committee of "SAFE-LAB", a publication on safety by CSIR, New Delhi, India.
- **National Council of Science and Technology Communications (D. S. T, Govt. of India)** took me in the expert panel as a resource person to conduct "Science Journalism Workshop" throughout the country.
- **South African Pharmacology Society, South Africa** along with **International Union of Basic and Clinical Pharmacology (IUHAR)** and **International Council of Science (ICSU) Collaboration** has proposed the use of scientoons for creating awareness about health care in Africa.

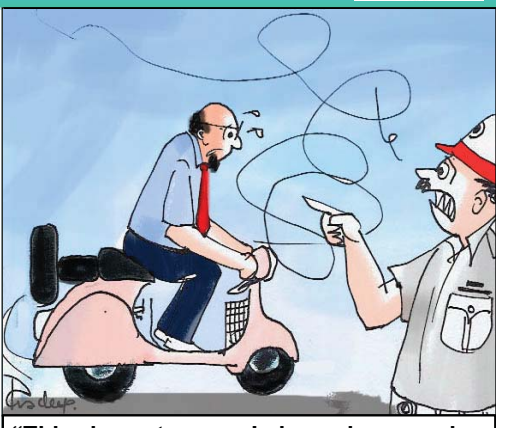
Importance of scientoons

The Scientoon based audiovisual technique is more useful when a scientific programme is undertaken for higher education/ mass awareness on the subjects like environmental pollution, biodiversity conservation, nanotechnology, DNA technology and human genome, AIDS awareness, food and good health, mass spectrometry, diseases like malaria, Hepatitis B, ascariasis, filaria, parasitic diseases and many other subjects and areas for communicating amongst experts of different disciplines. Scientoons can fill a gap among the various experts**.**

SCIENTOON

BROWNIAN MOVEMENT

The zig zag movement of the suspended particles in a fluid medium is called Brownian Movement.



"This is not your Lab and remember Professor! You are a human being and not a particle to follow *Brownian Movement* on the road."

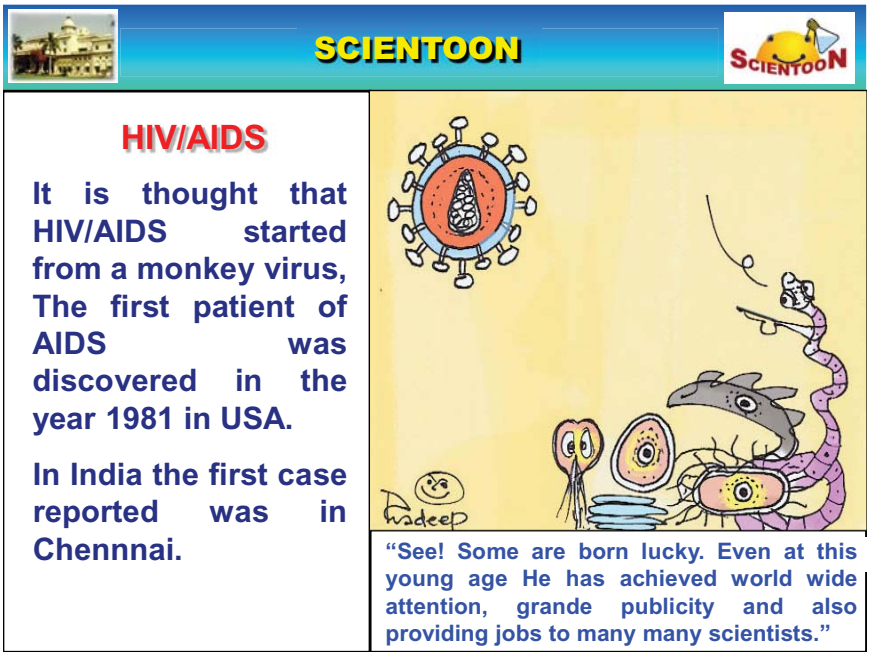
SCIENTOON

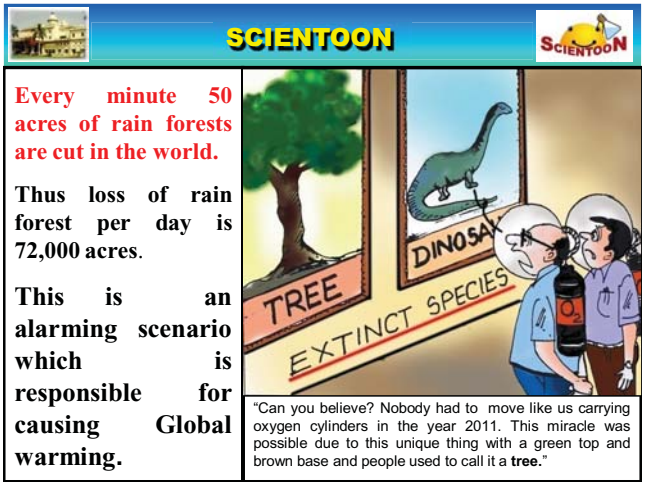
One researcher has genetically engineered tobacco plants in his laboratory to produce a bacterial enzyme that breaks down explosives such as TNT and dinitroglycerin.

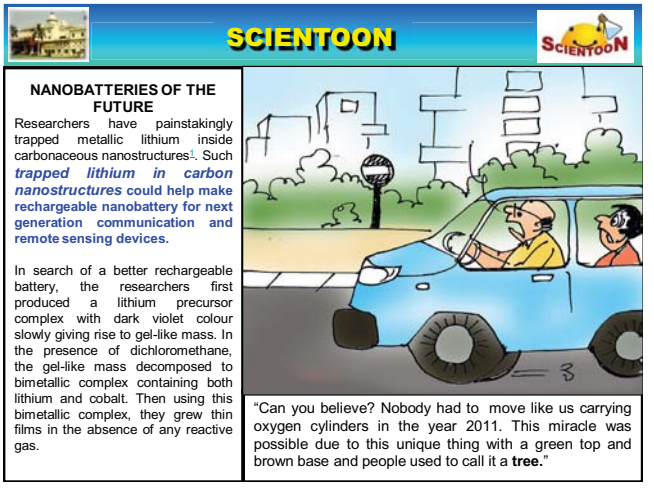
Waste that would take centuries to break down in the soil can be cleaned up by simply growing these special plants in the polluted area.

"Genetically engineered tobacco plant! Great! Here lies the solution. Even if I reach 15 minutes late from the office, my wife explodes far worse than TNT."


The allotment of double rooms in this hotel is based on "Hunds Multiplicity Rule" that the rooms will not be doubled till they are occupied singly first.


SCIENTOON
SCIENTOON
HIV/AIDS
It is thought that HIV/AIDS started from a monkey virus, The first patient of AIDS was discovered in the year 1981 in USA.
In India the first case reported was in Chennnai.
"See! Some are born lucky. Even at this young age He has achieved world wide attention, grande publicity and also providing jobs to many many scientists."



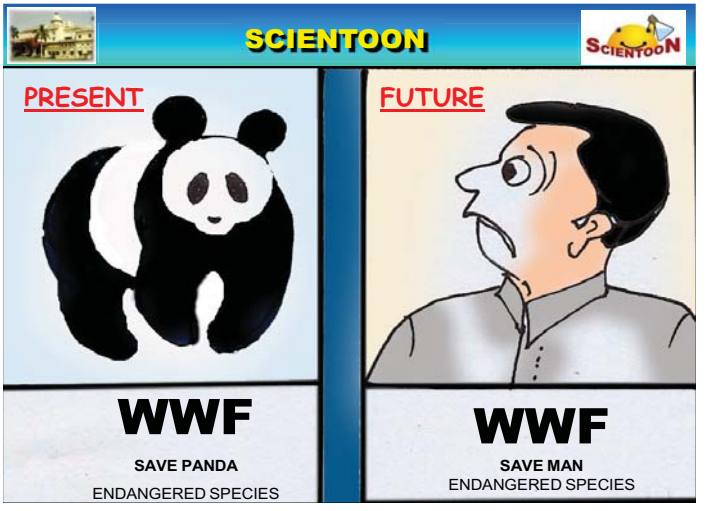


Origin of scientoonics

After delivering around 600 lectures in India and around the world covering more than 25 different topics in science, I thought the idea of a new science. Several names came to my mind but the best which I thought was Scientoonics. I delivered my 601 lecture in the **"First African Science Communication Conference"** held in the year 2006 at Dr. Nelson Mandela Metropolitan University, Port Elizabeth, South Africa, where I announced for the first time about Scientoonics, in my lecture.

"Scientoonics is new branch of Science that deals with effective science communication by using a novel class of science cartoons called Scientoons."

It was great that people in South Africa enjoyed and liked my concept and new science Scientoonics, very well.



How to learn making scientoons

Cartooning is a creative art. One needs tremendous imagination in order to make the concepts simple and understandable. Humour and sarcasm constitute the important components of a cartoon. A cartoon like a poem is a composition through expression elegantly and wittingly. In cartoons, not only humans but animals, birds, plants and fruits and even vegetable can also be made as a character. Making and designing of scientoons need a little skill of drawing, to understand how to draw the faces with different moods and expressions. One has to first understand the complex science subject in the simplest form, get the idea and then draw a cartoon, incorporate science part in that and thus a scientoon is generated. A 4-5 days workshop can be appropriate to make people learn how to create and design scientoons on various science subjects.

Looking ahead

Scientoons can a play vital role in making a common man understand the complex subject of science. Its greatest advantage is the visual which speaks a universal language, can be translated into any language of the world. In future these scientoons can be animated, can be allowed to speak and interact more closely with the children.

Scientoons have motivated government authorities in India to take certain steps for the betterment of the common man as they are very sharp, thought provoking and mind-blowing. Scientoons have made not only children but scientists, doctors, police officers, engineers, management experts, bank officers, railway officials, researchers and even people working in the government to understand the various issues related to health, hygiene, environment, science education and

civic work. Scientoons helped make people aware and take preventive steps. Radio scientoon and puppet scientoon were also created by the author involving experts from radio and puppetry. Dr Manoj K. Patairiya (India) is giving shape to Braille scientoon enabling visually challenged to enjoy the pleasure of learning and thrill of amusing through scientoons.

India and Brazil share many similarities in the area of science education, environment, health and hygiene; scientoon can be a powerful way of bringing science to common masses.

Scientoon book

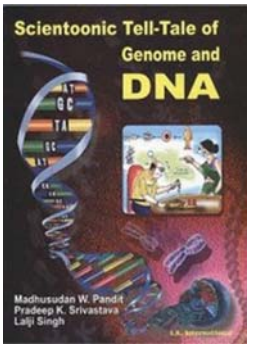
The first scientoon based book on DNA Technology focusing on DNA Fingerprinting ***"Scientoonic Tell-Tale of Genome and DNA"*** has been created by the author in association with Dr. Lalji Singh, an acclaimed scientist and father of DNA Fingerprinting in India. The book is becoming very popular especially amongst children, scientists, researchers, forensic experts, layers, and police officers, etc.

First scientoon based book of the world published and launched worldwide

Scientoonic Tell-Tale of Genome and DNA

Scientoonics is a new discipline in science that deals with science communication by using a novel class of science cartoons called scientoons. These are essentially cartoons based on scientific concepts, discoveries, results, and their applications. The present book is an effort with entirely novel approach in communication of scientific facts in their true perspective. It will not only help the common man to acquaint himself with the scientific jargon but also make him understand how best we can make use of such facts in our day-to-day life. Recent advances in scientific research, in fact, demand pro-active efforts from the scientists so that complex ideas reach to the people effectively. The present book has essentially tried, through Scientoons, to depict present concerns brought forward by the recent explosion of knowledge, especially the knowledge about Human Genome and related areas. This collection of scientoons has addressed areas such as DNA, DNA fingerprinting, Human Genome, Conservation of Wildlife, etc.

The authors have elaborated on the scientific aspect of the scientoons and have taken an opportunity to provide information that would not only help the readers in appreciating the spirit and the humor in scientoons but also enrich their knowledge about scientific advances which are taking place around the world. Each scientoon is therefore associated with a text that narrates the serious part of the science or its applications. This book is an endeavor to reduce the gap between the excitement of some of the scientific advances in science of the present time and the curious readers who want to know more about science.



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References

The Columbia Encyclopedia, Sixth Edition. 2008. Encyclopedia.com. 7 Oct. 2011

The Oxford Pocket Dictionary of Current English. 2009. Encyclopedia.com. 7 Oct. 2011

Chemistry International, USA

Patairiya, Manoj K., Science Smiles: A Scientoon Makes it Happen, Indian Journal of Science Communication, July-December 2008.

GZ-RAIS

Cultural Perspective

EOZEM-OS

Chapter 20

Science with Engagement and Passion

Yash Pal

The position of a research student at the Tata institute of Fundamental Research (TIFR) was the only job I ever sought after. I cannot imagine a better beginning of a career. If I am given another life and the TIFR is still around I would like to come back as a research student here – provided, of course, I am accepted. I understand that the competition is tougher now.

Why should one be so sentimental about one's beginning? After all there are many wonderful worlds only after my belonging with the earth, the smells, the trials, problems and dreams of this land. The TIFR provided me an opportunity to do some excellent science, but simultaneously its environment encouraged engagements beyond the formal contours of science.

I would not dwell too much on the science I did here or elsewhere. Instead I would expose my struggles in which the joys, spirituality and perspectives of science co-mingle with larger issues that demand simultaneous attention to the intimate and the cosmic. My sorrow remains that such a mindset is rare, especially amongst the powerful, the affluent and the dominant. I believe that only those who inhabit the perceptive and intellectually honest corners like the TIFR can further a way of thinking that might provide the solitary ingress to a world that is secure, to an India that moves ahead to build a peaceful and inclusive society. I will try to explain why.

I was on the roll of TIFR for 34 years. Even after my name ceased to be on that roll I did not feel that I had ever departed. There was an infectious element seeded into the environment of the institute that has stayed with everyone who spent any time here. It would remain a mystery as to how it came about. I am not even sure that it was all planned beforehand. Was it merely the result of a blind faith that the right chemistry would automatically develop if some excellent young people were put together in a free atmosphere and allowed to do their own things?

One of the joys of having been involved with Indian science and academic world for nearly all of its independent years is that one meets friends everywhere one goes. The surprising thing is that they even recognize you, even though many of them may have no idea of what you have done, or done anything at all. I am embarrassed when many people think that I am a social scientist – I mean many people who themselves are not distinguished scholars in social sciences. The latter find me out before I have uttered more than a couple of sentences, partly

because I do not refer to the work of other scholars, but of other workers. I hope you would discern the temperament of a worker in what I am going to say.

Towards the end of 1972, I was invited by Dr. Satish Dhawan, Chairman, Space Commission, to organize the Space Applications Centre, building on a number of application oriented units of Indian Space Research Organization (ISRO) in Ahmedabad, and adding a number of new entities as required. This was my transition, temporarily I thought at that time, to becoming a space technologist and, simultaneously, some sort of a social scientist.

The most important task ahead was to concretize the dream of Vikram Sarabhai and get ready for the Satellite Instructional Television Experiment (SITE). True, the satellite was to be provided by NASA, with whom we developed very fruitful collaboration, of a kind rather difficult to imagine now. However, we had to learn to develop and build two major earth stations, design, develop and get fabricated, thousands of direct reception sets, along with their low noise amplifiers and antennas. Not only this, we also had to design and manufacture a large number of solid state TV sets, which had not yet appeared in the market anywhere. All this equipment suitable for the difficult environment of a rural India, had to be deployed in several distant clusters, across a distance of a few thousand kilometers and, after deployment, to be maintained for a couple of years. We could not buy most of these systems anywhere in the country, or abroad. We also had a strong motivation to do the deployment ourselves, because achieving self-reliance in all these areas was an important objective.

That particular period- for me-was the period of immense learning. It was probably true also for my one thousand and odd colleagues, most of them very young, who grew into mature technologists in a short span of time, because of the challenges thrown at them. Alongside communication, the other major application of remote sensing also began at that time. Perhaps a couple of experiences of trying to grow scientists and technologist would be in order.

We had to design the front-end converter for the satellite receiver, to test it and send it to Goddard Space Flight Centre of NASA for checking, before transferring the know-how to local industry for manufacture. We worked in a place that, at that time, had no environmental testing facilities. For high temperature we used the Sun and for low temperature, a rickety old refrigerator. Six units were sent to Washington. Two days later I got a telex saying that all of them had very poor temperature stability and the only way a meaningful development could be done was to send our engineers to NASA. The experiment was coming on and we had no time to waste. I discussed the problem with our engineers and after convincing myself that the problem was understood, sent a telex back to NASA saying, no thank you, we will do it ourselves. Simultaneously, I sent telexes to half a dozen of our radio- astronomers, requesting that they drop everything and come to Ahmedabad to review our altered design.

My cry for help was worded that they all came. They were astronomers and not space technologists. However, I was sure they would be able to understand the

requirements. Following this the newly designed units were fabricated and sent to Washington for testing. Back came a congratulatory telegram, expressing surprise at the almost perfect performance of the new design.

I believe that lot of later self-confidence of the engineers in the Centre came from this one incident. If they had been denied the chance of doing it themselves, it would have been difficult to develop the atmosphere of creativity that came to pervade the Centre.

I am mentioning this because in the present day rhetoric of globalization and opening up, some people forget that often it is more important to invent a thing yourself than to get it. Unless a taste for discovery is established early, it will never come. I believe that a civilization that protects its young from the hassles of doing things themselves also deprives them of great joy and ultimately leads its society into a state of permanent dependence.

In 1972, NASA launched its first remote sensing satellite ERTS-I. While communication satellites abolished distance on earth and made it possible to choose neighbours independent of distance, remote sensing has enabled us to get a new look at the planetary features and understand their relational aspects- we can see the forests, while on the ground we were only aware of trees. It seems strange, but it is true that there are things we realize only by looking at them from far away. Perspective can't be acquired from close proximity. Incidentally, this applies equally in matter personal, social or political. We also wanted to grow remote sensing at the Space Applications Centre, starting from almost nothing. This was done, and surprisingly well. Indeed we were able to launch our experimental remote sensing payloads into orbit within four years, even earlier than the communication payloads.

I need not go into all these details, except to point to a strategy somewhat at variance with the practice where we keep sending our people for specialized training abroad whenever we want to develop something different. Any physicist with minimal self-confidence could persuade himself that remote sensing technology can't be very different from techniques of astronomy, or even nuclear physics, except in specifics. Hence I started a campaign to persuade three old colleagues from TIFR, one from infrared astronomy, and another from nuclear physics and the third from computer science, to move to Ahmedabad for developing the technology and science of remote sensing. They needed a month to think over and then they came. Many other joined them, scientists and engineers. The result was that by now we have had operational remote sensing satellites whose performance compares favorably with that of others launched by any nation and further, the programme has been coupled intimately with a large number of socio-economic programmes, including detection of ground water sites. Much of it has been done after I left, with different leadership. I suspect though the beginnings couldn't have been so bad.

By now you must have become aware of my allergy against standardized training programs so patronizingly offered by some well- meaning agencies. By

their very nature they can take you only thus far and no further. In creative fields there is no alternative to starting on your own, making your own mistakes.

Coming back to the growing connection with rural India, via space, my romance with space technology has been a continuing struggle to bend it in a direction of wholesome connectivity. Many a time it has been a losing battle. Even your successes get largely appropriate for purposes that are routine and ordinary, sometimes even profane. I hope something of value has remained.

It was possible, for example, to insist that staying true to the objectives of the SITE experience, one had to really know one's audiences, to assess their needs and in fact involve them in creating programs for themselves. This was an unusual preoccupation for a space centre, but the argument was accepted to the extent that at one time we had nearly 200 social scientists working with us. We learnt to build studios, to modify inexpensive video cameras for fieldwork, involve many fresh people in actual program making. All India Radio, the predecessor of Doordarshan had the prime responsibility in this regard but it was amazing that the job of providing needs assessment and later evaluation of the impact of the experiment was 'naturally' organized by a space centre!.

We produced science programs for children with the help of fresh young producers from the Film and Television Institute. I sought help from all friends and old colleagues in this challenging task that demanded that we keep in mind the fact that the only laboratory most of these children could access was their natural environment, their play and their homes. Madhuriben Shah, the then Education Officer of the Mumbai Municipal Corporation responded promptly to a single telephone call to spare two tall rooms near Grant road to set up a studio had to be in Mumbai because I had friends like late V.G. Kulkarni and Bhai Udgaonkar alongside. With whom I had worked in Mumbai municipal schools to upgrade their science teaching using a discovery approach. Many other friends at TIFR joined in to help and there was a time when many of the scripts for these programmes were honed up around the coffee tables in the West Canteen of the TIFR. Besides, many friends in theatre and film world were fired up to be partners in this crazy adventure. Names like M.S. Sathyu, Dina Pathak, her daughter Ratna and Supriya and Habib Tanvir come to mind. Most of it was a labour of love. It was wonderful to discover that when the objective has value and you seek help, worthwhile people consider it a favour that you asked them.

Perhaps one can say with some justification that these efforts produced a culture of audio-visual communication, which has been soaked into the work of many individuals and organizations, most of whom have no connection with space any longer. However, I believe that 'space' way of thinking brought my colleagues and me in close relationship with people, some of which has remained with us. In point of fact, a negative feature of space broadcasting provided the real motivation. It extends your reach, which is good; but it allows the possibility of cultural domination, even indoctrination, even when you are well meaning. Since the reach was precious, we had to spend much effort in ensuring that it

didn't become exploitative. In fact we even worked out a hybrid broadcast system involving space broadcasting and low-power terrestrial system for implementation with the Indian national satellite, when it came. The hardware system has actually been implemented. But our suggestion that the local transmitters, with a 20 km. reach, be given over to the community, even colleges and universities, to operate has not been implemented, in spite of lip service being paid to the concept that best communication must be a mix of the local and the intimate with the long range and global, opening windows to the country and the world. I suspect that such a system is not liked by the powerful, whether in administration, or in advertising. So the low power transmitters yet remain slaved to the national and the state programming.

Cable is now sweeping across the country, supported largely by farms of dish antennas grabbing signals from all manner of satellites, including several channels of INSAT satellites. Perhaps, in addition, they would introduce the local element, so necessary for intimacies of dialect language, customs and problems.

- Inter-university centres
- Real education for the real India coupling with subterranean system of education

In this connection, let me share with you a couple of experiences. I am sure you are familiar with the story of JUGAD. This is a vehicle designed by a farmer who was somewhat handy with technology. He used his diesel pump used for irrigating his field, some spare parts from a used vehicle junk yard, built a wooden cart, with four tyre- wheels, springs, and old jeep clutch, a radiator and a sum of 30,000 rupees to build himself a vehicle. This could go 40 kilometers an hour, was inexpensive to run, could carry thirty persons lot stuff and even water his field when there was a need. If anything went wrong he could fix it himself. And if he did not want to invest in a new pump the same pump could be used for pumping water. Other farmers saw this contraption and they built their own, somewhat different but basically the same.

Support technicians developed and lot of these vehicles started plying, first in the villages of Punjab, then Haryana, Rajasthan and Western UP. I met some of the people who built and used them. They seemed proud and swore about its usefulness. Taxis using these JUGADS started plying and then the officialdom and other interested parties got into the act. The vehicles were banned from the roads, because they did not have engine numbers and were not registered. They still ply, but the organized industry frowns upon them. For the big guys there is not enough money in this. Farmers showed the way by demonstrating what was adequate, in their control and affordable.

These are not the attributes that the industrialists like very much. How dare farmers become independent thinkers? It is possible that some educational institutes have done some projects in this regard, but no student is likely to get his masters or Ph.D. on a project like this. I have also encountered other examples of this kind and I am sure you have many more. Such creativity has value much

beyond an inorganic technological revaluation of the innovation. Even while applying the most sophisticated things we do in our laboratories we must fold in the intimacies of the local situation.

Let me share another story with you. Some years ago, I along with some colleagues, was working on a report entitled Technical Education for the Real India. In this connection we visited a Krishi Vigyan Kendra near Patiala. I was very impressed with what they had been doing there, "Do you ever get useful suggestions from farmers themselves: after all they must know something because they were already taking in four crops a year? He replied in affirmative and told me about a recent conversation with a farmer who was a regular visitor to their Kendra. Apparently the farmer had also planted a large tract of sunflower in addition to all his crops. The Kendra scientists admonished him for having done such a foolish thing; they feared that the birds attracted to the sunflower seeds would also destroy his other crop. The farmer smiled and informed them that he was not such a fool and what he had done was after some thought and experimentation. He had also started keeping a lot of honeybees. The bees visited the sunflower patch and for some reason that kept the birds away.

Whether the birds ate some honeybees or were frightened by them was not clear. But the end result of this innovation was that the farmer had a fifth crop and also, a bonus, lot of honey. Such an innovation cannot be thought of in a laboratory or the boardroom of a multinational seed company.

- Peoples Science Movements
- Science Communication- Emphasis on Understanding, The Turning Point Experience
- Besides our Basic Humanity, only the Perspectives of Science can provide the Social and Personal Values, Scientific Temper

To summaries, following are the few areas with which I have tried to engage with some passion. I must say that the degree of success in each of them is perhaps inversely proportional to its importance. There is a long road ahead, at least for some of these areas. I retrospect I could say that my passion has been to replace the impenetrable walls and boundaries with two-way permeable membranes.

1. Walls between Universities and Research Laboratories, between Industry and Academic Institutions.
2. Walls between the Subterranean Learning and Innovation and Formal Education and Research.
3. Walls between Disciplines and resulting Infertility of Information.
4. Walls between Instructing and Learning from Children: How not to imprison ourselves in Disciplines.
5. The Thick Wall between Intellectual Understanding and Societal Brainwashing

Source: Public Lecture, TIFR, July 29, 2002.

Chapter 21

Today we are Closer than ever before in the Last Two Centuries…

Renato Janine Ribeiro

Abstract An increasingly intense cooperation between India and Brazil is an imperative for both countries, as well as quite beneficial to the world - and yet, something that will not happen without a strong political will of both parties. Even if both India and Brazil entered the European history at the same time, ca. 1500, and shared a colonial master for three centuries, in the last two hundred years our histories have driven us apart. In the 16th century Europeans would go to India via Rio; now, we go to your country via Europe. However, many opportunities are open to us since we have assumed the BRIC acronym – initially no more than a description of some big emerging economies – and converted this into what can become an alliance for a common strategy. But this will imply that we know better each other, which is a difficult, if necessary, challenge to meet. I hope that Universidade de Sao Paulo, hosting this meeting, will begin to develop the studies on Indian languages, culture, society, history, and economy, that are necessary if we want the South countries of the world to have their say in international policy.

Keywords *India, Brazil, culture, history, cooperation.*

An increasingly intense cooperation between India and Brazil is an imperative for both countries, as well as quite beneficial to the world - and yet, something that will not happen without a strong political will of both parties. Everything, or almost everything, keeps us apart. However, both India and Brazil did enter the European history, that is, what is known as world history at the same time. It happened during the first tempo of globalization, when the cultures of Asia, Africa and what was not yet called America were put in contact, be it for the first time, as in the case of the Americas, be it after many previous unsuccessful attempts, as between European and Asian societies. In 1498, Vasco da Gama was able to establish a permanent sea route from Europe to the Indies. This is why he remains to our days a sort of a hero in Portugal and some other European countries, while his reputation in India is very tarnished by the massacres he organized. Theeconomic progress that his travels allowed would and did benefit the West, not the East. Two

years later, in 1500, heading also to India, his compatriot Pedro Alvares Cabral "discovered" Brazil. After claiming the new land to the Portuguese crown, and spending only a couple of weeks in a possession he considered as being no bigger than an island, Cabral continued his journey to the destiny that really mattered, the country of the spices. All this is highly symbolic. We are linked to you from the beginning of modernity, from what we call globalization 1.0: the destination of the first European ships to see Brazil was your country. For a long time we have been taught that Brazil had been discovered fortuitously, because trying to avoid an African coastline that had few winds Cabral would have come to the new continent: but, behold, this would mean that we were a mistake. You were the true target, we were no more than a fringe benefit that, by the by, would take half a century before the Portuguese would begin to try and colonize it and a whole century before sugar began to yield profits to our faraway master, the Lisbon crown. (Of course, for a long time now this explanation by the winds has been left aside by serious historians). Your spices, our sugar; your jewels, our gold: it seemed as though our role and also yours was to make the world more pleasurable, or more beautiful, even at a huge cost for the human beings that lived in India or in South America.

We have at least another point in common. For centuries, we shared - Brazil as a whole as well as fair parts of India - the same colonizer. My late friend, the historian Afonso Marques dos Santos, used to relate the rebellion of Goa in 1787, known as Goa conspiracy or Pinto revolt, to Brazilian contemporary attempts to achieve independence from Portugal, as the "inconfidência" in Minas Gerais province in 1789, and the revolt of the poor from Bahia a few years later. We had the same master, the same enemy, similar problems, but Brazilian and Goese histories took different shapes.

Until 1822, we Brazilians were ruled by the same power that had been the first European nation to create colonial factories in India, and that stayed there until 1961, when Portugal became the last European country to lose her possessions in the then young Union of India. I was eleven years old when, eating *feijoada* on a Saturday in Sao Paulo with my father, a veteran journalist, I heard a colleague of his, Nelson Gato,tell us how he had witnessed a couple of weeks before the occupation of Goa by Indian troops. If I were a bit older, I could have compared this moment to what happened when Portuguese colonial troops were expelled from Brazil in the years 1822 and 1823. Incidentally, Nelson Gato was arrested by the military dictatorship that began to rule Brazil in 1964. Then, to pursue our comparison with India, your country has been able in her sixty-odd years of life as a unified and independent Republic to maintain a democratic form of government. The only exception has been the state of emergency declared in the 1970s which, nevertheless, ended when voters ousted the government, something that is not usual when you are under a dictatorship. Our differences, starting out there, are not small.

To begin with, if the year 1498 may mean the arrival of the Europeans in a country – or a series of countries – that already had a history amounting to thousands of years, in Brazil 1500 is associated to what we still call"discovery", assuming that what was not known to Europeans was almost inexistent or, at least, not meaningful. And indeed, the populations that occupied what is now our country had almost nothing in common with present-day Brazil. In India, though politically it has changed a lot in the last five hundred years, the cultural bases remain remarkably close to those that were engendered over thousands of years. The Brazilian state has only a language. Its population shares a culture that has much in common. Conversely, India has achieved the feat of keeping together a population that has numerous languages, religions and cultures, sometimes paying a high price for it, but without departing from democracy or losing the political will to play an important role in world society. This will have not been as constant in successive Brazilian governments.

To sum it up, what else does separate us? We are tempted to say: almost everything. Geographically, we live far away from each other. Brazilian harbors are no more on the way to India. If we want to go to Delhi, or if you come to Sao Paulo, more often than not both will fly via Europe. We are not obvious partners, be it in economy, culture, or politics – although, if we want things to change, we will have to begin by a political endeavor to associate ourselves; of this, more a little after. When I went to India in 2008 as deputy president of Capes[1], in order to negotiate an agreement with our Indian counterparts that would be signed during President Lula's visit to New Delhi, the experience was very interesting.

The head of Capes had instructed me to negotiate scientific cooperation in biotechnology, nanotechnology and biofuels. But our Indian partners began by expressing their concern about the possible replacement of food crops by fuel, a move they would not approve of. Since Brazil has a lot of cultivable land for her population this is not a major problem for us, but India is a much more populated country and must then follow strong criteria concerning what it will seed in the good lands she has. And they said more. They suggested that our agreement should induce more Brazilians to study India, and conversely. We should consider the development of Brazilian studies by the Indians, and of Indian studies by Brazilians. This proposal changed completely the draft of our memorandum of understanding. Finally, we were asked how Brazil researched her traditional medicine, meaning, herbs employed for medical purposes by indigenous, African and poor populations. Scientific study of Ayurvedic medicine, we were told, is an important concern in India. I felt then that the proposals that had been written by the head of Capes could refer to any country, not necessarily India, while the Indian delegation had very clearly in mind that they were from India and we, from Brazil. Our agreement was not to be a piece of paper where a blank could be filled with the name of any country. Our negotiation should be customized, targeted to important traits of both cultures. In short, if we would deem important for Brazil

[1] Brazilian Federal Agency for Evaluation and Support of Graduate Programs.

and India to cooperate, this political decision should take into account the best features of both countries.

The above mentioned agreement has not been executed, as far as I know, and I regret it; anyway, I left Capes some months later and could not help to implement it. But let us come to some acronyms that can make us understand that now is the time to develop our relationship. As is or should be well known, BRIC is the word that has been coined by Jim O'Neill, of Goldman Sachs, in a paper of 2001. It referred to Brazil, Russia, India, and China as four important emergent economies. They would sometimes be called "the BRIC countries", or "the BRICs", but the final "s" in the latter expression would mean nothing, only a plural form. "BRICs" would then describe a situation – some common features these four countries share, but not an action on their part. BRICs is a term used for a description of a quasi-passive nature of huge countries in terms of population, territory, natural riches, agricultural possibilities, and some other features. It was not employed in order to describe or to foster some initiative on their part. It does not point to a common strategy. Even if two among the four BRICs have a veto power in the Security Council of the United Nations, and the two other ones have been doing their best in the last fifteen or twenty years in order to have at least a permanent seat on the same board, "BRICs" would refer to a passive condition, never to the four countries acting as political protagonists in the world scene.

Then came IBAS – the acronym for India, Brazil, and South Africa. On Brazilian part it meant that we were switching, beginning 2003, from a North-South strategical priority to a South-South one. Three important countries, each one of them being a sort of a leader in its continent, would put their efforts together in order to act. None of them is or has been an important capitalist economy. None of them has been or is a Communist state. Anyway, even if IBAS is less rich and powerful than would be a BRIC commonwealth, the novelty was that the acronym was coined by the countries directly concerned and, thus, it meant they wanted it to express a strategy, not a situation. Of course, we know that IBAS did not get too far. The 2008 Brazilian presidential visit to India and the agreements then signed did not represent a meaningful change in our relationship – unfortunately. But in the last year or so we are getting more and more used to hear BRICS, with a capital S in the end, which means that the only country that was a member of IBAS without being present in the acronym BRIC is becoming a part of the latter – namely, South Africa. Diplomats have been doing their best in order to consider that the most important emergent economies in the world should also try and develop common aims that might be able to change international political landscape. This is a good omen, and I would like to conclude here. But we should not yet be too optimistic, and I will give an example of my own University, the Universidade de Sao Paulo, which has the honor of hosting the present meeting. In the early 1960s, when many countries of Africa and some Asian nations got their independence, it was decided that the University of Bahia (now, the Federal University of Bahia) would have some courses of African languages, while USP

would be the home for several courses of Asian languages. It means that today we deliver undergraduate degrees in languages as Russian, curiously considered as being an "Eastern" language, Chinese, Japanese, Arabic, Hebrew, Armenian, and Sanskrit[2]. Unfortunately, and even though we have hundreds of thousands of citizens, to consider no more than the city of Sao Paulo, of either Japanese, Arabic, or Chinese descent, these courses enroll very few students. There is no university course at all for Vietnamese or Korean, even if in the last decades each of these two ethnicities has attained six-digit numbers of members in Sao Paulo capital city area. When I was at Capes, I tried to persuade my colleagues at USP of the importance of not only studying Eastern letters-and-literature, but also their history, sociology, economy, and culture as a whole. If Brazil wants to have closer ties to Asian countries, it must develop studies about all of them. Of course they did agree with me, but human and financial resources were lacking, so I was told. At that time, I knew by the responsible of Economy at Capes that there was only one Brazilian holder of a Ph.D. thesis on Arabian economy. All of us can thus measure the knowledge deficit we have concerning countries as the Arabic-speaking ones, India, China, and Japan. The only university research group about India in Brazil, the USP one, deals with your sacred language, Sanskrit, which of course must be known on its own, but will not help too much if Brazil is to develop closer ties with India. I think then that, after saying some optimistic words about the opportunities we now have, as Brazilians, to knot new ties with so rich a country as India, I can conclude with this remark about the duty we have, as members of the University of Sao Paulo, to develop new tools that will help us to meet the challenge we now face. USP and Brazil should do their best in order to know you better, and I am sure you think the same about us.

[2] According to the web page of the Departamento de Letras Orientais, there are no more undergraduate degrees in Sanskrit. Graduate degrees are delivered in Hebrew-Arabic (maybe the only place in the world where both studies are so closely associated), Japanese, and Russian.

Chapter 22

Brazil and India: Building Cultural Bridges

Makarand R. Paranjape

Introduction

This is not a learned paper nor a scholarly exposition, but a personal reflection on the cultural ties between Brazil and India, two large federal democracies, with strong emerging economies, and richly plural societies. It may be considered a poet's appreciation of a country very different from his own. In 1924, India's Nobel Laureate Rabindranath Tagore, visiting the neighbouring Argentina, opened up the space for enduring cultural ties between Latin America and the Indian subcontinent. While we can only wonder what might have happened had he also come to Portugal, it is clear from the Brazilian reception of Tagore's works that his impact is not inconsiderable. Tagore's *Gitanjali* was published as a Portuguese translation in Sao Paulo as early as 1914, just a year after he won the Nobel Prize for Literature. Certainly, Tagore remains the best-known Indian poet in Brazil. The enthusiasm for Tagore's poetry in Brazil may be seen in the laudatory poem that Cecília Meireles, an India aficionada, and major Brazilian modernist poet who also translated many of his works into Portuguese, wrote on Tagore. Calling Tagore "Most Divine Poet," she says,

> *There's such a profound and great and languid charm*
> *In your secret poems, hovering like moons*
> *Over the world, that I've never known, in your songs,*
> *If the words are of God or of your own….*
>
> *(Translated by Dilip Loundo)*

This translation and several others by Loundo have been published by the National Book Trust, New Delhi, in an important anthology of Brazilian writers in English translation.[1] Such exchanges can form the basis of deeper understanding between Brazil and India. What follows is an account of my own journey of building

[1] *Tropical Rhymes, Topical Reasons* (New Delhi: National Book Trust, 2001) brings together excerpts from novels and short stories, along with translations of major Brazilian poets into English. Meireles also travelled to India and wrote about her experiences. See *Travelling and Meditating: Poems Written in India and Other Poems* translated by Rita R. Sanyal and Dilip Loundo (New Delhi: Embassy of Brazil, 2003).

cultural bridges with Brazil. It may be considered a poet's journal or reflection on how Brazil and India can come closer.

Re-enchanting the world

My first visit to Brazil was a little over ten years back in April-May 2001. I was invited to a unique gathering of poets and artists held in a small city called Ita Peserica da Serra, not too far from the city of Sao Paulo. It was organized by two friends, Hamilton Faria and Pedro Garcia, who ran an NGO called Polis in Sao Paulo. The meeting was a part of the Alliance for a Plural, Responsible and United World. The basic assumption of the group was that art and poetry constituted a special language which could touch the hearts of people all over the world. Given what some might consider the absolute tyranny of reason in post-Enlightenment Europe and the consequent triumph of science as the defining universal narrative, it was necessary to restore the role of culture in human communication. The present civilizational crisis demanded a special intervention from artists and poets who could exert their influence to bring together diverse cultures in non-competitive and cooperative relationships. Art, it was thus believed, could re-enchant the world "through symbolic exchange forming thereby, a true community of emotion."[2]

After arriving in the large and vibrant city of Sao Paulo, we drove to the venue of the conference. That evening, we were taken to a Benedictine monastery. It was modern, beautifully designed, but yet spiritual. No more dwelling on the crucifix, that painful image of the Son of God tortured and bleeding, but more on the Brazilian Christ and his ministry of love and compassion. It was there that I understood that Christianity in Brazil was quite different from Europe or the United States. It was a very plural space, with considerable freedom and room for personal growth. What is more, it co-existed with many alternate belief systems, without being in conflict with them. During our meeting, we would have a native African blessing ceremony from Bahia in which old Yoruba rituals imported from Africa many centuries back were still practiced. We were also taken to a handicrafts village. Like India, so many beautiful arts and crafts still survived here in Brazil. I also noticed the utterly amazing ethnic mix of Brazil, which made it a cauldron of so many different races and peoples. It was really like being in a new world.

The meeting was extremely innovative. I still remember one workshop in which all the writers were asked to express themselves in paint on a canvas sheet which was over twenty feet long. The artists, on the other hand, were asked to write about how they felt. I found myself going back to nursery school, wonderfully happy to make a mess and think in colours and figures, not in words. The participants from over fifteen countries in the world read and heard each other, listened to each others presentations, and spent time understanding one

[2] An account and outcome of the meeting was the book *Re-enchanting the World* edited by Hamilton Faria and Pedro Garcia (Bangalore: Pipal Tree, 2003).

another. My room mate, a famous Brazilian designer, was actually a yogi who meditated each day. He gave me a book and a t-shirt that he had designed himself.

I had some wonderful experiences during that week in Brazil. I would often wake up feeling very refreshed. I also had good meditations, with great clarity and freedom from anxiety or fear. In the evenings, there was always some music. It's amazing how musical and fluid Brazilians are. They're always singing and dancing, at the slightest pretext despite a day full of hard work and efficient execution of projects. One of the participants, whom I had met earlier in another meeting in Bangalore, took hold of me and both of us danced. On another day, there was a puppet show, and finally a composition of drums from all over the world, beating out the message of peace.

During the meeting I was reminded of Ezra Pound's statement that "Artists are antennas of the human race." It really felt as if we could make a difference. This did not mean returning to some notion of "committed art" as practiced by the Socialists, but to the general aesthetic enrichment of the life of the whole society. In the globalized environment of today, art and literature would definitely be inter-cultural, not merely national or regional.

Another world is possible

My second visit to Brazil, in February 2003, was equally memorable. I was invited to the 3rd World Social Forum, which was being held that year in Porto Alegre. This is a beautiful, very European city, in the South of Brazil, on the Atlantic seaboard. The weather is somewhat cooler than the rest of Brazil. I was curious to learn about civic governance in Porto Alegre, the first city in the world to have a participatory budget. Here the citizens themselves voted on how to spend their money, not leaving it to their elected representatives or bureaucrats. It seemed like a revolutionary move forward not only in keeping corruption to a minimum, but also in democratizing governance, giving the people the power to decide their own priorities and outcomes. Sure enough, I found Porto Alegre a very efficient and well-run city. The public facilities, especially the transport system, were excellent. On the very first day I found myself going from my hotel to the venue of the Forum by bus instead of taxi.

The theme of the Forum was "Another World Is Possible." It struck me as almost prophetic. There were many famous speakers including the American public intellectual and linguist Noam Chomsky and the Indian author Arundhati Roy. But the most popular and influential presence was that of President Luiz Inácio Lula da Silva, who had just been elected. The mood of the Forum was electric, especially as he had agreed to address the delegates in the opening session. This session was held in a huge auditorium, which was more like a sports stadium, but shaped like a dome, with the stage on the ground level in the centre, and tiers upon tiers of seating rising up around it. When President Lula came to the podium, he was greeted with a standing ovation, continuous clapping and

chanting, "Lula, Lula, Lula," which went on for several minutes. The only other occasion on which I have witnessed this sort of enthusiasm for any major political leader is when President Obama won the nomination of the Democratic Party to be its Presidential Candidate in 2008. Back to President Lula, it was another matter that immediately after the Forum, he was heading to the World Economic Summit at Davos, Switzerland, to meet the leaders of the rich nations to make a case for easing credit to "developing" countries like Brazil. Brazil, in those days, was not doing too well financially. I found a great deal of resentment for the rich nations and for the rising tide of globalization.

Right then, it became clear to me that another world was indeed possible and that for it to come into being, the cooperation and mutual understanding of countries like Brazil and India was essential. A world beyond Euro-American domination but also one that did not support the counter-systemic threat from terrorism, which had shocked the world recently. It would be a world based on social and economic justice, with cooperation not exploitation as the watchword. Such a world indeed seemed desirable, even possible then. It would literally be a third world, not in the conventional sense of the phrase, but a *third* kind of world. I had these thoughts long before notions of BRIC alliances became common.

Today, far from the richer countries helping us, Brazil and India are being called upon to bail Europe out of its sovereign debt crisis. Much has indeed changed in less than a decade. Both countries have registered robust growth rates; their economies are thriving and their future prospects look very promising. But, while economic ties are desirable and mutually beneficial, cultural bridges are much more important in the long run for lasting relationships and deeper reciprocal understanding.

Colonial pasts, post-colonial present, and alter-globalizing futures

My subsequent visits have been more academic than artistic, but they have resulted in very productive and fruitful exchanges. I have been a Visiting Professor at the Federal University of Minas Gerias (UFMG) and at the University of Sao Paulo (USP). India Studies at both these major institutions of higher learning in Brazil is at the point of take up. A Centre has already been set up in UFMG and another is in the process of being established at USP. During these visits in which I taught India-related courses to both undergraduates and graduate students, I had occasion to think further about Indo-Brazilian relations.

If the importance of strengthening cultural ties is accepted, when it comes to Brazil and India, we encounter some expected and some not so obvious barriers. First of all, there is the enormous physical distance between us—we are literally at two different ends of the world. The travel time between the two countries is also considerable, with mandatory stopovers in Europe, the Middle East, or South

Africa. But in these days of shrinking space and time and with improved aviation opportunities, we may discount, to some extent, this barrier of physical distance.

But what about the language barrier? Apart from Goa and Div, no part of India has a history of sustained contact with Portuguese. Even so, the importance of the Portuguese connection cannot be entirely overlooked. To this day, a large number of Indian words in Portuguese and Portuguese words in Indian languages attest to this. Commonly used Indian words like *achar* (pickle), *ananas* (pineapple), *balti* (bucket), *batata* (potato), *chavi* (key), *feta* (tape or tie), *girija* (church, from *igreja*), *ispat* (steel, from *espada*), *istri* (iron, from *estirar*) *kaju* (cashew nut), *kamiz* (shirt), *kamara* (room), *padri* (priest), *pao* (bread), *sabun* (soap), *sapota* (also known as *chikku*, a kind of fruit), and so on, originate in Portuguese. Interestingly, the very word for English in Indian languages, *angrezi or ingreji* comes from the Portuguese *Ingles.* That many of these words denote fruits and vegetables also suggests the origins of these plants, some coming to India from Brazil and others, like the mango, going from India to Brazil. Yet, the colonial connection via Portugal was supplanted by that with Britain. India now has so many natural affinities with the English-speaking countries of the world. Yet the legacy of the older Portuguese colonization, though subterraneous, is still vital not only the "East Indian" communities which have Indo-Portuguese roots, but also to a vast number of native Christians in India with Portuguese surnames like Alvarez, Carvalo, Coelho, Couto, D'Souza, D'Costa, D'Cruz, Gomes, Lobo, Moraes, Rosario, Suares, and so on. Unfortunately, even in Goa, Portuguese is fast disappearing. English, on the other hand, is growing in influence and reach in Brazil, especially as the language of international commerce and communication. Perhaps, in the future, the language barrier may also be somewhat mitigated.

Despite the distance and difficulties in communication, however, cultural ties between Brazil and India are poised for a take off. Never before has the time been as ripe as it is now to make a major push. I believe that the governments of both countries are also aware of this and are taking appropriate, if somewhat gradual measures, to improve matters.

In this journey of mutual exploration, our past gives us some unexpected points of contact. It is widely believed that Brazil was discovered by Pedro Alvarez Cabral who was the Captain of the 2nd Portuguese India Armada. The discovery was supposed to be accidental. Cabral was on his way to India, following Vasco da Gama's journey to India in 1498. Da Gama had gone with a fleet of just four ships, but the amount of profit reaped from the cargo of spices that the brought back was so immense that King Manual I sanctioned a second *Carreira da Índia* (India Run) within a year of da Gama's return to Lisbon in August 1499.[3] The

[3] It is no surprise that da Gama is one of the heroes of *Os Lusíadas*, or *The Lusiads* by Luís Vaz de Camões, widely considered the Portuguese national epic in the tradition of the great European epics of Homer and Virgil. It celebrates the Lusiads or the sons of Lusus, that is the Portuguese, as great heroes who are destined to become gods. The heroic conquests and astonishing feats of this small nation are thus celebrated in a series of laudatory speeches by its heroes. Much of the action of the epic from Cantos IV to X deals with da Gama's journey to India, the discovery of new lands, the

2nd India Armada was also much bigger, consisting of a fleet of thirteen ships, ten of them designated specially for India, while two were bound for Sofala, in East Africa, and one was a supply ship. Cabral, apparently, allowed his fleet to drift further South West, finding himself in the new landmass which was Brazil. Christopher Columbus, looking for a route to India, had less than a decade earlier in 1492, "discovered" the Americas; now, Brazil too had been found by a fleet that was on its way to India. The quest for India, thus, is the sub-text of identities of the new world.

The major American poet, Walt Whitman, captured this in his wonderfully evocative poem, "Passage to India," a title that E. M. Forster used for his masterpiece of the same name published in 1924:

Passage to India!
Struggles of many a captain—tales of many a sailor dead!
Over my mood, stealing and spreading they come,
Like clouds and cloudlets in the unreach'd sky.
Along all history, down the slopes,
As a rivulet running, sinking now, and now again to the surface rising,
A ceaseless thought, a varied train—Lo, soul! to thee, thy sight, they rise,
The plans, the voyages again, the expeditions:
Again Vasco de Gama sails forth;
Again the knowledge gain'd, the mariner's compass,
Lands found, and nations born—thou born, America, (a hemisphere unborn,)
For purpose vast, man's long probation fill'd,
Thou, rondure of the world, at last accomplish'd.

Whitman speaks of the intrinsic relationship between the ancient and the modern, the East and West, the search for the old continents of Asia and the discovery of the new ones in the Americas.

But to Whitman this passage to India was at once a passage to something more than India:

Passage to more than India!
Are thy wings plumed indeed for such far flights?
O Soul, voyagest thou indeed on voyages like these?
Disportest thou on waters such as these?
Soundest below the Sanscrit and the Vedas?
Then have thy bent unleash'd.

He sees these voyages and discoveries as a part of the onward human evolutionary journey, of the unfoldment of God's own plan for the soul of man:

Lo, soul! seest thou not God's purpose from the first?
The earth to be spann'd, connected by net-work,
The people to become brothers and sisters,

---

battles fought to win them, and encounters with a variety of Indian actors and settings including the Zamorin in Calicut (Kozhikode).

The races, neighbours, to marry and be given in marriage,
The oceans to be cross'd, the distant brought near,
The lands to be welded together.

The human soul must expand outwards, stretching its boundaries in its effort to find itself. The earth has to fully mapped and traversed, and all its peoples come together as brothers and sisters, all races and communities to inter-marry and all lands to be brought together in this irresistible movement. Whitman is thus voicing the old Vedic idea of *vasudhaivakutubakam* or the universal earthly family of which all of us are a part. The mingling of races, communities, and tribes that he predicts is evident equally in Brazil as it has been in India for over five thousand years. In a sense, then, the poem embodies the cultural and civilizational aspects of globalization, with the different peoples of the world coming together in friendship and harmony, so that the spirit of man reaches greater heights of self-realization. Surely, this lofty goal signifies a more sublime objective than merely economic globalization, which so dominates our world today.

Whitman's poem was first published in 1871, at the height of both Victorian optimism and the expansion of the United States. In its enthusiasm, however, it overlooks or neglects to mention the negative side of colonial expansion and conquest, which include slavery, indenture, genocide, starvation, disease, and the destruction of native cultures and ways of life. Indeed, when he wrote the poem in 1869, slavery had just been abolished in the United States after a bloody civil war; in Brazil it was still in practice. Both Brazil and India, in different ways, struggled against colonialism and political repression for over a hundred years. In both societies, severe inequalities and social imbalances have hampered the march towards a just and prosperous society. If today both countries can boast of robust economy and a free society, then these victories have been dearly bought.

The colonial legacy in both countries, however, points to the importance of seeking an alternative to the dominant Euro-American alliance that still rules the world, not only in economics, science and technology, and political power, but also in intellectual and cultural pursuits. That is why it is so crucial to strive for a new alliance, a third space that consists of societies which are neither dominated nor dominating. Though Brazil was a settler colony and India an invader colony, their relationship to their colonial past and former masters is both complex and fascinating. It is at once a relationship of collaboration and resistance. Each society derived or learned to be "modern" from this encounter, to the extent of being shaped by it. Yet, both countries resist the dominance of the colonial presence and look for ways to bypass or transform it.

In this respect, the life and work of Mohandas Karamchand Gandhi (1869-1948), popularly known as Mahatma Gandhi, can serve as a valuable point of reference to both countries. When I was in Brazil in 2007, some colleagues of mine at the University of Sao Paulo and the Federal University of Minas Gerias initiated a project to produce the first Portuguese translation of Gandhi's *Hind*

Swaraj (1909).[4] In this important early work, Gandhi explains his vision of a non-violent struggle against colonial authority and the establishment of a new and free India. This work is also a far-reaching critique against the ills of modern (Western) civilization, which, according to Gandhi, was "Satanic." He wanted India to cling to its ancient civilization as a baby clings to its mother's breast. Gandhi believed that modern, industrial civilization was based on the multiplication of bodily needs while the traditional Indian civilization was devoted to the cultivation of virtue. Gandhi's disquiet with modernity has had far-reaching impact, especially in the spheres of ethics, equity, and ecology. Non-violent resistance or *satyagraha* has found multiple resonances in different parts of the world. Today, many in Brazil are curious to understand more of Gandhi's philosophy and praxis. Gandhi represents a unique example of a distinctly Indian post-colonialism, thus showing us the third way more than 100 years ago. At the World Social Forum I met many Brazilians who were not only interested in Gandhi, but who also wanted a different kind of globalization, not one which was the champion of the relentless march of greed and commerce, but one which was marked by the spread of solidarity and justice all over the world. Interestingly, in the Rio Carnival, one of the largest groups of revellers call themselves the "Followers of Gandhi," even donning the so-called Gandhi cap as a part of their dress.

Conclusion: terra (in) firma?

I believe that Indo-Brazilian friendship, cooperation, and partnership are extremely beneficial not only for the two countries involved, but for planetary futures. If a new world must be created, then the inputs and energies of these two countries would be the necessary prerequisites. Having been to Brazil five times, having visited some of its major cities, and having taught there twice, I am convinced that Indians have so much to gain from this encounter. In Brazil we find a different way of living, a different language of being. The people are not only relaxed, but so much more at ease. It is one of the least anxious societies that I have encountered. Not only are Brazilians friendly and welcoming, they are also quite comfortable with themselves and with one another. The whole culture is extremely expressive in its physicality, but body-awareness or identification does not necessarily lead to a loss of the higher dimensions of life. Indeed, I see this country representing the heart, while India may stand for the spirit, and modern Europe and United States, for the mind. All there, of course, are needed—heart, mind, and spirit—in order to find the fullest expression of the human condition. But both the physicality and the emotional ease of Brazil make it a remarkable human habitat and destination. Beyond the stereotypes of football and carnival lies a very diverse, vibrant, and culturally well-endowed society, with beautiful

[4] Published as *Hind Swaraj: Autogoverno da India* (Brasilia: Fundação Alexandre de Gusmão, 2010.)

beaches, rivers, much natural beauty, and some of the most impressive cities in the world.

Inspired by my travels and stay in Brazil, I wrote a series of poems on it which, I hope, will be published one day as a book. I would like to include two of them in this essay. The first, "Terra (In)firma," is set in Belem, a beautiful, old city where the Amazon flows into the ocean.

Terra (in) firma

At Belem, where she comes from,
A city curves and heaves into the sea,
Hewing out a bay, brown on one side,
Blue on the other—Guajara.
It rains every day here
At three in the afternoon.
Quoting her favourite author,
She declares, not just the water—
Rain, river, ocean—but the earth,
Seemingly so stable and fixed,
With concrete pavements,
Huge parking lots, shopping malls,
Apartment buildings, and beyond these,
The hills, studding the landscape like
Humps of large, green animals, bending down
To drink by an ancient pool, or even further
Below, primeval structures beneath ocean
Floors—all these are not immobile or still,
But moving, fluid, infirm, like all of us—.
Mount Everest itself, never resting really,
But born deep inside its sea-womb,
Thrust up when the great continents
Collided into one another, the island
That was India, primal Jambu-dveep,
Crashing inland, thrusting out from
Below the waters of Tethys,
The world's tallest mountains, now
Forever snowbound, but the fault lines
Still show the deep granite gorge
Where India smashed into Asia.
A plume of hot magma rises from deep
Below the tectonic plates; I feel
The ground shift beneath my feet. I
Fear an earthquake or at least sense myself
Slipping, losing my foothold, falling. Yet
Our two continents were never together

Not even in Pangea, for there was always
An Africa snug between us. So I send her
The song of "the wild boar of the rapids":
The waters of life, sentient earth, moving,
Stirring, all the time, the gnosis that
Understands this, the art which through
Atahualpa form can imbue an image
With philosophy, and the open wound,
Which shows the infirmity of our beings,
But which can heal by shifting us
Into eternity.... I shake, so empty now,
Very light, like light, cloaked by the night—
She cannot see me because it seems
As if there is nothing here, except insight.
So, until the next surfac/ing, I tell her,
Rest gently like the enchanted Belem Bay
Where it rains everyday at three in the afternoon,
Where the river is a road, drawing you
Deep into the ocean of vast remembrances....

This poem speaks of the relation between nature and man and also between man and woman. In both, we see a fragility, an impermanence; what appears as solid ground at first is revealed, on closer examination, actually to be a state of flux, changing every minute, subtly unstable. And yet we human beings continue to believe in the value of lasting ties, we continue to hope that they endure. Thus we lose and find ourselves again and again, both in giving ourselves to others but also in gaining from others a measure of affection, friendship, and companionship.

The second poem which I wish to offer is from the end of the volume. In a way, it is the obverse of the previous poem, showing how though we seem to be apart, we are so deeply connected.

Why we are one

These roots are like ropes of rubbery wood.
They thrum like taut strings, thwacking the ground.
You are so far, but your roots, in the shallow sand,
Extend to where I stand. Only when I heave them
Free, do I see the form beneath the upturned earth—
The myriad subterraneous connections, countess
Wiry, interlocking networks, living and organic—
How deeply we are interlinked, each continent
To the other. Hewed out of a single sheet of earth,
Now forgotten, drifting apart millions of years ago,
But with family trees so intertwined that they reach
Out from beneath these wide oceans to lock us into

One embrace and produce, despite all our differences,
Our common destiny, and the fact of a single race.

Underneath apparent differences, there is a great unity between us because we all belong to one planet, one race, and one family. Thus we have a shared past and common future. Our destinies are thus intertwined and inseparable.

I have tried to suggest in this short essay how cultural ties are important to reach a deeper understanding between two nations. Though business, science, politics, and other such aspects assume greater importance in today's world, the domain of culture is really the foundation or the ground in which they can flourish. Culture is the matrix from which springs all human endeavour for one way of defining culture is the sum total of all human endeavour and expression. From this point of view, it is essential for both countries to invest in cultural understanding. We in India certainly need to learn much more about Brazilian culture, its literature, arts, music, movies, and multitudinous creative productions. Brazil has already made a beginning by airing a very popular soap opera, *Camniho das Indias*[5]. Bollywood, too, has paid tribute to Brazil in movies such as *Dhoom 2*. The future, therefore, seems not only promising, but limitless.

[5] For more on this show, http://caminhodasindias.globo.com/. Also see

Chapter 23

India-Brazil Cultural Relations in Historical Perspective: A Brief Overview of Recent Decades

Angelo Segrillo

Abstract The direct relations between India and Brazil in the beginning have been marked by the strong presence of (colonial) central powers as an interfering factor. The voyages of discovery by Portuguese explorers Vasco da Gama to India in 1498 and Pedro Alvares Cabral to Brazil in 1500 were symbolic hallmarks of an era when the two countries could not establish direct contact. For example, India could not export directly to Brazil. Commerce had to be intermediated and approved by the Portuguese metropolis. Not even the Portuguese colony of Goa in India could trade directly with the Portuguese colony of Brazil. Relations between the two countries were stunted from the very beginning.[1]

Although the Brazilian side became fully independent from Portugal in 1822, this situation would change perceptibly only after 1947 when India became free from British colonial rule. The post-www II situation seemed favorable for a deepening of relations between these countries. The decolonization process was in full swing and a new wave of cultural self-assertion and solidarity was cresting among the Third World Countries. However, the practical problems of decolonization overwhelmed them in their efforts to forge closer ties amongst themselves. Enormous resources were needed for the tasks of development and India and Brazil were concentrating on the areas where they had the greatest influence and closest ties to. The sheer physical distance and the absence of tradition of closer ties between the two countries made themselves felt and prevented an appreciable increase in the level of cultural or economic ties between the two countries. The fact that Brazil at first supported Portugal´s position on the dispute over the territory of Goa in India in 1961 did not help in this regard and created a temporary malaise between the two countries in the beginning of the 1960´s. Although they

[1] These prohibitions and regulations of direct free trade between the two countries did not mean that the commercial exchanges were negligible. Approved by the metropolis or via contraband, a flow of goods went from India to Brazil (e.g. coconut, mango) and from Brazil to India (manioc, cashew) in this colonial early modern age. Ironically but rather understandably, after Brazil´s independence from Portugal in 1822 the commercial flows between Brazil and India fell to near insignificance.

felt rather close in Third World Forums like UNCTAD and the Non-Aligned Movement,[2] the realities of the cold war also had indirect consequences on them. The fact that the 1964-1985 Brazilian military regime aligned with the United States and India was perceived being closer to the USSR helped keep relations between India and Brazil in a low web in the 1960´s and 1970´s. One example of this was the 1968 visit of Indira Gandhi to Brazil within her tour of Latin America. She signed three important documents with the Brazilian government; an Agreement on Cultural Cooperation, an Agreement for Cooperation in the Peaceful Use of Nuclear Energy and an Agreement on Trade. These seminal documents, if implemented as envisioned, could have brought about a boom on cultural, scientific and commercial exchanges between the two countries.

The end of the 20-year long military dictatorship and the beginning of democratic civilian rule in Brazil in 1985 opened an era of new quests in Brazilian foreign policy. In relation to India a very important document was signed that year in India by the Brazilian foreign minister: the Agreement on Cooperation in the Fields of Science and Technology, effective from 1990.

Thus, we go into the early 1990´s with a new framework for developing the cultural exchanges between the two countries. In the early 1990´s historic turning-points in India´s inner developments will deeply affect her outlook for foreign relations in general, which will affect Brazil in particular. Then finance minister Hon'ble Manmohan Singh will lead the country into structural economic reforms which will derive India from its traditional protectionist, inward-looking economic policies and sensibly open her economy to a fuller participation in the international market and greater share of foreign investment in it. The general success of these reforms will launch India into a more aggressive quest for involvement in world affairs. In Brazil, a similar process occurred. After decades of a more inward-looking, protectionist economic model, in the 1990´s Brazil opened her markets initiating a process of internationalization of her companies. As we entered the first decade of the 21st century, the two countries were seen as such powerful emerging markets that they were grouped in the concept of BRICs: Brazil, Russia, India and China as big countries with growing, evermore influential economies which will probably dominate the world scene in future decades. These external perceptions turned out to be self-fulfilling prophecies; In 2009 these countries formalized the group of BRICs with regular summits between them.

Let us see what were the important steps in the deepening of the Brazil-India relations in this period. Indian Prime Minister Shri Narasimha Rao comes to Brazil in an unofficial visit to take part in the ECO 1992 Conference in Rio de Janeiro. The same year a Memorandum of Understanding about Matters of Common Interest is signed between the two countries.

[2] Brazil had the status of observer in the Non-Aligned Movement whereas India was one of its leaders.

In 1996 Brazilian president Fernando Henrique Cardoso visited India. This visit will consolidate the coming of age of the relations between India and Brazil in a formalized and more regular way. In this sense, Cardoso signed the Joint Declaration on an India-Brazil Agenda for Scientific and Technological Cooperation. What was new and original is that instead of the "wait and see what happens" attitude until then prevailing in the previous agreements signed, this time a formal joint Committee was created to set up permanent and regular workshops between the two countries that could propose and direct the implementation of the policies and actions envisioned in these accords. A Brazil-India Business Council was proposed (and finally implemented in 2002).

The New Brazilian President Luis Inacio Lula da Silva in January 2003 would give a strong boost to Brazil-India relations. A former left-leaning trade-unionist, Lula, from the start, demonstrated strong interest in strengthening ties with developing countries. Of special interest would be the relationship with the now-called BRICS countries (Brazil, Russia, India, China and South Africa). Actually, the ties with India and South Africa were among the first to be formally strengthened. Formalized by the June 2003 "Brasilia Declaration" and having its first summit in 2006, the IBSA (India, Brazil, South Africa) Dialogue Forum aims at promoting closer coordination between the three countries and fostering "South-South cooperation", which is very important in view of the foregoing discussion here; the fact that relations between India and Brazil have historically been mediated by or suffered interference from the central (formerly colonial) powers. If implemented, this motto may signify a new, and truly independent, form of interaction between these two giants of Asia and the Americas. Symptomatically 2003 was also the year of creation of the G-20 group. In 2003 Brasilia Memorandum of Understanding was signed by the two countries in the first meeting of the India-Brazil Joint Commission in 2003, which was established on August 22, 2002. This Joint Commission will have regular meetings and will greatly enhance the coordination of governmental bilateral policies for economic, political, scientific, cultural and technological exchanges between India and Brazil.

All these formal permanent and/or regular forums will add a great dose of professionalism to the India-Brazil relations, away from the ad hoc character so pervasive in previous periods of time.

This new tone has been felt in the business sector. Up to the early 1990´s, the volume of trade between the two countries was always below US$1 billion. By 1999 it reached US$1.4 billion. In the first decade of the 21st century another hike with the trade volume hovering around US$5 billion at the end of the period (US$5.6 billion in 2009). In absolute terms it is still a small flow in comparison to the size of the two economies. But the trend is positive and upwards.

In the scientific and technological fields, the new array of treaties of exchange and forums for official discussion between the two countries should facilitate a greater communication between these two giants who have traditionally been

kept alien from each other. It is in this still under explored area that the Brazil-India Symposium (Building Knowledge Networks through Universidade de Sao Paulo) can make a contribution. The creation of a joint graduate program in Public Communication of Science, Technology and Culture with personnel from India and Brazil will certainly be a watershed in the advancement of university exchange between South Asia and Latin America.

Annex: Timeline of agreements and documents signed between Brazil and India

Title	Signed	In Effect
Agreement on Cultural Cooperation	23/09/1968	15/07/1970
Agreement on Trade with India	03/02/1968	13/10/1969
Agreement on Cooperation in the Fields of Science and Technology	22/07/1985	24/01/1990
Convention to Avoid Double Taxation and Prevent Tax Evasion in Matters of Income Tax	26/04/1988	11/03/1992
Memorandum of Understanding in Regard to Matters of Common Interest	22/02/1992	22/02/1992
Adjustment to the Agreement on Cooperation in the Fields of Science and Technology, Regarding Scientific and Technological Cooperation in the field of Railway Transportation	15/09/1993	15/09/1992
Joint Declaration on the Brazil-India Agenda for Scientific and Technological Cooperation	27/01/1996	27/01/1996
Joint Declaration on the Term of Reference for the Establishment of the India-Brazil Business Council	27/01/1996	27/01/1996
Common Agenda for the Environment	27/01/1996	27/01/1996
Adjustment to the Agreement on Trade, Regarding Sanitary and Phytosanitary Measures	02/07/1997	03/08/1997

Memorandum of Understanding on Cooperation between the Diplomatic Academies of Both Countries	05/05/1998	05/05/1998
Supplementary Adjustment to the Agreement of Cooperation in the fields of Science and Technology, regarding Health and Medicine	05/05/1998	05/05/1998
Memorandum of Understanding regarding Technological Cooperation in the field of Ethanol Blending	08/04/2002	28/02/2006
Memorandum of Understanding Establishing a Joint Commission for Cultural, Technological, Scientific, Economic, and Political Cooperation	22/08/2002	22/08/2002
Agreement on Cooperation in Matters of Defense	01/12/2003	27/12/2006
Agreement on Visa-Free Travel for Officials and Bearers of Diplomatic and Official Service Passports	25/01/2004	17/11/2004
Program for Exchanges in Cooperation in the Field of Education	01/02/2006	01/02/2006
Memorandum of Understanding for Cooperation in the Field of Human Settlements	12/09/2006	12/09/2006
Memorandum of Understanding for the Implementation of the "Brazilian Culture Weeks in India" and "Indian Culture Weeks in Brazil"	12/09/2006	12/09/2006
Memorandum of Understanding in the Struggle against Hunger and Poverty	18/02/2008	18/02/2008
Memorandum of Understanding in Matters of Sports and Youth	18/02/2008	18/02/2008
Memorandum of Understanding in the Field of Infrastructure	18/02/2008	18/02/2008

Memorandum of Understanding in the field of Humanitarian Assistance and Emergency Management	16/04/2008	16/04/2008
Memorandum of Understanding on Cooperation in Agriculture and Similar Sectors	16/04/2008	16/04/2008
Memorandum of Understanding for Cooperation in the Gas and Oil Industry between the Ministry of Energy and Mines of the Federative Republic of Brazil and the Ministry of Oil and Gas of the Government of the Republic of India	16/04/2008	16/04/2008
Agreement on Cooperation in the field of Tourism	25/01/2004	-
Framework Agreement on Cooperation for the Pacific Use of Outer Space	25/01/2004	-
Agreement on Remunerated Activities by Family Relations Dependent on Diplomatic and Consulate Personnel	02/02/2006	-
Agreement on Air Transportation Services	12/09/2006	-
Agreement on Scientific and Technological Cooperation	12/09/2006	-
Agreement on Audiovisual Co-Production	04/06/2007	-
Supplementary Adjustment on Cooperation to expand the Brazilian Terrestrial Station for the Reception and Processing of Data from Indian Remote Sensor Satellites	04/06/2007	-
Agreement on Mutual Assistance in Customs Matters	04/06/2007	-
Extradition Treaty	16/04/2008	-

Chapter 24

Studying Science Communication in India through People's Science Movements

Binay Kumar Pattnaik, Subhasis Sahoo

Abstract It hardly needs emphasis that PSMs in India have been very unique and such movements are not seen elsewhere although science popularization/ science communication movements were seen in USA, Europe and Australia. As such social phenomena have caught our academic fascination, we first tried to characterise the phenomenon; second, tried to locate such phenomena historically meaning, locate their socio-historical roots. Lastly through extensive studies of six cases of various types of PSM we have tried to analyse them from the view point of social movement perspective.

Introduction

People's Science Movement (PSM) is a little studied phenomenon in India although these have been in existence for several decades now. But these are seen as wider current of social movement. Rooted in social reformists' thinking of the 1950s, PSMs attempt to popularise non-mystical, scientific thinking, especially among India's common masses. Many PSMs have evolved into significant centres of activism. There is variety in PSMs of different shades. These shades can be combined under three trends: (1) humanitarian – a matter of personal conscience, without any social rationalisation; (2) nationalist – an urge to contribute to the development of the national personality, coupled with realisation which requires development of the economic conditions and the creativity of the broad masses of the people with whom, S&T must link directly; and (3) radical: an urge to contribute to the liberation of masses from social oppression and exploitation and through this to the release of creative mass energy, a task mobilisation which needs intellectual input and a scientisation of mass culture. A mixture of these three trends generates a variety of people's science initiatives:

1. Frontier challenges: going to the people and enquiring what their material needs are, and applying scientific and technological knowledge to meet them at costs within the means of a greater number of people;
2. Knowledge transfer: mass education in science and technology;
3. Stimulating mass creativity: working together with the masses to devise

'appropriate technology', in the process stimulating technological creativity of the masses;

4. Technology as a tool in political struggle: devising technology to serve as a tool in the political struggle of the exploited masses against their exploiters, more 'self-reliant' technology from the point of view of the poor, through which they may have greater control over the production of process;
5. Conscientisation: seeking to raise the capacity of the poor to analyse their environment scientifically and bringing to them scientific knowledge of wider reality to help them take appropriate courses of action to change reality in their favour (Rahman, 1979: 59).

The first three varieties are consistent with the first two trends i.e. humanitarian and nationalist. The third of these may not inconsistent with the radical trend and may be seen to overlap with the fourth. The fourth and fifth are explicitly radical. However, the 'conscientisation' in improperly motivated hands can be reactionary or reformist aimed at preserving or marginally improving, the societal status quo.

PSMs have been widespread in India at the regional and national level since 1960s. PSM's critical role has been felt and recognised through the symbolic value of science. By accepting the symbolic value of science as its major political value, PSM finds its demand for the dissemination of the scientific temper among the masses as a pre-condition for social transformation. On the other hand, they demand for the use of scientific information and procedures in the method of decision-making and implementation of decision by the ruling elite.

Therefore, whether it is in the area of science education, spreading reasons and scientific temper in society, or the critical role of science in the developmental process for creating an equal and social just society, the changed nature of relationship of science and society can no longer be ignored.

The socio-historical context

Among various people's movements, PSM is a growing and unique movement in India. It is unique to India since it is difficult to find a similar movement in other parts of the world. Parayil (1992) calls the PSM as a 'unique social movement'. He finds that it is probably the only citizen's movement of its kind, and perhaps in the whole World. PSM has been initiated in specific contexts, by middle class intelligentsia. Guha (1988: 8) notes,

Matthew Zachariah (1989), one of the protagonists of PSM, stresses, economically poor and politically powerless people constitute the vast majority in most of the nations of Asia, Africa, and Latin America. Although the governments of these nations are or appear to be committed to development, their policies and actions to promote development mainly through stimulating growth in certain sectors of the economy do not necessarily improve the living standards of most poor people and indeed, create large groups of victims of development. The attempts of various Western governments, institutional agencies, national governments and

non-governmental organisations (NGOs) to promote development in Asia, Africa, and Latin America during post-World War II and their acknowledged failure to do so in large measure have resulted in vigorous criticisms of the motives, approaches and actions of these institutions.

The most persistent and valid criticisms of the attempt by most Western as well as national governments to promote development is that it ignores, except in rhetorical statements, the genuine aspirations of poor and powerless people. Three other major criticisms too follow. The national and international elites use the state to put in place where policies promote their own class interests prompting the legitimate question i.e. development for whom? These elites do not understand the real problems people face and the contextual rationality that motivates such people to think and act in the ways they do. The elites do not value the knowledge and experience of the people on whom they impose their policies for development. This has been known as the 'top-down' approach.

The phrase 'development from below' acknowledges the validity of these criticisms and argues for a perspective focusing on the (a) importance of confrontation and conflict in any genuine development process and (b) the necessity to make genuine, deliberate attempts to improve the living standards of poor people, attempts that cannot be too hasty or too slow. The dominant class of the society commonly referred to as elites control and manipulates all affairs of the state. They control scientific and technological knowledge hubs i.e. the university and research institutions. They also control all developmental superstructures.

Of late a class of intelligentsia is emerging in the society which appears to have a deep concern about growing alienation between minority dominant classes i.e. elites with access to knowledge, resource, power and privileges, and the majority common masses is deprived from it. Such deprivations resulted into the form of 'people's organisations' in the country. There has also taken place a remarkable spurt in consciousness of common people which largely remain unnoticed and unserved by institutional structures that prevails and exploits the masses. For example, when state's corporate policies destabilized the environmental balance by polluting air, water, and further deforestation triggered the emergence of people's movements in various parts of the country.

While the servility of the elite to western paradigm of progress and modernisation gave rise to academic colonialism which produced a university system and a research and development set up that are turning out a class of scientists and professionals without social commitment, many people's organisations are coming up with commitments to disseminate scientific knowledge among the masses. May of the PSM organisations are of this kind. It is not merely intellectual content but initiatives from 'intellectuals' that distinguishes PSMs from other movements. Throughout Indian history that intellectuals originated and existed away from the common people. Such intellectuals have, by and large, confined to the writings in alien language which could not empower the masses with their ideas. Post 1960s brought some intellectuals who resulted from the growth of

people's movements in rural areas. These intellectuals who are equipped with the direct experience of various problems and expressions existing in the society started contributing to spread and strengthen of PSMs in different parts of the country.

PSMs organisations present opportunities to intellectuals for interacting with people. Intellectuals also learn from the life experiences of the people. They have vast unstructured experiences. They are not capable of viewing their experiences in a structured whole and consequently unable to understand the complexity of the problems in larger social context. The intermingling and interaction of intellectuals and the common people brings an enrichment of knowledge. From intellectuals' side, this leads to the democratisation of knowledge which in turn helps not only in reducing the prevailing social and economic inequality in the society, but also in achieving a better quality of life.

PSMs consist of a large number of actors consisting of science professionals, engineers, doctors, scientists and a large number of teachers, local people and communities, and in many instances with the *panchayats* (elected local governing bodies of India), in very large numbers to work across the country. The movement combines reconstruction and struggle in its efforts working in areas of education, literacy, environment, health, rural production, energy and local governance systems and uses various forms of struggles to resist the neoliberal policies. Whenever feasible, it collaborates with the government, but also confronts it when it finds itself in disagreement. In particular, it has experimented actively in local level people's planning methods, in collaboration with the *panchayats*, as a mean of resisting the centralising tendencies of the neoliberal paradigm (Raina, 2005). The crux of the PSM seems to be in making scientific and technological thinking and knowledge available and relevant to the common people in terms of their everyday experience.

Genesis, formation and growth of people's science movement

The genesis of the concept of PSM in Indian context is a post-colonial phenomenon. The decisive intervention came from the Kerala Shashtra Shahitya Parishad (KSSP). It was formed in 1962 as a Forum of Science Writers. The Science Writers Association of India (SWAI) was another independent initiative. KSSP was confined to the language of Malayalam (a south Indian language), while SWAI, mostly in Hindi and English. In 1966, half a dozen other organisations came into existence in Bombay (now Mumbai), initiated mainly by scientists from Bhabha Atomic Research Centre (BARC) and Tata Institute of Fundamental Research (TIFR). These organisations were also networked into a Federation of Indian Languages Science Association (FILSA) in the same year. It was founded by M. P. Parameswaran and his associates. As an individual, he was influenced

by Soviet model for science popularisation while pursuing his doctoral studies in Nuclear Engineering from the Moscow Power Institute in 1965.

Initially through the efforts of FILSA, the various Indian languages were used for science popularisation. These languages were Malayalam, Tamil, Kannada, Telugu, Hindi, Gujarati and Marathi. But FILSA was active only for two years i.e. from 1966-1968. It had no formal office during the functioning period. It had held two or three workshops over the period of two years. It did not have funding. However, it organized half a dozen meetings during the period of two years. Most of the meetings were workshops by nature. Even the organisations under FILSA are almost now deceased except *Hindi Vigyan Sabha* (Hindi Science Assembly). The headquarters of FILSA was in BARC, Bombay. FILSA was the pre-formation of the present All India People's Science Network (AIPSN). In other words, FILSA was the proto of AIPSN.

One of the important constituents of PSMs in India is KSSP. A brief background of KSSP helps to understand the formation of the PSMs in India as well. KSSP is the largest[1] among all the PSM organisations in India and most active association in this field since 1962. KSSP was formally inaugurated in September, 1962 at Kozhikode of the state of Kerala. It was formed by the merging of three groups of intelligentsia. The first strand was the *Sastra Sahitya Samithy* (Science Literary Forum) formed in 1957 at Ottappalam, by a group of activists and science writers. The second group was formed in 1962 at Kozhikode by a group pf science writer. The third group was the Malayalee scientists working in Bombay, who started *Sastra Sahitya Parishad* in January 1966 after coming in contact with KSSP. It is witnessed that how the small local groups of science writers and people involved in activities for the diffusion of scientific knowledge in Kerala society. As a part of KSSP's activities, several publications were brought out in order to popularise science in keeping with its objectives of science for the development of society in Kerala. In the 1970s and 80s, the KSSP as an organisation expanded into a mass movement[2] which devoted itself to other concerns, such as elementary education, health, environment, literacy, energy, development and micro planning etc. In 1973, the KSSP adopted the theme 'Science for Social Revolution' (Zachariah and Sooryamoorthy, 1994: 20) and had taken up a specific issue for intensive mobilisation. Till 1978, KSSP was situating all the dissemination of science activities under the very term 'science popularisation' only. But the phrase

1 According to AIPSN member organisation profile (2002, May), KSSP has 45,051 members. *Paschim Banga Vigyan Mancha* of West Bengal, the second largest PSM has a membership of 25,000; 16,000 in Tamil Nadu Science Forum of Tamil Nadu State, *Jan Vigyan Vedika* of Andhra Pradesh State consists of 12,000 members; 5,000 in *Karnataka Rajya Vigyan Parishad* of Karnataka State (Isaac et al. 1997).

2 KSSP achieved the status of mass movement, "the only of its kind and perhaps the whole of Asia" in mid 1970s itself (Krishnakumar, 1977; Krishna 1997b).

'people's science movement' was coined by K. P. Kannan, another activist of KSSP and introduced formally, for the first time, in 1978 at the Trivandrum Convention of people's science groups. A distinction can be drawn between science popularisation and people's science movement on the basis of their nature they played in Indian context. The former denotes apolitical by nature and the latter is political.

The Trivandrum convention brought all the voluntary groups[3] together under the banner of PSM who were working in areas of the interface of science and society. Some voluntary groups were attempting to popularise the natural sciences; some were engaged in focusing attention on the irrational attitudes and policies towards such basic issues as health and sanitation; some were engaged in highlighting the adverse impact of development activities as a result of wrong application of science and technology; particularly in the field of environment; a few were engaged in demonstrating innovative and interesting ways of teaching science; while quite a few were engaged in the application of local/indigenous S&T in development activities in the areas of health, non-formal education, appropriate technology, housing, etc. The role and experiences of these voluntary groups in the broader socio-economic and political context of the country was discussed in the convention. The deliberations were around four general themes such as (i) formal and non-formal education, (ii) people's health movements, (iii) scientific research and technology, and (iv) the utilisation of science for social revolution (Vaidyanathan et al., 1979: 57).

In May 1985, the KSSP and the other science-based voluntary groups organised an all India *jatha* (procession) in memory of thousands died at Bhopal disaster. The science-based mobilisations in the states like Karnataka, Maharashtra and Andhra Pradesh had joined with the KSSP in organising this *jatha*. As the contacts among the various groups and organisations grew, the concept of a *Sastra Kala Jatha* (Science Art Procession) took shape. The KSSP had been organising such *jathas* since 1980 with the involvement of local artists. The 1985 *jatha* was followed by similar programmes in Tamil Nadu Science Forum (TNSF) and the Pondichery Science Forum (PSF), and in the state of Gujarat with the assistance of the *Gujarat Vigyan Sabha* (Gujarat Science Assembly).

It was these initiatives that enhanced the coneptualisation of PSM. By the early 1980s other organisations for the propagation of science had also emerged in different parts of the country. These voluntary organisations, through mutual interaction and sharing of ideas influenced each other and these interactions empowered and equipped them to be relevant in Indian context. Along with the KSSP, 26 other like-minded organisations came together during the same year on the eve of third anniversary of the Bhopal Gas Tragedy in October-November, 1987 to organise the *Bharat Jan Vigyan Jatha* (All India People's Science Festival/ People's Science Procession of India) which was sponsored by Department of

[3] The website of KSSP provides the list of PSMs, who are the members of AIPSN.

Science and Technology (DST), Government of India (GOI). The *jatha* covered 500 centres in 14 states of India. Five *jathas*, along with cultural or *Kala* (Art) groups from five different regions of the country, gathered in Bhopal. Even a 2,000 km procession converged at Bhopal from five different directions. The message was – science for peace, humanity, secularism and self-reliance. This was a massive attempt for the development of scientific communication to promote scientific awareness through a cultural caravan. It helped for the expansion of PSM into a network of people's science organisations across the country. The success of *Bharat Jan Vigyan Jatha* (BJVJ) was followed by the first All India People's Science Conference, which was held in Kannur in Kerala in 1988. At this conference, AIPSN, a loose coalition of people's science organisations across the country, was formed. It is an existent network, one of the leading actors of PSM.

The basic philosophy of the PSM is to treat S&T as means to achieve the goal of an equitable and sustainable society. The PSM organisations believe that the public needs to develop a critical understanding of S&T in order to be able to participate in the application of S&T, especially in the choice of technologies in different contexts. Given the widespread literacy, the efforts to propagate science awareness and create a scientific temper among the people should go hand-in-hand with efforts in mass literacy. In 1989, the KSSP undertook a massive literacy drive in the district of Ernakulam in collaboration with the district administration. The KSSP made use of its well-honed medium of *kala jatha* to reach out to the population. This proved to be a major success. The success led AIPSN to take up literacy as an empowerment programme in the campaign mode, for which it set up a separate organisation called the *Bharat Gyan Vigyan Samiti* (Indian Organisation for Learning and Science) with the primary responsibility of placing 'literacy' on the national agenda. Indeed, literacy campaigns later on formed an essential component of almost all the people's science organisations.

However, the PSM activities in India can be classified into four broad categories:

1. ***Science communication and science education:*** The basis of PSM in several states has been science communication and science education. It is the basis for the movement in several states. It involves science teachers, working scientists and the science-qualified middle-class and students. The activities include science publications, popular science lectures, street plays and school science activities. The publication of science books, periodicals, articles in the vernacular languages was the initial and central activity. Cultural forms of communication are extensively used in the *kala jathas*. One of the sustained activities of the *Haryana Vigyan Manch* (Haryana Science Forum) has been its campaign against superstitions and myths. For children, in particular, science popularisation by the PSM organisations have been through children's science festivals, children's science projects, quiz contests, science tours and children's science books. Besides, innovative science teaching methods are also propagated by some of the PSM organisations. Many of the PSM

organisations are the recipients of the NCSTC's National Awards in Science Communication, e.g. PSF, TNSF, Haryana Science Forum, the *Karnataka Rajya Vigyan Parishad* (Karnataka State Science Association), the *Madhya Pradesh Vigyan Sabha* (Madhya Pradesh Science Assembly), *Srujanika in Orissa*, the Assam Science Society, the *Paschim Banga Vigyan Manch* (West Bengal Science Forum) and the KSSP (in Kerala).

2. ***Policy critiques especially in S&T*:** The PSM organisations allow scientists and professionals not only to critically evaluate state policies about S&T and research and development policies but also to study their inadequacies and propose viable alternatives. The underlying idea is that a detailed critical understanding of developmental policies may enable people's organisations to intervene in scientific decision-making. Sustained interventions in the area of S&T policy and management are required if a people-oriented science-society linkages gets emerged.
3. ***Grassroot level development interventio*ns:** This has been a major component of the PSM's initiatives through mass campaigns and discussions. By developing pilot models in literacy, health, agriculture, credit cooperatives, watershed development, local level planning programmes, promotion of small enterprises and their networking, the PSM organisations have been able to intervene effectively in the decision-making process in several instances. These campaigns serve the purpose of people's resistance to bad policies and highlight their demand for appropriate alternatives. The best illustration of this kind could be the BGVS.
4. ***Alternative technology and development*:** The PSM organisations have engaged in developing and encouraging people-oriented alternative technologies that are less capital -intensive and empower a large number of people, workers, craftspersons and artisans. Some examples of such initiatives are: wireless in local loop for telecommunications, the computer and village information software, bio-mass as replacement for cement/concrete in civil constructions, windmills and bio-mass based energy systems, organic inputs to boost agricultural productivity, improved small-scale mechanised looms, small-scale oil presses and other food processing units, and mechanised black smithy. Roughly, once in every two years, the PSM organisations come together at the All India People's Science Congress (AIPSC) to review their actions, interact with experts, and learn from their experiences and plan ahead.

Thus, the PSM has come a long way from merely disseminating scientific information to involving the people in advocacy, discussions, and interventions in science-related policy and developmental issues. The movement has gone from strength to strength to become a vibrant mass movement with practically every State having an active people's science organisation. The efforts of the PSM are becoming more relevant in contemporary Indian society as the adverse impact of liberalisation and globalisation is felt increasingly by the common masses and the

state is gradually abdicating its responsibilities in education, employment, health and social welfare.

Ideology is a particular type of understanding reality and a movement can not keep itself alive unless it develops its ideological frame and identity. An ideology of a movement relies on sets of ideas that explain and justify its purpose and methods. Moreover, ideology provides legitimacy to the action programmes of a movement. The ideological underpinnings grant the movement acceptability and recognition among the people at large in a society. It also helps to generate involvement to the cause and becomes a rallying point to assemble people to consolidate the gains of collective mobilisation.

Although every movement evolves its own body of ideas and goals, it is frequently under the powerful influence of already established ideology like Gandhism and Marxism. Both Gandhism and Marxism have influenced people's science movements in India at different times. Both Gandhism and Marxism are two distinct, mutually contending ideologies with distinct praxis in India. They have been responding to Indian reality in the different ways. Though they are evolved within, and as response to modernity, in different ways, apparently they do not differ on the epistemology of science.

On the one hand, PSM links science with society and studies the impact of modern science on society and vice-versa. On the other hand, it envisions a better, egalitarian society and believes that modern science can be used as a tool for the revolution to transform the social system from capitalism to socialism. It believes that science has the inherent potential to change society. S&T are developed by sharing of the experiences of the community and is the result of the generalisation of the experiences. Therefore, science is the common property of humanity. Having said so, we are now to present six empirical as well as secondary source based case studies (of various shades) in People's science Movement in India, e.g, case studies of BGVS, JVV (both based on science activism of radical type), DSF (purely discursive and critical), OBPS (discursive and science popularizing turned social activism type), PBVM (fusion of science popularizing and social activism type) and MVP (purely reformist and science popularizing type).

The articulations of six case studies are based on the use of both empirical and secondary data collected by the researchers. Further the six case studies do make a representative sample of the various PSMs in India as these are from various shades of PSM.

Bharat Gyan Vigyan Samiti (BGVS)

In order to understand cognitive process in formation, it maybe useful to divide the BGVS into three major phases with defined characteristics. The first phase, from 1989 to 1993, a period of awakening, was characterised by mobilisations for literacy, starting from the formation of the BGVS of 1989 followed by three major *jathas*. The second phase, from 1994 to 1997, a period of movement building,

was marked by a transition from literacy to other development initiatives and an attempt to establish a strong interface between the two. These were mainly in the areas of natural resource management, health, initiatives in basic education and the generation of social awareness through publications and the formation of saving groups on the heels of major women's mobilisations through *Samata Vigyan Utsavs* from 1996 to 1999. The third phase, from 1998 to the present, is defined by an attempt to consolidate through decentralised instituionalisation, around continuing education centres and *Gyan Vigyan Vidyalayas*, i.e. centres of non-formal education and interface with formal schooling.

According to Saldanha (2003), an assessment of the history of BGVS, suggests that there were two primary factors that influenced its trajectory; the external environment and the organisational dynamics and strategies internal to BGVS, in response to the former. Factors related to the external environment may be seen as those related to the socio-economic contexts of intervention and those resulting from the interactions with the other major agency in the literacy campaigns e.g. state/government. The strategies of the BGVS were largely in response to the spaces provided to it by the government.

The keywords of the ideological perspective of the BGVS interventions over more than a decade, explicitly and those are the following:

1. ***Equity and self reliance:*** Access to literacy and basic education itself was seen as access to equal opportunities. A perspective on self reliance was especially required in a growing unipolar and militarised superpower context and where other basic educational programmes were tending to be flooded with 'foreign aid'. This perspective was increasingly being influenced by liberalisation and privatisation of the economy in contexts of globalisation. It further promoted by restructuring of economies and innovation in communication and knowledge distribution.
2. ***A people's movement approach, decentralised democracy, secularism and national integration*:** The mobilisation process and organisational structures for implementing the literacy campaigns emphasised these values. The very structure of Village Education Committees was an operationalisation of this principle where an attempt was made to put together major social forces such as the government, the voluntary organised and unorganised sectors and the teaching-learning community.
3. ***Voluntarism and scientific awareness*:** The main body of the literacy campaigns worked on the principle of voluntarism. This involved at different times and over more than a decade voluntary activists that might number over 12 million persons. Involving these persons in acting through popular, electronic and the print media in the spread of critical scientific awareness, and literacy as possible as enabling skill to this end, was one of the important features of the literacy campaigns.

The BGVJ used different strategies for raising people's awareness on various scientific and social issues. These strategies were:

- Developing a set of centralised messages but allowing for enough flexibility to encourage adaptation to suit local needs, problems, aspirations,
- Evolving an organisational structure that is pyramidal in nature with a broad base of activists at the local or village level tapering off to smaller numbers at the taluka, district and state levels,
- Involving activists on a voluntary basis and sustaining their missionary zeal through on-going training,
- Undertaking meticulous planning of activities and time schedules to be followed, but allowing for corrections and modifications on the basis of feedback receive from the people,
- Involving leaders and workers of political parties irrespective of ideology, and eliciting their involvement and participation in the programme,
- Carrying on the whole campaign, in a time bound period i.e. almost on a 'war footing' and sustaining the tempo of the campaign and finally
- Involving the entire community in different ways, thus generating a mass support for the programme.

Delhi Science Forum (DSF)

DSF is a noted PSM organisation concentrating on policy issues related with S&T. Though it started functioning in 1978 but was registered as a non-profit public interest organisation under the Societies Act in 1981. The organisation is based in New Delhi. It is engaged mainly in issues related to S&T policies and science popularisation. DSF works in areas of interface between science, technology and society, focusing on S&T policy issues, their impact on India's self-reliance and sovereignty, and their societal implications, particularly regarding interests of underprivileged sections of the Indian society. DSF also works to promote peace and disarmament, utilisation of S&T for environmentally sustainable development and a scientific temper including awareness of the potential of S&T. Unlike KSSP and BGVS, DSF is not a mass organisation. It is a catalyst organisation and the movement it runs is of discursive type only. It is not a mass based organisation; rather it is a nodal agency among other PSM organisations in India. In fact, it is a pressure policy group among people's science movements in India.

The technical dimension of DSF includes campaigns among working scientists, technologists, other professionals and academics on the one hand and campaigns among the general public, especially directly affected sections, for their empowerment and informed participation in decision-making by acquiring greater awareness of S&T issues. In order to do this, DSF employs various means of communication such as street plays, slide shows, exhibitions and workshops, etc. The material produced for the communication addresses different target audiences, including policy-makers, activists, academics and general lay public.

While the major content of this material is nationally coordinated, the same gets transcribed and produced at state/ regional levels in local languages. The strategies of DSF are for creating material for campaigns on policies related to drug industry, health, the nuclear holocaust, the Bhopal disaster like and the WTO issues.

Publication is the major work of DSF which brings out the critical studies of S&T policy related issues. Here DSF plays a leading role because its distinctive leadership lies in publications on several policy issues involving S&T. For DSF, a good state policy can do more good than many hundreds of NGOs working in small pockets. A bad state policy can do a lot of harm and undo the gains from several years of efforts. Therefore, there is a need to understand policy inadequacies and pose alternatives. Developing well-studied and detailed critiques of developmental policies is essential for empowering people's organisations to seek participation/ consultation in the decision-making process. S&T policies have social, economic and political implications on the people. In the table 4, it is pointed out that the publications of DSF's policy work fall in the areas of: (i) nuclear disarmament, (ii) IPRs and patent laws, (iii) health policy and policies on pharmaceuticals, (iv) educational policies, (v) energy and environment policies, (vi) sectoral policies – telecom, power, R&D, (vii) panchayats and decentralisation policies. That apart, DSF has organized large number of seminars/ conferences to pursue its agenda.

Jan Vignana Vedika (JVV)

Jan Vignana Vedika (better known as JVV) was formed on 28 February, 1988 by a group of people comprising of academics, medical doctors, scientists, and teachers in Vijayawada of Andhra Pradesh. The formation was as a result of the idea gathered from the *Bharat Jan Vigyan Jatha* (BJVJ), 1987 with the following set of objectives:

- To popularize science and to promote scientific temper among public
- To eradicate obscurantist, superstitious and paranormal and mystical practices from public by means of popularization of science
- To understand the scientific basis behind several of the problems faced by the public and to explore remedial solutions for the same
- To facilitate the benefits of science among the larger public which are otherwise confined to the certain section of the population
- To encourage quest for knowledge and to strive for national integrity, self reliance, world peace, social progress and cultural vibrancy
- To encourage research in divergent areas with public welfare
- To design programmes corresponds to the objectives set as above

JVV involves in three kinds of activities such as: educative, agitative and constructive and such activities spread over areas like environment, health, education, energy, development, literacy, science awareness, campaigns against retrogressive social practices such as untouchability, child marriages, superstitions

etc. JVV works on mainly issues related to science and society, however, education, health and science communication are the major three operational domains of JVV.

1. ***Education:*** With the strength of several thousands of teachers as its members, the JVV organizes teacher training to make them enjoy teaching and promotes pedagogic innovations to make learning an enjoyable activity for children. It also assesses curriculum and textbook contents and concepts and organizes children's science festivals, such as joyful learning, *bala melas*, (children's fair) etc. frequently on massive scales.
2. ***Health:*** Over the last few decades, JVV has actively been campaigning for people-oriented healthcare health policies. Led by a group of committed medical professionals and science activists, the organization conducts surveys and analyzes the ground realities of healthcare at all levels while preparing village level health plans and cost-effective solutions. As an active partner of *Jana Swasthya Andolan* (People's Health Movement), JVV has been critically examining the health policies of the government and formulating alternative health policies.
3. ***Science communication:*** Popularization of science and inculcation of scientific temper among the people is one of JVV's major tasks and priority areas. Its modes of popularization of science among people include folk arts, street plays, dance, magic, sound and music and other art forms besides the usual lectures, book exhibitions, demonstrations, debates, presentations, etc.
4. ***Publications:*** JVV has published many books and literature for children and adults. One of the major strengths of JVV is its publication wing. It has been publishing and circulating different kinds of books on science, culture, history, education, health, etc. for all levels of people. Promoting reading habit from the childhood has been a regular and ongoing activity of JVV. It organizes book exhibitions, reading festivals and readers' clubs. Most importantly, it publishes and circulates booklets, pamphlets, bulletins contextually too whenever socio-scientific, natural or astronomical events take place.
5. ***Women:*** Samatha is the name of the women's wing of JVV. It strives to empower women so that they are aware of their rights and sensitive to their problems and become prepared for the remedial measures. JVV organizes frequent counselling and teachings to educate adolescent girls about mysteries surrounding their own physiological changes.
6. ***Campaigns on environmental issues:*** JVV organizes several kinds of programmes to bring in awareness of environmental degradation, ecological balance, sustainable development, etc., among public and policy makers. It sensitizes people against the ruthless consumption of natural resources. With the National Forest policy of 1988, JVV educates the villagers how to manage their forest. With a pro-poor people discourse, it encourages industrialization and technological automation.

Paschim Banga Vigyan Manch (PBVM)

Paschim Banga Vigyan Mancha (PBVM) was established in the year 1986. It should be acknowledged that if the long tradition and rich experiences of institutions like *Bangiya Vigyan Parishad* and a good number of science clubs were not there, the emergence of PBVM would not have been possible. It emerged as a common platform for expression of science conscious public and the science clubs of West Bengal. It is one of the largest PSM organisations of India. It has over 300,000 members and these members are drawn from various sections including scientists, engineers, medical doctors, students and trade union activists as well. It has got its units in all 19 districts of West Bengal. It has been working through lowest level units in rural and urban areas. With the help of innumerable units throughout the state it is maintaining links with thousands of science activists who are working with commitment to take S&T to the people. PBVM although had a soft left wing ideological leniency and had links with the then ruling Communist Party of India (Marxist) CPM it was not a radical organization. It believed more in bringing change through awareness building, spread of scientific knowledge and consciousness and in introducing reforms in education and training (reforms). Hence we would like to treat this as a science popularization movement organization and not a peoples' science movement organization.

The aim of the PBVM is to build a science-conscious society and the concrete objectives of PBVM are: (i) to make the people conscious about the uses of S&T in daily life; (ii) to develop the awareness of the people about environment, public health etc; (iii) to educate the people about the harmful effects of different products manufactured by the MNCs; (iv) to encourage innovative, fundamental, scientific R&D; (v) to promote science education in local language; (vi) to fight against fundamentalism, superstition and obscurantist ideas and the spread of scientific temper and attitude among the people of the state; (vii) to oppose the implementation of any technology that is against the interest of society; (viii) to initiate, support and coordinate in the formulation of peoples oriented science and technology policies; (ix) to publish popular science magazine, science related books, monographs, pamphlets for infusing the spirit of scientific inquiry and attitude in the in the impressionable minds of the youth in schools and colleges.

Since the inception PBVM has taken up a large number of activities and time based programs linked with the objective of creating, spreading scientific outlook, taking advantages of S&T to the people who are yet to have it even in this age of unprecedented development of S&T. PBVM's activities cover issues like environment, health for all, self-reliance in agriculture, energy question, technology upgradation for artisans, low-cost housing, translation of scientific works in local language and explaining scientific ideas in a simple language while making them relevant to the local context.

1. ***Environment:*** Environmental issues are an important agenda since the inception of PBVM. PBVM have been continually taking different steps for the better environment of the state as well as conservation and protection of the nature & natural resources.
2. ***Health:*** PBVM is engaged in awareness of people's health issues since its inception. It's conception of health planning is 'People's Health in People's Hand.' All components of health such as preventive, promotive, curative, rehabilitative health care activities come under PBVM's purview. For this, PBVM follows 'bottom up' approach which includes public should be empowered to recognize their own health problems, analyze the situation, given proper scientific knowledge to plan for solutions, prioritize the needs, implement them by integration of different available inter-sectoral and intrasectoral resources, target oriented programmes initiation, evaluation the status after a specified period, dissemination of experience with public, modifying the programme according to the outcomes.
3. ***Jana Swasthya Chetana Prasar Samonnyay:*** Committee was formed at State level & District Levels with the initiative of PBVM, involving many health organizations, professional and voluntary Organizations as well.
4. ***Technology transfer:*** Setting up district level S&T centres to facilitate the activity of 'technology transfer', for example, an unit was set up in the name of Kudrati-Khuda, a scientist, in Margram of Birbhum district and another such unit is being run successfully at Kalna, Burdwan, Haripal, Hoogly & Nabagram, Murshidabad. Moreover, PBVM has taken up large scale implementation programme for setting up 'Improved Chulla' and 'Sanitary Murt' for spreading the health consciousness among rural people.
5. ***Samata:*** Development of Samata in all the districts to ensure participation of women in science awareness programmes and also to motivate them in the spirit of self-reliance. *Publishing:* One of the achievements has been in the sphere of publishing. These publications are in both Bengali and English. These publications are addresses to different audiences such as primary school children, high school teachers, college students, farmers, formal and informal members of the PBVM. Until the PBVM began publishing science literatures, the only science books that published were textbooks prescribed for specific academic courses. Some of the publications include: *Sera Sholo Vigyani*, *Char Vigyani*, *Chai Vigyani*, etc.

Orissa Bigyan Prachar Samiti (OBPS)

On August 7, 1949 Orissa's first society for popularizing science called as Orissa Bigyan Prachar Samiti (OBPS) was established at Cuttack for the Oriya speaking people. This society was formed with combined efforts of late Gopal Chandra Pattnaik and Gokulananda Mohapatra. In the first meeting of the Samiti the other

members present were eminent economist Sadasiba Mishra, noted psychologist Radhanath Rath, plant scientist Shymananda Pattnaik, and professors of medicine like Mahendra Chandra Mishra and Raikrushna Mohanty. In all nine members were present in the first meeting and among them six were from Ravenshaw College and three others from medical college, Cuttack. To begin with, it was known as Utkal Bigyana Parishad but later it changed its name to Orissa Vigyan Prachar Samiti. This society was registered as a formal organization in 1961. The Samiti during its inception had three objectives:

1. Spread the messages of science through discussion forums and popular lectures in vernacular language
2. Publication of books based on science in vernacular language and finally
3. Publication of a popular science magazine

Besides, the chief objective of the society was to provide a comprehensive language (terminology) and style suitable to students and common people to study science. Their sole aim was to make science simplified for the people and students in particular as it was so intricate. In 1944, Oriya was made the medium of instruction in schools. Exactly on that year science was introduced into the high school curriculum. But as there was not a single science text book in Oriya language the students were faced with a lot of difficulties. In view of this the OBPS desired to publish Oriya text books on science. Probably because of this students in the then Orissa showed a little interest in science. With a view to mitigating the plight of science education on Orissa then, Gokulananda Mohapatra along with Harihar Pattnaik published the first Oriya book on science for matriculation students which were frowned upon by some of the college teachers of the time. Those years in Ravenshaw College large number of students enrolled in Arts departments but a few in Sciences.

However, after the ten years of establishment of Orissa Bigyan Prachar Samiti (OBPS) the government of Orissa recognized their contribution and recognized as an educational society. The OBPS did not deny funding offer made by the government on its own. As a result, a few education ministers have extended financial help to the OBPS. In one of its meeting OBPS gave birth to Orissa Bigyan Academy (OBA) not only for science propagation but also to perform many other activities that were not done by OBPS. It is interesting to note that Orissa Bigyan Academy (OBA) now is a government organization to propagate science originated from the OBPS. In the absence of a regular office usually the meetings of OBPS were held in the private quarters of its members.

In the recent years the OBA has become active in Orissa by organising science exhibitions, discussions, workshops, seminars in all parts of the state, publishing magazines, newsletters, etc., to sensitise the public about the role of science and technology for the development of the State of Orissa. Even presenting various awards to senior and junior scientists as a source of encouragement, felicitating the eminent scientists and awarding the prominent writers for their significant

contributions to the scientific literature (in Oriya), arrange for imparting proper training to science teachers and writers of the state and the like have been the activities of OBA. Besides, the bi-monthly science magazine *Bigyan Diganta* (Science Horizons) is being published regularly with the assistance of Odisha Bigyan Academy (OBA). This magazine is very popular among the students.

Many established science writers of Orissa have been the members of the OBPS. Among its members note worthy are Gokulananda Mohapatra, Radhanath Rath, Gadadhar Mishra, Debakanta Mishra, Pranakrushna Parija, Banabihari Pattnaik, Biswanath Sahoo (1910-1991, Kalantira, Cuttack), Basant Kumar Behura (1922, Bilipara, Jagatsinghpur), Harihar Pattnaik (1924, of Balarampur, Jajpur), Gopal Chandra Pattnaik (1930-1985, Kotapalla, Khurda), Nityananda Swain (1943, Kaniha, Jagatsinghpur), Pramod Kumar Mohapatra (1956, Oliha, Kendrapara), medical researchers like Niranjan Tripathy (1942, Jodapur, Jagatsinghpur), Sachidananda Satpathy (1950, Samang, Jagatsinghpur) and Ramesh Chandra Parida (1947, Jamapada, Kendrapara). The association of these active scientists with the Samiti helped other science writers to come forward for spreading scientific knowledge. Thus the formation of OBPS may be considered as the first institutional effort to popularize science in Orissa (Pattnaik and Sahoo, 2006).

All these Oriya scientists resolved to popularize science in vernacular language because they thought that communicating ideas in the language of the people would be more appropriate and effective. For them, people could also understand science and apply it to their day-to-day lives, if it was done in vernacular language. To P K Parija, the noted plant biologist who guided OBPS, such a possibility would not only facilitate the task of communicating this precious knowledge (scientific knowledge) more effectively to the native Indians but also enable the Indians to make the achievements in science on their own. He felt that reception of instructions in the mother tongue is more instinctive and natural. Very Similar views were expressed by Maulana Imdad Ali, founder of the Bihar Scientific Society (1868) and by Syed Ahmed Khan, the founder of the Aligarh Scientific Society.

Hence Parija wanted to get all the scientific terms translated into Oriya. For that purpose, he made a Paribhasha Committee (PC) during his Vice-chancellorship at Utkal University. In the Paribhasha Committee (PC), he appointed all the experts of the different sciences and who developed a scientific terminology in Oriya language for different disciplines like Life Sciences, Physics, Chemistry, Mathematics, Medical Sciences and Engineering disciplines etc. As a result Oriya scientific terms increased and became popular.

Parija argued that the spread of science can change the society both at the level of structure and culture. At the level of culture, he found that beliefs about natural phenomena that existed in Orissa were based on conjectural untested claims. These beliefs and associated traditions were seen as impermeable for new ideas. Under these conditions, Parija and his colleagues took initiatives to popularize

science. Implicit here is that under Brahmanism, except the upper castes no other castes were to get access to literature and knowledge. Not merely caste system but in colonial Oriya society ruled by Zamindars and feudal Kings of Princely States, the political authority structure itself was a source constraint for the masses to get English education and acquire the benefits of modern science. In this context appropriate would be to focus at the then socio-cultural and political conditions of the then Orissa in which these scientists took initiatives for popularizing science.

Factual **e**vidences are found to establish that science popularization in Orissa had become institutionalized at the end of the successful movement (Pattnaik and Sahoo, 2006). Institution of several awards for popular science writings in Orissa include:

1. Utkal University- Gold Medal for popular science writings
2. Bigyanaloka's- Best popular science author
3. Bigyana Bandhu award by Orissa Bigyana Paribesha Vikasha Samiti
4. Samanta Chandrasekhar Award is given every year to a scientist for his outstanding research contribution in the field of S&T in a particular year.
5. OBA award for most popular science writer
6. P K Parija Bigyana Sahitya Award by Utkala Sahitya Samaj
7. Orissa Sahitya Academy Award for popular science literature

Marathi Vidnyan Parishad (MVP)

MVP is a genuinely unique social movement organization (SMO). Established in 1966, it was the offshoot of efforts of a number of scientists and engineers in Maharashtra who wanted to take science to the public as they were worried that scientific information were inaccessible to the majority of the Marathi speaking people. After a decade of success in translating scientific books and articles into the local language and making them available to vernacular schools and citizens, MVP's efforts were to foment a scientific inquiry attitude among the population aiming at self-empowerment and social change. The growth of MVP displays certain features of social movement, particularly new social movement (NSM).

1. The central goal of MVP is not to bring down the existing political and social structure but to concentrate on diverse issues such as the promotion of scientific knowledge among the common public, innovation in science communication, public awareness on S&T issues, gender and health related aspects, and building a cultural identity.
2. The agenda of MVP was to focus on grass-root activities by forming loose associations. The organizational structure of MVP is rather decentralized, lacking regulation, differentiation, control, and power. Its officials and members consist of voluntary workers who rely on nominal donation.
3. The members of MVP do not view themselves as a class, and do not have any class-specific agendas. They are part of the intellectual history. The actors of MVP were scientists, engineers, technologists, policy analysts, journalists,

teachers, and students. They were urban, educated, and middle class actors. The methods used were – campaigns, scholastic writings, mobilizing public in a methodical/strategic manner, media management – also suggest that MVP was able to fire the idealism of the India's middle class in S&T arena. These middle class actors did not believe in the -hierarchy while functioning of the organization. Thus, it is mostly a discursive movement.

4. MVP focuses on science popularization among children and formulate additional/supporting curriculum. To MVP, additional/supporting curriculum means science education that is not viewed as part of the school curriculum e.g. "learning by doing" and in some cases has highlighted the importance of collaborative learning environments
5. MVP propagates science amongst both the rural and urban masses. It argues that the relevance of science to the society needs to be realized by the entire spectrum of population, instead categorization between rural and urban.
6. MVP does not spend its time and resources on agitating against bogus god-men and fraudulent consumer products. Such agitations may be socially necessary but that does not fit into MVP's policy. Besides, developing and disseminating communication material for print, electronic and digital media, it trains science communicators, catalyzes scientific creative activities and conducts research in various aspects of S&T communication.
7. MVP has no political ideological overtone and moreover, unaffiliated with any political party. In essence, MVP claims that it doesn't attach any political values to its science propagation activities. It believes in "science for science sake" or "science for enlightenment". The members of MVP call itself a science propagating organization (MVP, 2004: 18).
8. The constitution of MVP (1983) identifies it as a people's movement for disseminating scientific knowledge in Marathi and enriching the Marathi language for expressing scientific thought.
9. Most of the top leadership positions in MVP already have highly secured professional jobs elsewhere and considers MVP as their avocation. As soon as their regular jobs get over, they arrive at MVP offices to do the hundreds of mundane, however, essential activities for its functioning. They do it for many reasons, not the least of which is their commitment to the cause and the camaraderie that has developed between them and the other volunteers of MVP.
10. The members of MVP tend toward reform-minded advocacy while engaging themselves in science communication activities. It was observed that MVP lacks radicalism in its approaches/views. It didn't involve in any grassroots mobilization of the masses. It does not lead any activism in spirit. Though it looks at the policies of Maharashtra Government critically, but it never uses the means of protests/rallies/demonstrations against the government's policies and programmes. Instead, it plays a suggestive role by providing the guidelines to the Maharashtra Government.

As an organization, MVP was formed in 1966 and a constitution formulated specifying that the organization aims to:

- Popularize science through local language (i.e. Marathi) and enrich Marathi language for expressing science
- Explicate and enhance importance of science in human life
- Use science as a means of social criticism

Annual conference: MVP hosts its annual conference (*Marathi Vidnyan Sammelan,* Marathi Science Conference), a parallel event of Indian Science Congress but on a small scale. It organized the first conference in 1966 and since then the conference has become the most important feature not only for MVP but for the state of Maharashtra.

MVP conferences bring MVP in close contact and collaboration with the local people who are interested in different topics. Science-writers, science-activists and science-popularizers are felicitated every year during this conference. Science exhibitions are organized at Nehru Science Centre, Mumbai. The last day of the conference is usually reserved for visits to places of scientific interests. By following this pattern, the conference creates a sense of enthusiasm towards the propagation of science. These conferences were held in both villages and cities.

Science fiction writing competition: Science fiction is a broad genre of fiction that often involves imaginations based on current or future S&T. It is found in books, art, television programs, films, games, theatre, and other media. It is defined as a class of fiction which contains the currents of change in science and society (Goswami, 1983: 2). It focuses on the critique, extension, revision and conspiracy of revolution, all directed against static scientific paradigms. Its goal is to prompt a paradigm shift to a new view that will be more responsive. The popularity of science fiction in English language started motivating a new generation of writers. The presentation of science through science fiction in newspapers and magazines is frequently adopted by professional science writers. Science fiction plays an instrumental role in meaning-making both in the production and representation of science. MVP has been a pioneer in evoking a sense for writing science fiction amongst Marathi writers.

Since 1970, MVP has been carrying a science fiction writing competition and the winners getting felicitated during its annual conferences. J. V. Narlikar, an astrophysicist and cosmologist, was the first scientist who wrote science fiction in Marathi language. His book *Tales of the Future* talks about ten best science fictions through story form. The main reason that made him turn to the genre of science writing was his desire to share his excitement of working in astronomy with the lay public. He was influenced by his mentor Sir Fred Hoyle, astrophysicist and the well-known writer of science fiction. Hoyle enquired that in many of the stories, an Indian scientist was at the centre of the plot. To him, if one is writing especially for readers at home, one could give the story part of science fiction a local touch so that the readers can more readily identify themselves with the plot. This is the reason why Narlikar wrote fictions in Indian contexts. He also realized

that the Indian epics can be an excellent source of fiction, with their effects like time dilatation, spatial contraction and transmission at great speed.

Vidnyan Mitra: Since 1983, MVP conducts an eight-day *Vidnyan Mitra* (Science for friend) course, especially aimed at standard eight or nine students during Diwali vacations. College students are asked to teach this course. Students are exposed to various issues like population control, recycling water, preventing diseases like cancer, and are also introduced to a hobby. In 2003, "Water" was the theme chosen for considering its importance in human life. Experiments regarding water, it's physical and chemical properties, usefulness of water to all living beings, water conservation project, water management systems, etc. were included in the course content. They collect up-to-date information to make a 10-minute presentation at the end of the course. Besides, MVP workers visit schools regularly or invite teachers and students to their premises for various shows and experiments. For instance, students are taught to save water, how to fix a leaking tap and how to replace a fuse. They are supposed to use a solar cooker and prepare food; conduct experiments, watch the night sky and so on. In short, the course prepares a student for a scientist's like. . In 2003, MVP decided to conduct *Vidnyan Mitra* course twice in a year and decided to select one subject for covering all its aspects within a week. Till 2004, a number of 300 students has been successfully completed its course. One of the spin-offs of this programme is that the students' network established within MVP premise, would act as the future resource persons of MVP.

Rural science clubs: MVP holds the classes in rural schools to teach children science through simple experiment and gadgets. MVP started its activities in the villages by establishing science clubs for high school students and although its activities now are far more broad-based, the science clubs continue to play an important role in their science education programme. In most villages, the contact point for these science clubs is the village library and the contact person is the village teacher. The teachers are involved for two reasons. First, traditionally the teachers have been easily accepted in villages and are respected by all. Second, they have direct contact with the students.

Initially some of the members of the MVP went into the villages, identified enthusiastic youth, spoke to them and tried to build up their confidence. The activities and discussions emerged out of public's day-to-day problems. Among rural schools, urea pits are a novelty. Often, a rural school has no toilet. Instead of using an open space, MVP workers suggested that the children dig pits near the school and enclose them with tin sheets. The children were advised to urinate or defecate in the pit, which was filled with leaves and grass every evening. In three months, this is converted into fertilizer which can be sold to farms. There are 79 science clubs in villages associated with MVP. In fact, the latter encourages village science teachers to establish a science club by providing them financial and material support for the first three years.

Science pedagogy: MVP has built a force of 300 science teachers from 140 schools in the state of Maharashtra who meet once in every month to present their innovative ideas on science pedagogy and later they experiment the discussed methods by employing in their own classrooms. They return to refine their evolving pedagogy based on what they have learnt with students in the classrooms. The discussions help the teacher in improving their performance at school which resulted in enhancing the fundamental knowledge in science for students. MVP's members, particularly scientists, act as advisers and resource persons for improvising the science pedagogy. In 2007, MVP established a preliminary microbiology lab and conducted a two-day training workshop on micro-biology for the teachers where fifty teachers participated. There is no paucity of examples of this kind to cite here.

Gender education: The audio-visual programme followed with the question-answer session with experts on important events of life of woman such as menstruation, before and after pregnancy and menopause was initiated by MVP way back in 1984. The programme was prepared under medical experts' advice. MVP has acquired a set of slides (approximately 40) which explains the transition of a girl to a mature woman and this slide-show span for two hours. After each slide show, girl students are encouraged to ask queries.

Livelihood Generating Programmes: Livelihood is considered as one of the most important educational programmes of MVP. It consists of solar-cooker or smokeless *chullahs* making workshops and training for manufacturing scientific toys. Over the last four decades, it has started several programmes for spreading science among the masses at various levels, especially children and women. MVP believes that children can grasp the scientific principle behind a toy, while playing with it. Such toys can be prepared with the help of cheap and easily available local materials e.g. pump with the help of used film roll container, bicycle tube etc., flute with the help of simple straw, and tortoise with the help of fruity box and so on. Under this programme, children are encouraged to learn and develop their own skills.

Publishing: One of the major activities has been in the sphere of publishing. The objective of publishing is to bring out science publications on different aspects of S&T in both Marathi and English languages for promoting a scientific culture. The publications include mainly books and magazines. These publications are in both English and Marathi languages. These books are addressed to five different audiences: primary school children, high school students, college students, and women, formal and informal members of the MVP. It has brought out titles like *Microbiology*, *Air Pollution*, *Scientists*, *Groundwater in Marathwada*, *Irrigated Agricultural and Land Problems*, *Balance of Development and Environment in the Vidarbha*. Low-cost popular science books for children are also published. The first edition of *Set of Experiments for Children* in Marathi was published in 1994 and 5000 prints of the copy was sold out in 2001. These publications are used as resource materials for different science popularization programmes.

The National Centre for Science Communicators (NCSC) was added as a new project to MVP in 1996; with the objective of filling to the science communication movement in India. It aims to (i) establish contacts among science communicators; bring them together on a common platform; (ii) promote science writing; (iii) disseminate information on the latest developments in S&T; (iv) identify the barriers and challenges of science communication; (v) encourage young science communicators and nurture their skills; (vi) organize conferences/ workshops/ seminars, and courses, group discussions, debates, etc., to achieve the above objectives; (vii) facilitate translation activities from one Indian languages to another; and finally (viii) liaison with media by science writers to publish and communicate their work A National Conference for Science Writers was organized in December, 1996 where science communicators had participated to discuss the history of scientific writing in their languages and various problems and issues.

Conclusion

PSM in India might have started as a discursive movement where activism started with a discourse and later on manifested some form of social mobilization. But as the analysis of this study shows discursive formation is not an encompassing framework to justly explain the movement. It fails to do so particularly because of the grassroots activities of KSSP and emergence of all India organizations like BGVS that indulges in social mobilizations. The analysis indicates that of late the PSM in India has taken the shape of social mobilization. At the same time it further indicates that the PSM has grown beyond the conventional social movement framework, i.e, from mobilization to institutionalization. The emergent institutions have not culminated as the end-processes, rather make an intermediary phase, beyond which some of these PSM institutions have become dormant, some have started declining, some have withered away making way for new institutions and some have emerged stronger by re-aligning themselves under larger umbrella organizations. In the process the movement renews itself, as new PSM organizations have also emerged. But at the same time it is observed that the movement has lost its original radical teeth, spontaneity and focus. More of it have come under the influence of the government and have shifted their areas of focus (to literacy, environmental awareness and even rehabilitation and resettlement issues). For example a radical ideologue like M P Parameswaran who spearheaded a radical movement like KSSP has been co-opted by the Govt. through BGVS (funding heavily). Similarly the more independent reformist type of science popularizing movements of OBPS has been co-opted by the state Govt. by funding OBA and the independent reformist type of science popularizing movement of MVP has been co-opted by the state govt. as well as the central govt. by heavily funding MVP as well as its offshoot NCSC. Hence, PSMs in India now have acquired more the hues of "Social –activism" (not that of pure

science as it was earlier) and later on often acquire the patronage of the state by withdrawing their radical teeth.

References

Dighe and others. *Campaigning for Literacy – The Experience of Bharat Gyan Vigyan Jatha: An Analytic Documentation Study*. New Delhi, 1991.

Goswami, Amit. *The Cosmic Dancers*, New York: Harper & Row, 1983.

Guha, Ramachandra. "Alternative Science Movement: An Interim Assessment." *Lokayan Bulletin* 6, no. 3 (1988): 7-25.

Jana Vignana Vedika, http://www.jvvap.org

Jaffrey, Anwar and others. "Towards a People's Science Movement." *Economic and Political Weekly* 18, no. 11 (1983): 372-376.

MVP. 1983. *Constitution of Marathi Vidnyan Parishad*, April: 1-22, Mumbai: Marathi Vidnyan Parishad.

MVP. 1989. *Annual Reports*, Mumbai: Marathi Vidnyan Parishad.

MVP. 2004. *Brief Report*, Mumbai: Marathi Vidnyan Parishad.

Mahanti, S, et al ,2003, National seminar on science popularization: A report, Dream, Vol.6, No.1, October, pp.25-28.

Narayan, E. K. "Communication Methods of Kerala Sastra Sahitya Parishath." In *Communication Processes, Media and Social Change, edited by* B. Bell and others, 1999. www.iias.nl.

Panda, Biswambhar. 2003. "Aspects of Effectiveness: A Study of Grassroots Environmental NGOs." Unpublished Ph.D. Thesis, Indian Institute of Technology Kanpur, India, 2003.

Parayil, Govindan, "Social Movements, Technology and Developments: A Query and Instructive Case from the Third World." *Dialectical Anthropology* 17, no. 3 (1992): 339-352.

Paschim Banga Vigyan Manch, http://www.pbvm.org.in

Pattnaik, B. K. and Sahoo, S. "Science Popularization Movement in the Indian State of Orissa." International Journal of contemporary Sociology 43, no. 2 (2006).

Rahman, A. "Scientists in India: the impact of economic policies and support in historical and social perspective." *International Social Science Journal* XXII, no. 1 (1970): 54-79.

Raina, Dhruv, "Scientism and Romanticism." *Images and Contexts: Historiography and Modernity in Indi, 40-41.* New Delhi: Oxford University Press, 2003.

Saldanha, Denzil. *The Bharat Gyan Vigyan Samithi: Organisation, Intervention and Perspectives in the Literacy Campaigns*, Mumbai: Tata institute of Social Sciences, March, 2003.

Vaidyanathan. A. and others, "People's Science Movements." *Economic and Political Weekly* 14, no. 2 (1979): 57-58.

Zachariah, Matthew, and R. Sooryamoorthy. *Science for Social Revolution: Achievements and Dilemmas of a Development Movement: The Kerala Sastra Sahitya Parishad*, New Delhi: Vistaar Publications, 1994.

Zachariah, Matthew, and R. Sooryamoorthy. *Science for Social Revolution: Achievements and Dilemmas of a Development Movement: The Kerala Sastra Sahitya Parishad*, New Delhi: Vistaar Publications, 1994.

Zachariah, Matthew. *Politics and the People: In Search of a Humane India*, Vol. II, Delhi: Ajanta, 1989.

Chapter 25

Scientific Attitude amongst Adolescent and Youth

Narottam Sahoo

Science as a pursuit to knowledge always keeps our minds open for truth. Science and technology together offer a tool for socio-economic development. The adolescent and youth can be developed as future scientists and technologists as well as good citizens of tomorrow, if they are able to develop a scientific attitude at the right age and time. Gujarat Science City endeavours towards that.

The 21st century is attributed to be the century of ''wisdom,'' advanced science and technology standards and abundant intellectual property are the principal source of national strengths and the key to sustainable development. As the century begins, natural resources are under increasing pressure, threatening public health and development. Water shortages, soil exhaustion, loss of forests, air and water pollution, and degradation of coastlines affect many areas. As the world's population grows, improving living standards without destroying the environment is a global challenge.

Every year on 11th July, we celebrate World Population Day. It is a world-wide event being coordinated by the United Nations Development Fund (UNFPA). The United Nations first organized World Population Day in 1987 when the population reached 5 billion. About 20 years later, despite great success in expanding access to family planning, the world's population continues to grow by 73 million a year. We are now going to reach a mark of 7.0 billion people living on our planet! That is approximately three and a half times the size of the world's population in 1900 – 1.7 billion.

Today, nearly half of all people on our planet are under the age of 25. Some 1.2 billion people are between the ages of 10 and 19. This includes the largest-ever generation of adolescents who are approaching

Catch them Young !

- The use and meanings of the terms 'young people', 'youth', and 'adolescents' vary in different societies around the world, depending on political, economic and socio-cultural context.
- UNFPA follows the definitions below:
- Adolescents: 10-19 year olds (early adolescence 10-14 and late adolescence 15-19)
- Youth: 15-24 year olds
- Young People: 10-24 year olds

adulthood in a rapidly changing world. This is the age of adolescent. 87% of these adolescents live in developing countries.

Young people are a source of creativity, energy and initiative of dynamism and social renewal. They learn quickly and adapt readily. Given the chance to go to school and find work, they will contribute hugely to economic development and social progress.

A time of learning and exploration

Adolescence is a period of transition from childhood to adulthood marked by (i) perceptible physical, biological and emotional changes, (ii) a need to extend relationships beyond the immediate family, and (iii) a sense of idealism, curiosity and adventure. Adolescents are resilient and resourceful individuals, with their own views and evolving decision-making capacities. It is a time of learning and exploring, and can be a good time to establish healthy attitudes and behaviours for life. For many, it is also a time when job skills may be developed and economic life begins, although often in underpaid, unsafe or exploitative conditions.

India has about one-fifth of the total population as adolescents in the age group of 10-19 years and the numbers are steadily rising. Though they constitute the healthiest segment of our population, they are also most susceptible to peer pressure to risk taking and to substance abuse. At times, they lack parental guidance at other times they lack societal support. By addressing their needs the socio-economic needs of the country in turn, would get addresses and societal concerns such as social harmony, gender justice and population stabilization would also get main streamed.

Understanding adolescents and youth

It is important to enable the younger generation to develop the sense of critical thinking to understand boundaries that may be physical or emotional, within relationship. Everybody should make adolescents comfortable while sharing their concerns with others. By developing the negotiation skills of adolescents not only to resist negative peer pressure but also to influence others to be involved in constructive action and positive behavior.

As adolescence is a transition from childhood to adulthood, the physical and emotional changes of this crucial period should be understood properly. Attempts

Youth Power!

- Half of the world's people are under the age of 25. Some three billion children and young people are, or will soon be, of reproductive age.
- Universal access to reproductive health, including family planning, is the starting point for a better future for the 1.5 billion young people (ages 20 to 24) who live in developing countries.

to be made to develop a scientific attitude and thinking to remove myths and misconceptions.

According to the latest projections, world population is increasing at the rate of two-and-half human beings per second, which means 150 per minute or 200,000 per day. That means that the world is adding 80 million people – or the population of Germany – to its stock every day.

Youth and the millennium development goals

Considering the importance of the world scenario, the United Nations has rightly put forward the focus fairly and squarely on adolescents and youth, since the world's fate will depend on their reproductive behaviour. Accordingly, the UNFPA has envisaged a specific vision of a world fit for young people. It is a world that promotes and protects their rights, provides opportunities to develop their full potential, welcomes and respects their voices and views, and where they live free of poverty, discrimination and violence. In such a world, young people possess the knowledge and skills required to make informed, voluntary and responsible life choices, including decisions about sexual and reproductive health.

The brief features of the Millennium Development Goals (MDG) are as follows:

- In 57 developing countries, over 40 per cent of the population is under 15.
- Despite a shift toward later marriage in many parts of the world, 82 million girls in developing countries who are now aged 10 to 17 will be married before their 18th birthday.
- About 57 million young men and 96 million young women aged 15-24 in developing countries cannot read or write.
- Half of all new HIV infections occur among young people—6,000 every day, and young women are disproportionately affected.
- Data from UNFPA site

MDG 1 Eradicate extreme poverty and hunger:

To reduce by half the proportion of people living on less than a dollar a day and those suffering from hunger. Applying the poverty line of $1 a day to young people, it is estimated that one in four young people in developing countries are living in extreme poverty. So, if we want to be effective in reducing poverty, we have to focus on youth. With regard to reducing hunger, it makes sense to focus on the many young women who are malnourished and anemic, and whose nutritional status may also affect their children.

MDG 2 Achieve universal primary education:

To ensure that all girls and boys complete primary schooling. There are significant numbers of youth who do not know how to read or write, and another major portion

of the children who do not go to school. And there are also another segment of children who, due to a variety of reasons, will be forced to leave school before having learned to read and write. Education – especially completion of secondary school – can help young women break out of poverty, in part because it often leads to smaller families. In countries with high population growth rates, for every extra year that girls spend in school, fertility rates drop by 5 to 10 per cent.

MDG 3 Promote gender equality and empower women:

Eliminate gender disparity in primary and secondary education. Two-thirds of the world's illiterate people are women, and the employment rate for women is only two-thirds of that of men. Studies shows the many benefits of investing in girls' education. And social change needs to start with the young, who are generally more amenable to changes in social norms than persons who are older and more set in their ways. This goal requires an end to discrimination and violence against women and girls, with changes in attitudes, behaviours, policies and laws.

MDG 4 Reduce child mortality:

To reduce by two-thirds the mortality rate among children under five. There are 30,000 children worldwide who die daily from preventable illnesses, or ten million children every year. An infant or young child often depends on a mother for survival, facing much higher risks without her. Obstetric fistula, a childbirth injury from obstructed labour, is more of a risk for very young mothers and can result in the death of the baby. Education, especially for girls and mothers, saves children's lives.

MDG 5 Improve maternal health:

To reduce by three-quarters the maternal mortality rate. Every year, more than 500,000 women die in pregnancy and childbirth, while an estimated thirty times that number suffer from pregnancy-related complications. One in ten births worldwide is to a teenage mother (one in six in the poorest countries), and childbirth is the leading cause of death for young women aged 15 to 19. The percentage of births to women under 20 years of age in the least developed countries is double that of the developed countries. And this puts their lives and those of their babies at risk. Reducing maternal and infant mortality requires universal access to reproductive health and rights. This is particularly important for young women, who currently face the highest risk and yet have the least access to reproductive health information and services.

MDG 6 Combat HIV/AIDS, malaria and other diseases:

To halt and begin to reverse the spread of HIV/AIDS, malaria and other major diseases. Half of all new HIV infections occur among young people – 6,000

young people aged 15 to 24 every day. HIV infection is increasing faster among young women than any other group. Most young people do not know if they are infected, how HIV is transmitted or how to prevent it. This is the generation that has never known a world without AIDS. We will never reverse the pandemic unless young people have the information and services they need. With no cure in sight, our first line of defense remains prevention.

MDG 7 Ensure environmental sustainability:

To integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources. There are 1.2 billion people worldwide who lack access to safe drinking water, and 2.4 billion who lack access to toilets. These environmental problems not only affect young people today but will have severe implications for their futures.

MDG 8 Achieve a global partnership for development:

In cooperation with developing countries, to create decent and productive work for youth. Each year, 100 million youth enter the global workforce. The lack of productive work for young people perpetuates poverty and is associated with high levels of crime, substance abuse, conflict and the rise of political extremism. This highlights the links between development and peace and security. For a majority of young people, economic life begins in the adolescent years, but unemployment is high for this group. Currently, half of the world's unemployed are under the age of 24. Enhancing skills, especially of the poorest, and especially for girls, can translate into better jobs and better pay – which means a better chance to escape poverty.

Towards a livable future

How people preserve or abuse the environment could largely determine whether living standards improve or deteriorate. Growing human numbers, urban expansion, and resource exploitation do not bode well for the future. Without practicing sustainable development, humanity faces a deteriorating environment and may even invite ecological disaster.

Taking action: Many steps toward sustainability can be taken today. These include using energy more efficiently; managing cities better; phasing out subsidies that encourage waste; managing water resources and protecting freshwater sources; harvesting forest products rather than destroying forests; preserving arable land and increasing food production through a second Green Revolution; managing coastal zones and ocean fisheries; protecting biodiversity hotspots; and adopting an international convention on climate change.

Stabilizing population: While population growth has slowed, the absolute number of people continues to increase—by about 1 billion every 13 years. Slowing population growth would help improve living standards and would

buy time to protect natural resources. In the long run, to sustain higher living standards, world population size must stabilize.

Scientific attitude

The Gujarat Science City is taking a bold step for capturing new heights in science literacy in the State. The aim is to inculcate scientific temper to explore the wonder world of science and technology for societal development. The basic understanding in science and an attitude towards scientific thinking not only educate the adolescents and the youth, but also empower them to be a change maker in the society.

Young people tend to have higher levels of educational attainment than in the past, but they also require better education and more skills to compete in today's world, and overcome social exclusion and poverty.

Adolescents and Youth need to develop positive assets and skills in decision-making, problem solving, communications, conflict resolution, citizenship, and leadership. The more assets and life skills youth possess, the more likely they are to become caring, contributing, and competent citizens. Youth also need to develop relationships with supportive and caring adults. The seminar on understanding Adolescence may discuss the following points on developing scientific temper among younger generation to achieve the objectives of the millennium development goal.

1. Scientific knowledge can eradicate superstition and irrational views about the universe.
2. An understanding the basis of modern technology brings better economic returns and promotes sound societal development.
3. Some knowledge in science will enable the young people to make better decisions in policy making.
4. The behaviours will improve if consequences are known and finally familiarity with the scientific knowledge will lead to a more ethical worldview.
5. The future health of scientific understanding appears to rests on the knowledge that science is interrelated with our culture, with our curiosity about physical and biological environment and with the realization that understanding of science can lead to an enriched life.

Furthermore, in order to realize these objectives, appropriate Youth Policy needs to be outlined in a planned approach to prioritize scientific outlook, centered upon strategic promotion of research and development, as well as reform in the formal education system. Necessary support mechanisms has to be identified for capacity building at the institution level – development of the culture, strategies, structures, skills, support mechanisms and policies required to deal with youth development commensurate with research in science and technology to support these young minds with an opportunity to make them conscious and informed future decision makers.

Chapter 26

Brazil, Science, Technology: Some Dilemmas and Challenges

Hernan Chaimovich

The importance of the options that will be made in the field of science and technology for the development of Brazil is evident today. But the scope of this essay requires that I choose certain aspects of such a vast theme. Therefore, I chose to concisely describe some organizational dilemmas, instead of dealing with internal challenges to science and technology. One of these involves how to balance the scientist's freedom and society's need for knowledge; another is the tension between the individual pleasures of creation and the objective conditions of the structure wherein the scientist works. I will also consider alternatives between a centralized generation of science and technology, and regional imbalances. And I hope to propound alternative funding sources and examine the challenges that derive from the ongoing conflicts between public and private dimensions. Furthermore, it would be difficult to conceive this subject without analyzing the current relationship between science, technology and innovation. Lastly, although the ethical dilemmas of science pervade all the above issues, they are quite another matter and will not be dealt with here.

At this moment in time, when globalization is presented as inevitable even as its meaning or meanings remain unclear, writing about the challenges to science and technology in Brazil implies clarifying the alternatives that may be borne bout by recent history.

Since the Industrial Revolution, the evolvement of science has been inseparable from its applications in the developed world. The boom in science financing in the United States after Sputnik was launched is a classic example. In the late 1950s, political needs determined massive investment in science at all levels, from secondary schools to research centers, from universities to corporations. The State's procurement might, in what was the world's most capitalist country, enabled the military/ industrial complex to exert a growing pressure on research organizations, which then expand to cover every field of knowledge. The result of such State-funded pressure was soon felt and the United States, both qualitatively and quantitatively, became the foremost center for the production of knowledge, technology and products in the ensuing decade. The Japanese interlude, as well as the short dance of the Asian tigers, without the sustenance of a corresponding

knowledge base, were ephemeral and never actually threatened the actual supremacy of the United States.

In times of globalization, it also becomes clear all over the world that the State's procurement power plays a leading role in those areas where social needs are marked by public interventions. Health, education and security, among others, continue to be, even in Brazil, areas where the public sector is fundamental. The interrelationship between the State's procurement power and scientific/technological development is clear in the developed countries. Brazil's adoption of this relationship might become a determining factor for the future of our science/technology and innovation systems – and, consequently, for our development. Changing the State's procurement power into a tool for scientific and technological development is a possible but not assured decision, given the existing pressures to reduce the presence of the State. The regulatory nature of the State in several areas does not diminish its power to procure, while in others it is precisely the State's procurement power that determines market sizes and relationships. As has happened elsewhere, technological development and the basic science associated with these technologies could be enhanced if the State decided to exercise its procurement power.

In the developed countries, the means to sustain the science-producing system extend from areas that are directly related to applications to others that apparently bear no relation whatsoever. The increased density of the "frontier" areas, often defined as those closest to an application, has enabled the entire extent of science to expand continuously in countries where science is duly applied. And applications may appear from where one least expects them. Who could have foreseen, for instance, that the observation of lotus leaves under a scanning electron microscope would lead to paints that, once applied, result in self-cleaning cars?[1]

In the developed countries, the results of this pressure to innovate extend from private interests to the State's procurement power. Particularly in recent times, this pressure has engendered a science-producing structure whose thematic density varies in time but, on average, grows inexorably.

And Brazil? Of course, evolution here is different. In this tropical country, whose very name derives from a tree, the export of brazilwood for dye extraction was not followed by a greater understanding of dyes or of how to conserve the trees that produced it.

In Brazil, the organized production of science is a fairly recent event. To be sure, we have always had scientists and some major discoveries were made here. But how does one organize science if the Portuguese Crown avoided at all costs the establishment of universities in her colony? Where might scientists gather to exchange ideas if the Brazilian Academy of Sciences was founded less than eighty years ago? Some of our public research institutes, older than the universities, have had spurts of scientific creation and precious applications, followed by long

[1] Barthlott W. and C. Neinhuis. "Purity of the Sacred Lotus or Escape from Contamination in Biological Interfaces", Planta 202, nº 1, 1997. See also www.botanik.uni-bonn.de/system/ bionics.htm.

periods in dire straits. The history of the professionalization of science in Brazil into a stable structure began with the founding of the University of São Paulo in 1934, introducing the concept of full-time dedication for faculty and researchers, which soon spread throughout Brazil. Because, as the saying goes, "everything planted here grows" the result of this seedling was possibly one of the most successful public initiatives of the last thirty years.

To analyze the recent evolution of science in Brazil, I have resorted to a system of organizing scientific information that compiles titles and summaries of works published in international journals: the Institute for Scientific Information (ISI). The use of this database has been sufficiently discussed and I will not attempt to justify it here[2].

Patents, which are an indicator of innovation, now increasingly display on their title page references to the same works indexed at the ISI. In more technologically active areas, the number of indexed scientific publications is becoming similar to the number of references to other patents – not to mention that these references have a strong national bias, that is, one country's patents tend to mention scientists from the same country more frequently than from other countries. Thus falls another myth, that countries that do not produce science may innovate with the science of others.[3] One of our most glaring challenges is a joint effort by universities, companies and government to assure that Brazil's modest contribution to patents will grow at rates comparable to the production of science, without impairing the different nature of each partner.

Brazil's contribution to indexed science has increased from 0.4% in 1990 to more than 1.2% in 1999. This ten-year increase reflects deliberate decisions that have more to do with funding science and postgraduate courses than with a corresponding increase in per capita GDP. Few countries in the world made this leap – a result of decisions and not determinist changes in per capita GDP in this part of the continent. Comparative data for some Latin American countries suggest this is a sustainable assertion. See Figure 1.

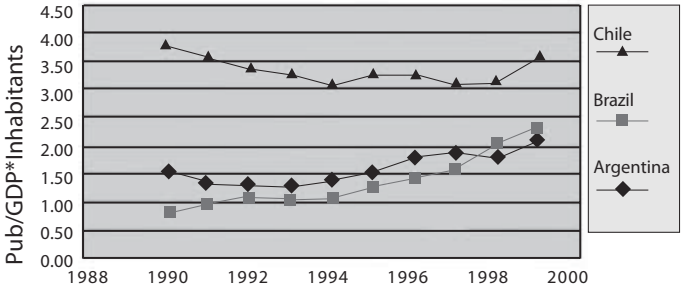


Fig. 1. Data showing sustainable assertion
Source: ISI and InterAmerican Development Bank

[2] Meis, L. de, and J. Leta. O Perfil da Ciência Brasileira, Rio de Janeiro, Ed. UFRJ, 1996, p. 104.

[3] Narin e Olivastro, Hamilton. Research Policy, 26, 317, 1997.

In Brazil, the ratio between number of publications, per capita GDP and total population has increased significantly over the last decade, notwithstanding the fact that the growth of Brazil's per capita GDP was the lowest in the period. The growth of per capita GDP during this period in Chile, Argentina and Brazil was 56%, 36% and 8%, respectively, according to the InterAmerican Development Bank. Using the same ratios, the rate of scientific production in the United States in 1999 was 5.89, and its per capita GDP ten times that of Brazil.

Thus, after adjusting the number of Brazilian scientific publications to the growth of the population, and even if our economic performance in the decade was poor when measured by per capita wealth, the performance of the small segment of the population that produced science deserves mention. The participating of public universities in the national development effort cannot be overstressed, notwithstanding the current fancy of stubbornly insisting on the bankruptcy of every public service. In Brazil, practically all production of science takes place in public universities, where undergraduate admissions remain stable but graduate and postgraduate courses are expanding. The expansion of higher education, which today embraces more than 2 million students, occurs mainly in a private system that contributes little to the national production of science and technology.

Thus, the central issue is the sustainability and growth potential of this hard fact. Consequently, decisions must be made to assure the sustainability. Or, alternatively, we must become aware that other decisions may quickly deter this spectacular growth. Such matters must be considered in the light of social convenience, and not merely as something that arises from the dynamics of the production of science.

We are sufficiently aware that, one, science and technology do not promote socially equitable development and that, two, no development is possible nowadays without an adequate science and technology system. Thus, when considering the need to consolidate our science and technology system, we must not go as far as believing that it is the system that determines development. There is no sustainable future if a country's science system is not related to its innovation system – adding value to export products, solving the serious income distribution problems and providing access to health services.

All over the world, the most significant funding source for science systems is the government. Basic science is developed almost entirely in universities and research institutes. In spite of all that has been said about the importance of private financing of basic science, all available data in the world show that this subsystem is overwhelmingly financed by public funds. Some areas may be temporarily more benefited than others in terms of funds for basic science development, but the system depends on harmonious financing that must essentially cover all fields of knowledge. Political decisions concerning this line of funding derive from an understanding by the State of the correlation between the production of basic science and the other systems that contribute to socially equitable development.

It is well known that science cannot be planned; however, investment in science must be planned4. The dilemma between the individual will of scientists (workbench) and the need to invest in priority areas (program) is a longstanding concern. The recent history of FAPESP shows how this dilemma may be solved in practice. The recent increase in the significance of FAPESP's programs has not inhibited, nor diminished, the balcony. Quality assessment is a common referential for the workbenches and for the programs.

The challenge, however, is extending this policy to Brazil as a whole. When the long-awaited Sectorial Funds finally emerge to finance specific research fields with new public resources, it is essential to continue funding the individual initiatives of researchers in every field of knowledge. Every federal funding agency must be aware that the workbench/program equilibrium must not entail workbench financing only for projects with a high probability of success. We would then run the risk of abating the central component of creation in science, namely, the quest for the truly unknown. In this sense, an additional challenge in planning science investments is to determine which undeveloped areas are avowedly a hindrance to the development of science itself – increasingly interdisciplinary nowadays. An example is the acknowledgement that the post-genomic age is entirely dependent on the development of so-called bioinformatics.

In Brazil, considering that the generation of science and most technological development takes place in public universities, access to higher education and the preservation of the research structure are a particularly crucial challenge today. The number of graduates in the secondary school system increases much quicker than the number of openings in the current university system. Thus, the dilemma also comprises the challenge of increasing the number of students admitted to institutions of higher learning. However, increasing the number of enrolled students in public universities without expanding the faculties and the infrastructure may destabilize the entire production of science in Brazil.

To face this dilemma, we must consider that perhaps not all higher teaching should necessarily take place in research universities. Without going into technological details, including distance learning, an bird's-eye view of the world will show us that in every country where more than 50% of 17- to 25-year old population is enrolled in institutions of higher learning (in Brazil the figure is 11%) the system is highly differentiated, i.e., we find the coexistence of research universities, universities that don't grant doctoral degrees, professional establishments, junior colleges, postsecondary technical schools and a wide variety of forms and structures of learning

One of the cultural characteristics of our milieu is the reproduction of a single form of teaching, the university, wherein the relationship between teaching and research, more than an organizational trait, is a way of responding to laws that, formally, should be obeyed. Public universities will be hard put to survive as producers of knowledge if the higher education system in Brazil is not differentiated, if the number of student admissions does not increase and if there

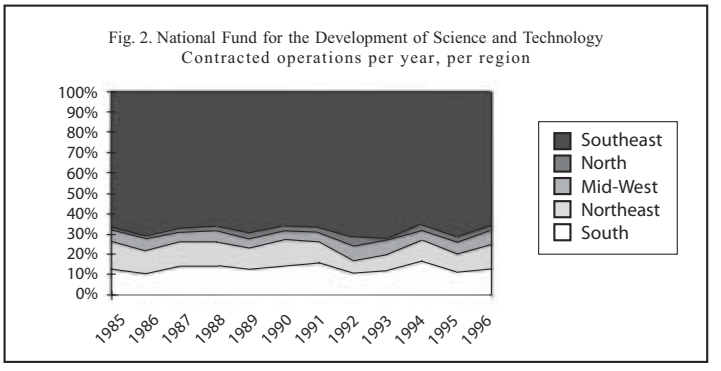
is no massive investment in personnel and infrastructure. As we are unlikely to see public investments of such magnitude, this dilemma might only be solved by differentiating the higher education system. Of course, the public sector is likewise responsible for this initiative, inasmuch as the expansion of the private system has resulted in organizations that, although formally replicating the public universities, lack the ability, or the interest, to provide alternatives. Thus, it is possible that with investments commensurate with our current situation, the creation of a differentiated system of public higher learning will result in more and better educated youths, in the consolidation of the research universities and – why not? – in the private sector providing alternative forms of post-secondary education.

Other dilemmas concern the structure of public research universities and the geographic concentration of knowledge production in Brazil.

The swift changes in society and in the systems of production, the growing urbanization, the deterioration of the social fabric in Brazil, the increasing concentration of income and the dissemination of violence have placed greater demands on the public research universities. The growing clamor for knowledge, transparency of the social impact of investments, and alternatives to public policies deriving from academic analyses is incompatible with the current structure of public universities in Brazil.

The structure of research universities in developed countries has evolved alongside with changes in the social clamor for knowledge. In Brazil, structural changes in public universities were not determined by any kind of structural adjustment to social changes. Therefore, the challenge consists in reconciling the multiple social pressures upon the research university with the preservation of a knowledge-producing academic structure that, while having the world as reference, remains focused on Brazil. This accommodation must include an analysis of how generic concepts – such as equality under the law and power – relate to this type of focus. While the academic dignity of everyone must be maintained as a fundamental principle, in practice personal and institutional objectives must be taken into account if they attain the assented goals of social impact. Such acknowledgement may dispense with equal treatment under the law. Power and the structures of power should be adjusted to stimulate the development of collective academic competence and the transference of knowledge thus acquired

The dramatic regional disparities in the production of knowledge are one of the core challenges when one examines the situation of science and technology in Brazil. Although abundantly well-known, due to a weakness in my upbringing I cannot resist the temptation of presenting a graph that illustrates this disparity. See Figure 2.



Source: Ministry of Science and Technology

Reiterating, as public universities are largely responsible for the production of the knowledge that derives from investment in science and technology, it is within these institutions that the decisions to change must be considered. To be sure, a region-by-region analysis is an oversimplification, and may even be misguiding, because each region has centers that produce knowledge of comparable quality to that of anywhere else in the world. Nevertheless, the overall disparity persists. And as has been demonstrated in the state of São Paulo, the existence of research-producing public universities can lead to changes in the chains of production and result in improvements in the quality of life.

I believe we have no other alternative but to assuage regional disparities, taking local vocations into account. This challenge certainly involves providing an adequate structure for public universities, but we must also assess the reasons for the failure of so many initiatives that attempted to reduce regional differences. A determining factor in failed past initiatives was a disregard for basic rules that indicate that academic quality is essential for the absorption of investments. It must also be stressed that if scientists do not participate in managing priorities, investments are rarely, if ever, successful. The existence of competitive fields of knowledge in a region with a low-density generation of science shows the correlation between faculty involvement in decision-making and the success of the change. By choosing physics and chemistry at the Federal University of Pernambuco as example, I had to discard many others – but any analysis will confirm this assertion. The challenge consists in harmonizing this awareness with career and power structures in federal universities that often deprive the academy of the power to make major decisions. The success of such investments, which have already been earmarked for the region by the Ministry of Science and Technology's new Sectorial Funds, depends overwhelmingly on detailing this type of reflection.

Today, the distance between basic science, technology and innovation is uniquely related to the product. If we accept that innovation is something that takes place in a business firm, the requisite prior technological development may, or may

not, have occurred in that company. As this issue is somewhat diversified, I will limit myself to providing an example. The sequence of certain genes (an element of basic science) may lead to the almost immediate launching of new methods for diagnosis, inasmuch as the passage from a datum of basic science (the sequence) to the product (the diagnosis kit) requires the incorporation of several well-known technologies – product manufacturing, product operation, marketing strategies, distribution. The introduction of a new drug, on the other hand, traverses a much longer path from the discovery (basic science) and the invention (usable drug), requiring the creation of new technologies and massive investment. It is the chain of production, not knowledge, that determines the option for public investment in technology and innovation. The limits of public investment for research in universities – and, therefore, the separation of knowledge (public) and innovation – imply challenges that, being dependent on the chain of production, have to be thoroughly discussed with the universities to define investment policies.

While the production of science and technology in universities fulfilled the dual role of cultural resistance and tool for personnel development, the structure of the university bore little relation with the needs of the groups responsible for this production. But today's multiple challenges – including, among other healthy pressures, the social use of knowledge, the increase in the number of university admissions, multiple relationships with the systems of production, and the deconcentration of the production of knowledge – require structural adjustments, particularly in the research universities, in order to face up to the demands and establish structural relationships that are compatible with explicit missions. In Brazil, for the system of production of science and technology in public universities to have a more central role in the country's socially equitable development, the requisite funding and planning decisions must include the academy as a significant and irreplaceable player.

Societal Perspective

Chapter 27

Trends in Growth and Financing of Higher Education in India

Ved Prakash

Abstract The Indian higher education system is presently facing several challenges. The challenge of global competitiveness has been added to other demanding tasks such as access, equity, relevance, quality, privatisation and internationalisation in the face of a resource crunch. This article gives an overview of trends in the expansion of higher education and examines variations in participation across states, gender and social groups. An attempt has also been made to discuss the trends in the financing of higher education and the required resources to meet the target of allocating 6 per cent of the GDP to education. It argues that without appropriate policy interventions in school education, it would be of little use to have interventions at the higher educational level, which discriminate in favour of girls, SCs and STs.

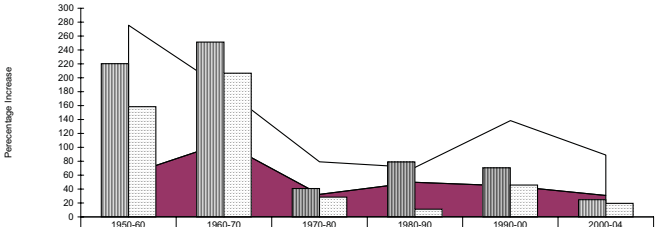
Introduction

Awell developed and equitable system of higher education that promotes quality learning as a consequence of both teaching and research is central for success in the emerging knowledge economy. It is widely acknowledged that education contributes significantly to economic development. The developed world understood much earlier the fact that individuals with higher education have an edge over their counterparts. They are the ones who always believed that any amount of investment in higher education was justifiable. It is, therefore, imperative for developing countries too, to give due importance to both the quantitative and qualitative expansion of higher education. From 1950 to the late 1980s, the planning strategy in India was geared towards ensuring distributive justice, balanced regional growth and positive discrimination in favour of disadvantaged sections. However, with the adoption of new economic policies, since the early 1990s, the development approach has taken an about-turn with the enhanced role of the private sector and the diminishing role of the state. Such an approach appears to be threatening the goals of social justice, equity and cultural diversity. In the recent past, the growth trends in higher education seem to have found favour with those courses of study that have high economic payoffs.

The participation of the private sector has resulted in the truncated growth of higher education. Besides, the implicit policy pursued by both central and state governments since the mid-1990s to promote school education at the cost of higher education has almost put the brakes on the expansion of public institutions. Such a policy has serious implications for making even existing institutions internationally competitive. Indian higher education system is, indeed, facing several challenges like access, equity, relevance and quality. Even after significant expansion in the post-independence period, access to higher education in India continues to be poor and more so for the disadvantaged groups. Unfortunately, the country has no comprehensive database to help assess the response of the higher education system to the impact of globalisation in the last one and a half decades. The present paper makes a modest attempt to discuss the trends in the growth and financing of higher education, besides highlighting some important issues regarding development of higher education in India. Given the limitations in available data, the paper gives an overview of trends in the expansion of higher education, and also attempts to examine variations in the participation in higher education across states, gender and social groups. An attempt has also been made to discuss trends in the financing of higher education and the resources required to meet the target of allocating 6 per cent of GDP to education. In the end the paper offers certain suggestions on critical development issues such as access, equity, quality, financing, privatisation, internationalisation and the need for creating a comprehensive database.

Growth trends

In ancient times, Indian universities like Nalanda, Taxila and Vikramsila were renowned seats of higher learning, attracting students from far and wide including countries such as Korea, China, Burma, Ceylon, Tibet and Nepal (Khemani et al 2006). During the colonial era, the rulers consciously did not use education for sustainable development. The first three universities were set up in the presidency towns of Bombay, Calcutta, and Madras in 1857. It took them another 30 years to set up the fourth university at Allahabad in 1887 and yet another 29 years to establish the fifth and sixth universities at Mysore and Benaras in 1916. These universities were established on the pattern of the University of London, thus, they were basically affiliating, examining and regulating bodies. The existing colleges engaged in teaching and learning were affiliated to these universities. For several decades, only colleges continued to offer the degree courses. It took a long time before post-graduate teaching and research departments began to be established at the university level around 1920.



	1950-60	1960-70	1970-80	1980-90	1990-00	2000-04
Colleges	214.71	77.41	46.82	21.32	93.91	58.13
Universities	60.71	106.67	32.26	49.59	44.57	30.83
Teachers	158.33	206.45	28.42	11.07	45.76	19.49
Enrolment	220.11	251.17	40.7	78.96	70.54	24.79

Fig. 1. Decadal increase# (in per cent) in the Number of Universities, Colleges, Enrolment and Teachers at Higher Education Level, 1950-51 to 2004-05

Note: # Refers to percentage increase in the previous decade, i e, between 1950-51 and 1960-61 and so on. Source: Table 1.

Since independence, the number of colleges and universities has registered a significant hike. From 1950-51 to 2004-05, while the number of universities has increased from 28 to 348, the number of colleges has gone up from 578 to 17,625. During this period, enrolment in higher education has registered a steep hike, from around 0.174 million to 10.48 million. The number of teachers has also gone up from around 24,000 in 1950-51 to 4,72,000 in 2004-05. It is evident from data that during this period, universities and colleges in the country have grown at an average annual growth rate of 4.94 per cent and 6.66 per cent respectively.

Table 1: All-India Growth of Institutions, Enrolment and Teaching Faculty at Higher Education Level, 1950-51 to 2004-05

Year	Universities*	Colleges	Enrolment@ ('000)	Teachers@ ('000)
1950-51	28	578	174	24
1960-61	45	1,819	557	62
1970-71	93	3,227	1,956	190
1980-81	123	4,738	2,752	244
1990-91	184	5,748	4,925	271
2000-01	266	11,146	8,399	395
2004-05#	348	17,625	10,481	472

Notes: * Universities include central, state, private and deemed to be universities as also institutions of national importance established both by the central and state governments. # Estimated.

Sources: P Agarwal (2006). @ Annual Reports of the UGC, various years.

As on March 31, 2006, the country had 20 central universities, 217 state universities, 102 deemed to be universities, 10 private universities, 13 institutions of national importance and five institutions established under the State Legislature

Act (UGC 2006). It is evident from the available data that within a span of four years beginning March 2002, while the number of central and state universities has grown by 11 per cent and 22 per cent respectively, the deemed universities have grown by 96 per cent. Besides, for the first time, 10 private universities have come into being during this period.

The decadal growth in the number of universities and institutions was much higher in the 1950s and 1960s, primarily because of the relatively small number of such institutions existing, since planned expansion of higher education began after independence. In the 1970s and 1980s, growth of institutions of higher learning was relatively slow, it picked up in the 1990s onwards (Figure 1). This has happened because of increased demand for higher education and participation of the private sector, particularly in technical and professional education.

This rapid expansion, however, hides the story of the stark inequality that prevails in access to higher education across states and union territories. While higher education institutions are nearly absent in Dadra and Nagar Haveli and Lakshadweep, 14 states and union territories have much higher levels of access to higher education compared to the national average (12.17) in terms of the number of institutions available per lakh population in the age group 18-23 in 2003-04. While Pondicherry has around 27, West Bengal has the lowest level of access with only around five institutions per lakh population in 2003-04 (GoI 2006) (Figure 2).

Access to engineering and technical colleges is relatively high in Andhra Pradesh (2.59 institutions per lakh population in the age group 18-23) followed by Goa (2.34), Karnataka (1.86), Kerala (1.81), Chandigarh (1.59), Maharashtra (1.56), Sikkim (1.41) and Tamil Nadu (1.27) (GoI 2006) These states and union territories also have high concentration of medical colleges per lakh population. It may be pertinent to mention that such an indicator is a crude one, for access to higher and professional education is largely determined by household demand and the learning ability of individual students. Nevertheless, looking from the supply side, this indicator provides a fair understanding of the spatial distribution of opportunities.

The Indian higher education system is the largest in the world in terms of the number of institutions. India has 17,973 institutions of higher learning as compared to around 2,500 in China. The number of institutions in India is more than four times the total number of institutions both in the US and Europe. The Chinese higher education system is the largest in the world in terms of enrolment, which caters to nearly 23 million students followed by the US and India. However, the average size of an Indian higher education institution in terms of enrolment is much smaller (500-600) compared to that of Europe and US (3,000- 4,000) and China (8,000-9,000) (Agarwal 2006:5). It is estimated that even after having the largest number of higher education institutions, India needs at least 3,000 more universities each having the capacity to enrol not less than 10,000 students to meet the increasing demand for higher learning (Bhargava 2006).

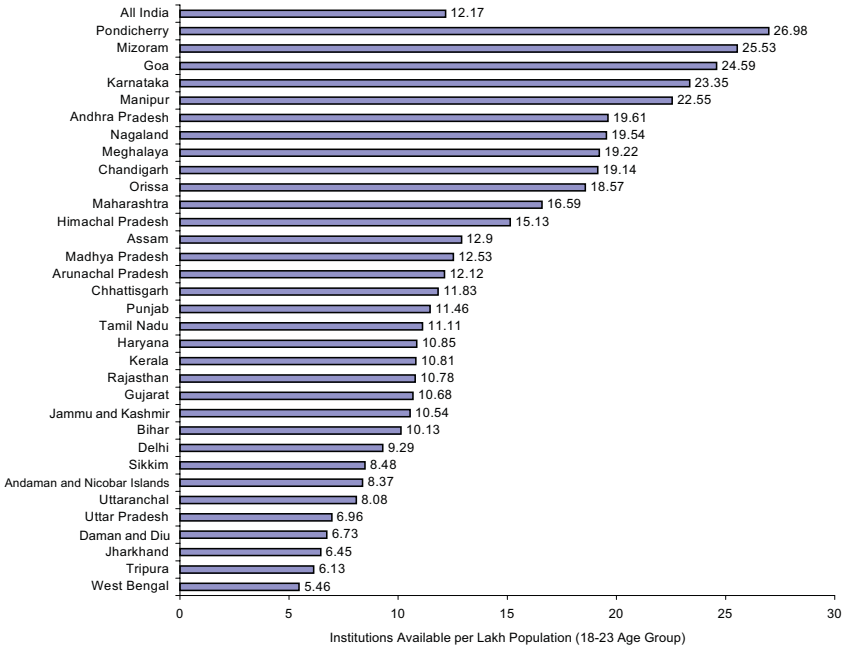


Fig. 2: Number of Higher Education Institutions Available per Lakh Population (18-23 years) in States and Union Territories, 2003-04

Source: GoI (2006), Selected Educational Statistics, 2003-04.

Growth trends in enrolment

The total enrolment in the higher education system (excluding distance education) has increased from 0.17 million in 1950-51 to 10.48 million in 2004-05 (Table 1). During the period 1950- 51 and 2004-05, while total enrolment at higher education level has increased at an average annual growth rate of 8.04 per cent, the growth rate in the total number of teachers has been 5.78 per cent. Nearly 87 per cent of students in the higher education system are enrolled in the affiliated colleges. In fact, more than 90 per cent of graduate and 65 per cent of post-graduate students are enrolled in affiliated colleges. It is also revealing that only 0.65 per cent of students in higher education institutions are engaged in research (GoI 2006).

An analysis of growth trends in higher education since 1950- 51 reveals that average annual growth rates of institutions, enrolment and teachers were very high in the 1950s and 1960s partly because of the slender base in 1950-51 and also because of fast expansion of the system (Figure 3). The 1970s saw the lowest growth rate of institutions and enrolment. Thereafter, the average annual growth rate of universities and enrolment saw an increase again from the 1980s; it declined in the 1990s and registered an upward trend after 2000-01. The hike in the average annual growth rate of institutions after 2000-01 could be attributed to the participation of the private sector, particularly in professional education.

The growth rate of teachers was an alltime low (1.1 per cent) in the 1980s, and thereafter, it has been increasing consistently.

There is a broad positive correlation between the Gross Enrolment Rates (GER) at the higher education level and the per capita GDP of a nation (Anandakrishnan 2006). Apart from the differences in the GER among different countries, the enrolment in most of the developed countries is either growing very slowly or is stagnant as compared to the emerging economies like China, Brazil, and Malaysia, where it is growing rapidly. Considering the demand for higher education, the GER in India relative to many of the developed countries is quite low (around 12 per cent) compared to the average of the developing countries (13 per cent), the world (26.7 per cent) and the developed nations (57.7 per cent).

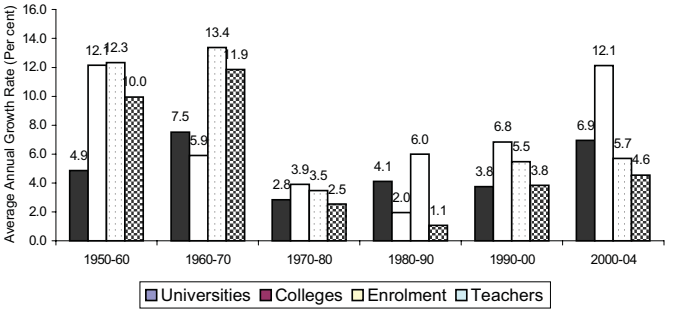


Fig. 3. Average Annual Growth Rate of Higher Education Institutions, Teachers and Enrolment in India, 1950-51 to 2004-05
Source: Estimated on the basis of data given in Table 1.

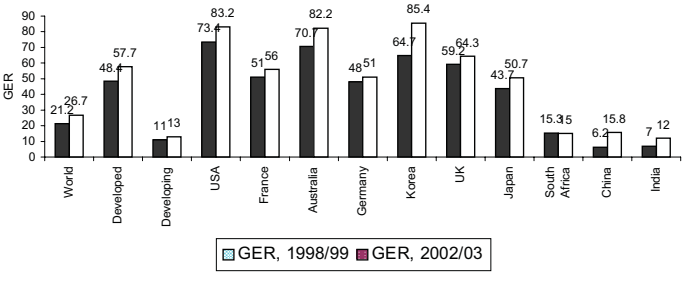


Fig. 4: Gross Enrolment Ratio in Higher Education in Select Countries
Sources: (i) UNESCO (2006), Global Monitoring Report 2006, Paris.
(ii) Agarwal (2006).

Although the overall demand for higher education in India is increasing, there are wide variations in GER across states and UTs (Figure 5). The GER at the higher education level ranges is as low as 4.33 per cent in Nagaland and as high as 28.68 per cent in Chandigarh. The GER is less than 5 per cent in Jammu and Kashmir and Nagaland, less than 7 per cent in Arunachal Pradesh, Tripura and Sikkim and less than 10 per cent in 14 states namely, Andhra Pradesh, Assam, Jharkhand,

Gujarat, Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Mizoram, Orissa, Punjab, Uttar Pradesh and Rajasthan.

Keeping in view the increasing demand for skilled manpower in the emerging knowledge society, the CABE Committee in its report of 2005 has recommended that it would be necessary to provide for a substantial increase in the GER, perhaps in the range of about 20 per cent in the next 15 to 20 years, by doubling the existing capacity. This would also call for provision of specifically targeted interventions in states where the GER is very low.

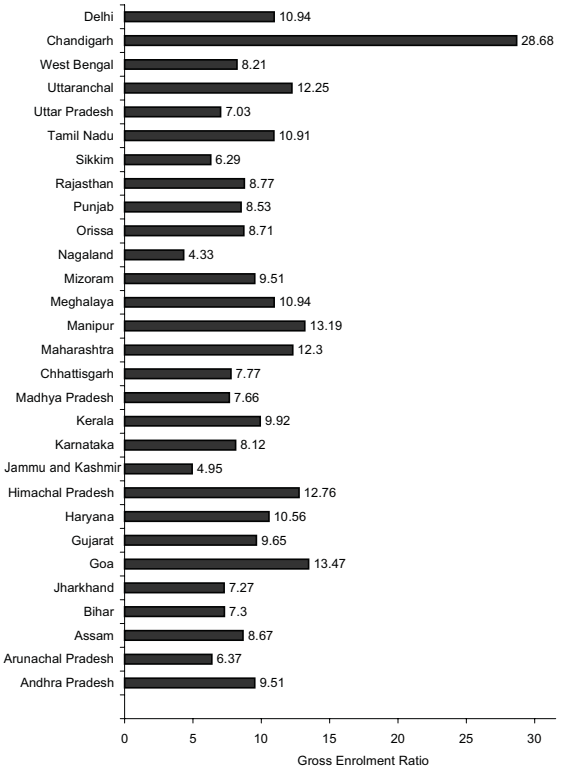


Fig.5. GER in Higher Education in Major States and Union Territories in India, 2002-03 *Source: Anandkrishnan (2004).*

It is important to underline the fact that from the Second to the Sixth Five-Year Plan period, higher education grew reasonably well with increasing attention coupled with rising allocations of public resources. But from the Seventh Five-Year Plan onwards, higher education did not receive the attention it deserved. This resulted in erratic growth of higher education, affecting the access, equity, relevance and excellence. Inequalities in access to higher education by gender, caste and religion increased and inter-institutional variations in quality of higher education became strikingly visible (Tilak 2005)

Table 2: Gross Enrolment Ratio (GER) in Higher Education in Select Countries, 1998-99 to 2002-03

Country	1998-99	1999-2000	2000-01	2001-02	2002-03
India	–	11	11	11	12
Australia	64	63	63	65	74
Canada	59	60	59	58	–
China	6	7	10	13	16
France	51	53	54	54	56
Germany	48	48	49	50	51
UK	59	58	59	64	64
USA	73	70	71	81	83

Source: Agarwal (2006).

Enrolment of girls, SCs and STs

It is evident from Table 3 that four out of ten students in higher education were in the faculty of arts, enrolled for courses in the humanities and social sciences including languages in 2002-03. Nearly two out of 10 students were in science courses. The ratio for commerce has decreased from 21.9 per cent in 1995-96 to 17.99 per cent in 2002-03. On the whole, 84 per cent of total enrolment was in the three faculties namely, arts, science and humanities in 2002-03 while the remaining 16 per cent were in the professional courses. Enrolment in engineering and technology accounted for only 7.5 per cent of the total enrolment. In a country, that depends on agriculture and allied occupations, enrolment in agriculture was just 0.6 per cent and in veterinary science, it was a miniscule, 0.16 per cent (Table 3). It can also be seen in Table 3 that as against 2002-03, there is not much change in the distribution of enrolment across the faculty in 2004-05.

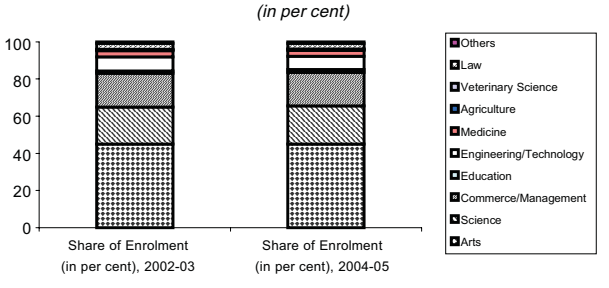


Fig. 6. Faculty-wise Distribution of Enrolment in Higher Education in India, 2002-03 (in per cent)

Source: Table 3.

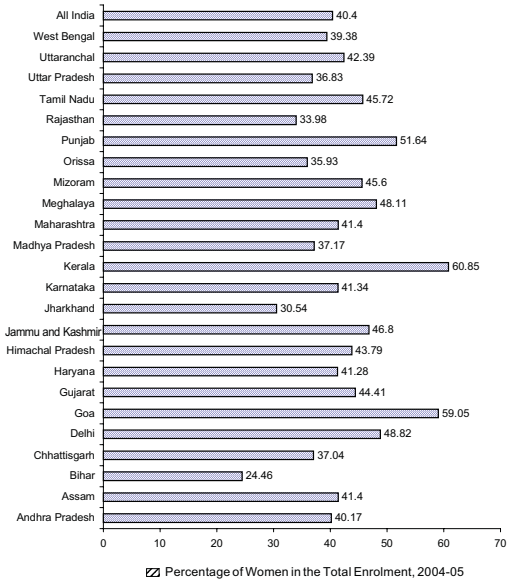


Fig. 7. Percentage Share of Women in Total Enrolment in Higher Education in Major States in India
Source: UGC, Annual Report, 2004-05.

The participation of girls in higher education has been increasing steadily since 1950-51. The share of girls' enrolment in total enrolment rose from 10 per cent in 1950-51 to 40.1 per cent in 2002-03 (Table 4). The participation of girls in engineering courses has gone up to a remarkable degree.

Similar trends are seen in the participation of SCs and STs in different courses during 1990-91 to 2002-03. At present, scheduled castes and scheduled tribes show almost 15 per cent participation in higher education though the distribution is spread unevenly across subjects. Their share in the total enrolment in higher education has been increasing steadily over the years (Table 4). From 8.5 per cent in 1990-91, the share of SC enrolment in total enrolment has increased to 11.3 per cent in 2002-03. STs constituted only 2.1 per cent in the total enrolment in higher education in 1990-91, which went up to 3.6 per cent in 2002- 03. Moreover, wide variations in the share of girls to total enrolment have been found across states and union territories (Figure 7). The participation of girls in higher education is relatively low in Rajasthan, Orissa, West Bengal, Madhya Pradesh, Uttar Pradesh, Jharkhand, Chhattisgarh and Bihar, the traditionally backward states in the country.

Although the participation rates of girls, SCs and STs have been increasing over the years, social and gender disparities still remain subjects of major concern. It may, however, be mentioned that differential access and participation in higher education reflect in turn unequal access to school education in the country. Without appropriate policy interventions in the school education sector, particularly in secondary and senior secondary levels, it would be of little use to

have interventions at the higher education level which positively discriminates against girls, SCs and STs.

Share of private sector

While international trends in the participation of the private sector in higher education throws up a mixed picture, privatisation and commercialisation of higher education in India is a major concern. There is a high participation of private sector in higher education in terms of the share in the total number of institutions in countries like Chile, Japan, South Korea, Malaysia, Brazil, the Philippines, Georgia, Mexico, Thailand and the US. But the share of the private sector enrolment in the total enrolment in higher education is relatively low in Malaysia (39.1 per cent), Georgia (23.8 per cent), Mexico (33.1 per cent), Thailand (19.0 per cent) and the US (23.2 per cent). In China, although private institutions constitute 39.1 per cent of the total number of institutions, their share in the total enrolment is just 8.9 per cent (see Figure 8). It does signify that higher education in these countries is predominantly a public service.

Table 3: Faculty-wise Enrolment in Higher Education in India, 2002-03 and 2004-05

Faculty	enrolment 2002-03	Percentage to Total 2002-03	enrolment 2004-05*	Percentage to Total 2004-05
Arts	41,58,606	45.07	4729048	45.12
Science	18,34,493	19.88	2142325	20.44
Commerce/ management	16,60,238	17.99	1885539	17.99
Education	1,32,572	1.43	154071	1.47
Engineering/ technology	6,92,087	7.50	754635	7.20
Medicine	3,00,669	3.25	330153	3.15
Agriculture	55,367	0.60	61838	0.59
Veterinary science	14,765	0.16	15721	0.15
Law	2,98,291	3.23	319671	3.05
Others	80,745	0.88	88041	0.84
Total	92,27,833	100.00	10481042	100.00

Note: * Estimated.
Source: University Grants Commission, Annual Reports, 2003-04 and 2004-05.

Table 4: Level-wise Share of Girls, SCs and STs in Total Enrolment in Higher Education in India, 1990-91 to 2002-03

Year	PG and PhD	Gradua-tion	BE	BEd	MBBS	Total
A Total Enrolment						
1970-71	136825	1363060	88494	48893	78244	1715516
1980-81	316788	1886428	103195	68250	67822	2442483
1990-91	387684	3285776	241368	92217	84393	4091438
2000-01	692342	7244915	418193	121733	148699	8625882
2002-03	847947	6864812	708643	118593	208465	9516773
B Share of Girls' Enrolment (percent)						
1970-71	25.8	24.4	1.0	37.3	22.4	23.6
1980-81	31.7	27.8	3.6	40.9	24.3	27.5
1990-91	32.2	34.7	10.9	44.2	34.3	33.2
2000-01	36.7	37.4	22.3	42.8	40.6	36.8
2002-03	42.3	42.0	22.6	52.0	41.6	40.1
C Share of Enrolment of SCs (percent)						
1990-91	8.7	8.7	5.7	8.4	8.6	8.5
2000-01	10.1	9.6	8.7	12.3	9.6	9.7
2002-03	11.4	12.0	6.7	13.9	13.2	11.3
D Share of Enrolent of STs (percent)						
1990-91	1.8	2.2	1.1	2.3	0.7	2.1
2000-01	2.6	3.0	3.3	5.3	3.6	3.0
2002-03	2.7	3.7	3.2	5.0	4.9	3.6

Source: GoI 2006.

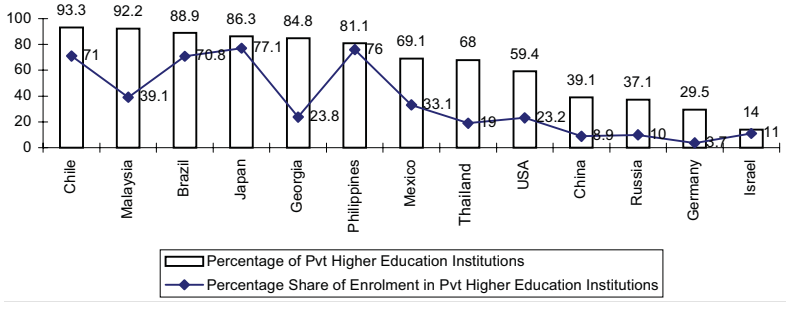


Fig. 8: Share of Private Sector in Higher Education in Select Countries
Source: Programme on Research on Private Higher Education, State University of New York at Albany 2005, available at www.albany.edu/dept/eaps/ prophe/data/ PHOPHEDatasummary.doc

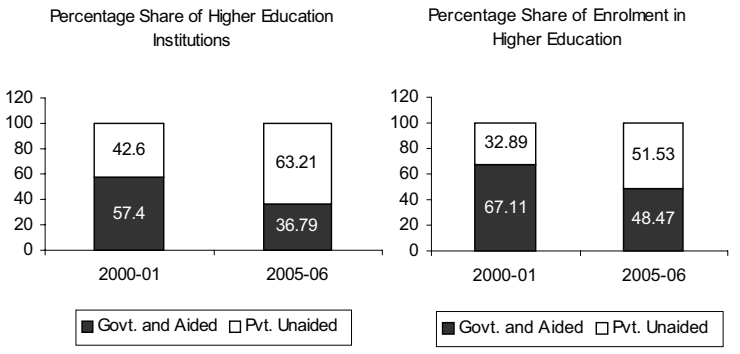


Fig. 9: Share of Private Sector in Higher Education in India
Source: Anandkrishnan (2006).

In India, however, there is an increasing trend both in the number of private higher education institutions and enrolment in recent years. In 2000-01, private unaided institutions constituted 42.6 per cent of the total number of higher education institutions, which increased to 63.21 per cent in 2005-06 (UGC 2006). Similarly, the share of enrolment in private unaided higher education institutions has gone up from 32.89 per cent in 2000-01 to 51.53 per cent in 2005-06 (Figure 9).

As mentioned earlier, given the high demand, the expansion of the higher education system appears to be slow. As financing is one of the critical factors determining the pace of expansion of education of any given level, an analysis of the expenditure patterns on education in general and higher education in particular would provide a better insight.

Trends in financing

Higher education has generally been recognised as a "public good", at least as a "quasi-public good" (CABE 2005: 7). The public good nature of higher education warrants that the state should play a more active role in the financing of higher education.

Indeed, the state has been funding higher education since independence. Early on, it was realised that a strong, self-reliant and modern industrial economy could be built only on the foundations of higher education. However, owing to several factors including the new economic policies adopted since the 1990s, state funding to education in general, and higher education in particular, has been declining in real terms. Further, private institutions, particularly in areas of management, engineering, medicine, computers, etc, have been coming up in large numbers raising issues of access, equity, quality and regulation. The entry of foreign institutions is making it all the more complex. Interestingly, higher education is facing these challenges at a juncture when it is expected to play a greater role in improving the nation's competitiveness in the emerging global knowledge economy.

Public expenditure on higher and technical education

Public expenditure on higher education has increased from a modest level of Rs 171.5 million in 1950-51 to Rs 95,620 million in 2004-05 (budget estimates) by a whopping 550 times. It had a good start during the 1950s with a real growth rate of 7.5 per cent per annum, had a golden period during the 1960s with a real growth rate of 11 per cent per annum but suffered a severe setback during the 1970s with the annual real growth rate declining to 3.4 per cent and recovered somewhat during the 1980s with the annual growth rate improving to 7.3 per cent.

With budgets being tightened and other fiscal problems that both central and state governments are facing, the financing trends have not been favourable to higher education since the 1990s. The public expenditure on higher education increased from Rs 23,120 million in 1990-91 to 95,620 million in 2004-05 (BE) in current prices with an annual growth rate of 12.3 per cent.

Table 5: Budget Expenditure on Higher and Technical Education

Year	Budget Expenditure (Revenue) (Rs Million)		Per Student Expenditure (Rs)		Index (Per Student)
	Current Prices	Constant Prices $	Current Prices	Constant Prices	
General Higher Education					
1990-91	23120	31400	5652	7676	100
1991-92	24440	29170	5636	6727	88
1992-93	27000	29640	6111	6710	87
1993-94	31040	31040	6738	6738	88
1994-95	35250	32170	7329	6687	87
1995-96	38710	32390	6944	5810	76
1996-97	42880	33430	7207	5619	73
1997-98	48590	35500	7793	5693	74
1998-99	61170	41370	9536	6450	84
1999-2000	82480	53710	10683	6956	91
2000-01	91950	57880	10543	6636	86
2001-02	80880	49230	9669	5886	77
2002-03	88600	51790	9310	5442	71

2003-04 RE	93810	53250			
2004-05 BE	95620	51520			
Growth rate# (1990-91 to 2004-05)	12.3	5.4	5.6	-1.5	
Technical Education					
1990-91	7530	10230			
1991-92	8090	9660			
1992-93	9070	9960			
1993-94	10180	10180			
1994-95	11890	10850			
1995-96	12900	10800			
1996-97	14500	11310			
1997-98	13230	11850			
1998-99	20730	14020			
1999-2000	24590	16010			
2000-01	25280	15910			
2001-02	25600	15590			
2002-03	28210	16490			
2003-04 RE	31390	17820			
2004-05 BE	33870	18250			
Growth rate (1990-91 to 2004-05)	12.1	5.2			

Notes: $ National income deflators were used to convert current expenditure into constant expenditure and refer to the year 1993-94.
Growth rates were calculated by fitting semi-log equation.

Sources:(i) Analysis of Budgeted Expenditure on Education, MHRD, various years.
(ii) GoI, Selected Educational Statistics, various years.

Rising inflation, however, makes this increase an illusion. To get a realistic picture, one may have to look at trends in public expenditure adjusted for inflation. After adjusting public expenditure both on higher and technical education for inflation with national income deflators, the annual growth rate turns out to be just 5.4 per cent and 5.2 per cent respectively (Table 5).

Though higher and technical education are on the concurrent list, by and large, financing remains the responsibility of states. The share of the central government has remained around 20 per cent since 1990-91 with a few exceptions in the present decade, wherein it increased to a little over 25 per cent. Much of the central government expenditure on higher education is routed through the University Grants Commission (UGC). It is interesting to note that the disbursement of funds by the UGC is uneven and the bulk of it goes to the central universities and their affiliated colleges and to a few deemed to be universities. A vast majority of universities and other degree awarding institutions are not even eligible to receive any kind of grants from the UGC. In all, only 158 out of 348 universities are eligible to receive grants from the UGC. In addition, the UGC provides general development assistance to a little over 5,000 colleges.

Since 1990-91, the central and state governments are financing the public technical education almost in equal proportion. Much of the central government expenditure (a little over 40 per cent) is understandably goes to Indian Institutes of Technology (IITs). The Indian Institutes of Management (IIMs), Indian Institute of Science (IISc), National Institutes of Technology (NITs), and All India Council for Technical Education (AICTE) each gets around 10 per cent of the total central government grants.

Declining unit costs

At a given level of education, the growing enrolment can also squeeze per unit availability of resources, though per student public expenditure on higher education increased in nominal terms but declined in real prices. For example, per student expenditure increased in current prices from Rs 5,652 in 1990- 91 to Rs 9,310 in 2003-04 (RE); in real prices, it declined from Rs 7,676 to Rs 5,442 during the same period registering a negative growth of 1.5 per cent per annum. In fact, the public expenditure on higher education per student in the 2000s is nearly 30 per cent less than what it was in 1990-91 (Table 5).

Intra-functional allocation

The austerity measures have also distorted the intra-functional allocation of resources in higher education. Since it is not possible to reduce salaries of the existing staff, much of the brunt of economy measures fell on fresh recruitments, books, journals, scholarships, etc. For example, the proportion of scholarships in the public expenditure of states on higher education declined from 0.49 per cent in 1990-91 to 0.24 per cent in 2004-05 (BE). Similarly, in case of technical

education, it declined from 0.45 per cent to 0.20 per cent during the same period (Table 6). The detailed estimates of public expenditure on fresh recruitments, libraries, laboratories, books, journals, consumables are, however, not available.

It is common knowledge that several universities have stopped recruiting faculty and subscribing journals and essential consumables, etc. The CABE Committee (2005a), taking note of the "severe inadequacy of physical facilities" recommended an "operation blackboard like programme" to ensure minimum facilities in public institutions of higher learning (pp 29-30).

Proportion of GNP on education

It is a common practice that the priority accorded to education is gauged with the help of indicators like public allocation as a proportion of GNP and budget. It may be noted that India has committed to allocate 6 per cent of GNP to education long ago. The Education Commission (1964-66) undertook a comprehensive exercise to estimate resource requirements and recommended increasing the allocation of resources to education to at least 6 per cent of GNP by 1986. All subsequent policy pronouncements reiterated this recommendation. Unfortunately, the promise still remains a distant dream.

Table 6: Expenditure on Scholarships in Higher and Technical Education

Year	Higher Education		Technical Education	
	Rs in Million (in Current Prices)	Percentage to Total Expenditure on Higher Education of States	Rs in Million (in Current Prices)	Percentage to Total Expenditure on Technical Education of States
1990-91	113	0.62	20	0.45
1991-92	130	0.67	24	0.48
1992-93	126	0.57	21	0.37
1993-94	134	0.47	57	0.94
1994-95	140	0.44	19	0.26
1995-96	147	0.41	18	0.23
1996-97	171	0.44	63	0.68
1997-98	134	0.30	19	0.19
1998-99	203	0.34	21	0.17
1999-2000	190	0.27	17	0.12
2000-01	153	0.24	36	0.25
2001-02	116	0.16	36	0.28

2002-03	115	0.16	77	0.53
2003-04 RE	191	0.25	71	0.43
2004-05 BE	183	0.24	36	0.20

Note: The expenditure on scholarships shown in the table refers the expenditure incurred by department of education only. It must be noted that much of expenditure on scholarships is incurred by department of social welfare, etc. However, consolidated data on the expenditure on scholarships incurred by other departments are not available.

Source: GoI (various years) Analysis of Budgeted Expenditure on Education, MHRD.

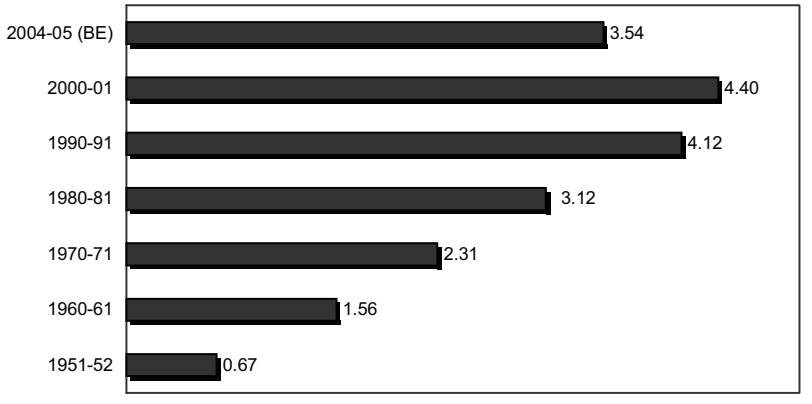


Fig. 10: Expenditure on Education (as Percentage of GDP)

Source: GoI (various years). Analysis of Budgeted Expenditure on Education.

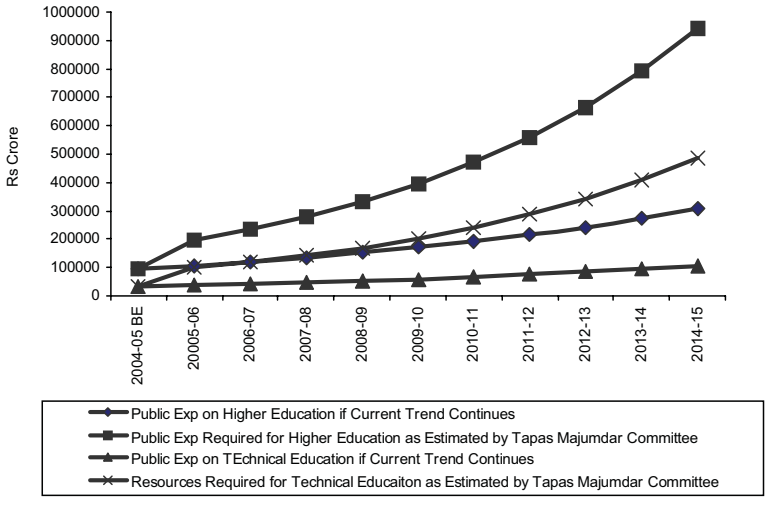


Fig. 11: Resource Gap in Higher and Technical Education

Sources: (i) Resource availability on the basis of current trends is estimated by fitting semi-log equation the data set for the years 1990-91 to 2004-05 BE. (ii) For Tapas Majumdar Committee projections MHRD (2005).

It may be mentioned that there are some countries including the developed ones, which are not spending 6 per cent of their GNP on education. But several of these countries have built a strong higher education system over a long period of time. As a result, a huge capacity has been created and allocations are made only to maintain it. In addition, given their huge size of GNP, even a comparatively lower proportion of GNP would yield higher amount of resources in absolute terms.

The proportion of GNP allocated to education (revenue and capital accounts together) has grown from a very low level of 0.67 per cent in 1951-52 to reach the all-time high of 4.4 per cent in 2000-01. However, since then, it declined sharply to 3.54 per cent in 2004-05 (BE) (Figure 10). The priority accorded to education thus has consistently declined since 1990 with the exception of a few years around 2000-01.

Proportion of GNP to higher and technical education

In the context of the intra-sectoral allocation of resources, it was observed that the constitutional commitment of providing universal elementary education is non-negotiable. The secondary education as a preparatory as well as terminal education cannot be ignored. In the context of globalisation and increased competition, the higher education cannot be overlooked either. Having regard to these realities, a consensus of a sort is gradually emerging to allocate at least 3 per cent of GNP to elementary education, 1.5 per cent to secondary education and the remaining 1.5 per cent to higher and technical education (CABE 2005:46; 2005a:12). With this background, now let us examine the priority accorded to education and higher education.

Since the 1990s, the priority given to higher and technical education has declined even as their importance in facing the new global challenges is growing. The proportion of GNP allocated to higher education has sharply declined from 0.46 per cent in 1990-91 to 0.34 per cent in 2004-05 (BE). The allocation to technical education declined from 0.15 per cent to 0.12 per cent as a proportion of GNP during the same period (Table 7). The allocations to higher and technical education put together hardly constitute 0.6 per cent of GNP in 1990-91 and further declined to 0.46 per cent by 2004-05 (BE).

Resource requirements

These trends clearly show that the public funding to higher education is not given its due importance as in the earlier decades. As a result, the growth of public higher education has been stunted and the sector is unable to meet the growing demand. In order to meet the needs of the emerging knowledge economy, it is desirable to raise the GER at the higher education level to 20 per cent. This is a tall order and requires massive amount of resources. The Tapas Majumdar Committee (2005) has projected the resources for education for the period 2005-06 to 2014-15 under three scenarios; scenario ‘c’, to the author, appears to be the

most desirable scenario (NIEPA 2005). Scenario 'c' assumes a gradual increase in the allocation resources so that 6 per cent of GDP shall be allocated to education by 2009-10, and thereafter, would continue to increase at the same pace. As a result, the proportion of GDP allocated to education will go beyond 6 per cent. According to this scenario, allocation of resources (in 2004- 05 prices) to higher education has to be raised to Rs 1,96,280 million in 2005-06, and further, to Rs 9,41,790 million in 2014- 15 from the current level of Rs 95,620 million in 2004-05 (BE). In case of technical education, the resources (in 2004-05 prices) may have to be raised to Rs 1,01,120 million in 2005-06 and further to Rs 4,85,160 million in 2014-15 from the current level of Rs 33,820 million in 2004-05 (BE).

It would be interesting to compare the projected resource requirements under scenario 'c' of the Tapas Majumdar Committee (2005) with the one projected on the basis of the current trends. This would show the gap that may likely to emerge if the current trends continue in resource allocation to higher and technical education (Figure 11).

Table 7: Public Expenditure on Higher and Technical Education as Percentage of GNP and Budget

Year	As Percentage of GNP					
	Higher	Technical	Higher and Technical	Higher	Technical	Higher and Technical
1990-91	0.46	0.15	0.61	1.58	0.51	2.09
1991-92	0.42	0.14	0.56	1.43	0.48	1.91
1992-93	0.41	0.14	0.55	1.42	0.48	1.90
1993-94	0.40	0.13	0.54	1.42	0.47	1.89
1994-95	0.39	0.13	0.52	1.40	0.47	1.87
1995-96	0.37	0.12	0.49	1.35	0.45	1.80
1996-97	0.35	0.12	0.47	1.30	0.44	1.74
1997-98	0.35	0.12	0.47	1.31	0.44	1.75
1998-99	0.39	0.13	0.52	1.39	0.47	1.86
1999-2000	0.47	0.14	0.61	1.61	0.48	2.09
2000-01	0.49	0.13	0.62	1.79	0.49	2.29
2001-02	0.39	0.12	0.52	1.31	0.41	1.72
2002-03	0.40	0.13	0.52	1.31	0.42	1.72
2003-04 RE	0.37	0.13	0.50	1.22	0.41	1.63
2004-05 BE	0.34	0.12	0.46	1.18	0.42	1.60

Source: Government of India, Analysis of Budgeted Expenditure, various years.

The projection has been made with the assumption that the growth rate for the period 1990-91 to 2004-05 (BE) in constant prices will continue into the future. The growth rate was calculated by fitting a semi-log equation and presented in 2004-05 prices.

As shown in Figure 11, a large gap is likely to emerge between the resource requirements of the system and the availability of resources if the present trends in financing of higher and technical education continue into the future. This may likely to jeopardise the efforts to make India competitive in the global market.

Major concerns and emerging challenges

Access: Though India can boast of having the largest system of higher education in terms of the number of institutions, in relative terms, it still lags behind developed and even several developing countries in terms of access. The access to higher and technical education is still abysmally low, around 12 per cent in 2003- 04. Obviously, this means almost doubling the access to reach a minimum threshold of 20 per cent. The primary onus of increasing access of this level lies with the state, which needs to mobilise additional resources to open new institutions, besides increasing the intake capacity of the existing institutions. Priority must be given to the backward areas in opening new institutions. Besides, the private service providers with a proven track record need to be identified, and alongside the public institutions, they too may be promoted through appropriate incentives.
Equity: It is important that the increased access to higher education should be inclusive. As discussed earlier, the representation of SCs, STs and women in higher education is less than their proportion in the population (Table 5). Education, particularly higher education, is being looked at providing avenues for social mobility for the marginalised sections. Indeed, the recent spurt in the demand for reservations for Other Backward Classes (OBCs) may be a reflection of the important role of higher education in social mobility. We can no longer afford to ignore such demands. Neither these demands can be satisfied with tokenism.

Plans are afoot to nearly double the intake capacity of the central institutions to accommodate the demand emerging out of reservations. At the same time, we should also guard against the dilution of standards. Extending access through sub-standard institutions will be of no good as it will segment the higher education and help in reproducing the socio-economic inequalities. High academic standards should be maintained with due consideration to special needs of marginalised groups. Students from marginalised groups should be helped through special arrangements for the required academic rigour. It has also been noticed that the students from the marginalised sections tend to concentrate in certain easy disciplines. They should be encouraged to take more progressive and hard disciplines so that social equity in higher education assumes utmost importance.
Cost recovery and privatisation: The higher and technical education in India is being increasingly privatised in multiple ways. On the one hand, the public

institutions had to resort to cost recovery methods to stem out from financial crisis. On the other, private institutions are cropping in large numbers changing the very face of higher and technical education. Some of these issues in turn are discussed below.

Fees: It is asserted that fee levels remain very low compared to the past. Though it is necessary that fees should not be at an absurdly low level, it may not be fair to expect the fee to provide substantial resources to higher education. In fact, it is noted by several researchers that the cost recovery level through fees is not high anywhere in the world and in advanced countries it hardly touches 15 per cent. In India also the total fee income constitutes about 15 per cent of expenditure on higher education. In many universities, the fee income exceeds the recommendations made by the Punnayya Committee (CABE Committee 2005). But we must be aware that any increase in fees beyond affordable levels may lead to regressive effects on the level and composition of enrolments.

Self-financing courses and seats: Many a time, the distance courses are being introduced solely with the aim of generating revenues for the university. The revenues generated through distance modes are seldom used for the benefit of distant learners but utilised to finance mainstream activities of the university. It hits hard the interest of especially those who are relatively underprivileged. Yet another method resorted to by several institutions is to create both self-financing seats in the normal courses as well as self-financing courses. Though no data are available on the nature and extent of self-financing courses and seats, it is generally believed that this practice is picking up and even the mainstream universities and colleges are adopting it to generate additional revenues. If the trend continues, a time may come when the higher education system would gradually be restructured to offer only self-financing courses to be self-reliant. This would not only lead to truncated growth of higher education but also weaken our society.

Privatisation: A matter of concern is that unlike the past, the private institutions of present genre are motivated by profit. The large growth of these institutions, it is argued, represents commercialisation of higher education (Tilak 2006: 114). These institutions make huge profits. This raises questions of affordability and equity. They do not even reserve seats for the marginalised groups with severe implications of equity. These institutions do not hesitate to admit students with poor academic credentials. They also attempt to be financially efficient by reducing costs on vital components which adversely affects the quality. The contribution of private sector to research and advanced level education is also found to be limited (Tilak 2006). It is rightly observed, "higher education is far too expensive to be made privately profitable unless it is reserved for the rich or is of very poor quality" (Patel 2003:151).

The regulation of private institutions is fraught with several legal issues. The courts are approached on almost all issues ranging from the criteria to admit students, fees, reservation policy, etc. The judicial response to privatisation is increasingly seen to be characterised by "ambivalence" (Kumar 2003). Though in

many cases the court favours the public nature of higher education and attempts to curtail the adverse impact of rampant privatisation, the trend is not good for the balanced growth of higher education.

Nevertheless, the participation of the private sector and emergence of private institutions cannot simply be wished away. In the context of the limited capacity of the public institutions and the existence of differentiated demand, we need to ensure how the two can co-exist. It is, therefore, imperative to strengthen the regulatory mechanism so that the divisive nature of private education can be contained.

Internationalisation of higher education: Another challenge faced by the higher education is its internationalisation, not in the traditional sense of sharing experiences, but by way of international trade in educational services. Indeed, several foreign institutions have already been operating in India. Many of these institutions have been resisting any form of regulation. Some institutions of Indian origin and also a few public institutions are showing keen interest in going abroad to establish off-shore campuses. In fact, some of them have already set up their offshore campuses. This situation makes things very complex and therefore we need to evolve a policy on this subject and sooner we do it the better it is.

Need to raise public funding: Now, it is very much clear from the above discussions that the public allocation to higher and technical education is not only inadequate but also declining since the last decade and a half. As the public funding of higher education could not keep pace with the growing enrolment, the real unit costs have fallen dramatically since the 1990s. The financial stringency has led to cuts in expenditure on several items not on the basis of importance and relevance to higher education but the ease with which one can cut expenditures. As a result, the austerity measures have taken a heavy toll on the quality of education. Thus, it is imperative that these trends in funding be reversed and public funding for higher education raised.

Need to evolve EMIS: The data base on higher and technical education system in India is very weak and limited to a few areas like enrolment by disciplines and gender, aggregate public expenditure, faculty strength, etc. Data is not available on several vital aspects of higher education. The private sector is either not at all covered or covered in a restricted way. Realising the importance of adequate data, the CABE Committee (2005a, p 30) recommended undertaking a NCERT kind of survey (i e, All India Educational Survey) of higher education. Indeed, there is a good case to evolve the Educational Management and Information Systems in Higher Education (EMISHE).

To conclude, there is an increasing demand for higher education in the growing Indian economy. The growing economy has, indeed, raised the aspirations of people of diverse background and it is necessary that system should respond by expanding access to accommodate these aspirations. The growing economy also needs highly educated manpower in large numbers. Unfortunately, the

expansion of public higher education has slowed down at a time when it should have been expanded fast to increase the access. It is necessary that these trends should be reversed and the state should come forward to open new institutions, besides strengthening existing institutions. Quantitative expansion and qualitative improvement of higher education should command highest priority in the policy discourse. It is important to note that the conventional system alone cannot do this job. Necessary convergence between conventional and distance modes has to be ensured besides bringing about qualitative improvement in all programmes of higher education.

Given the vast expansion needed to achieve the threshold level of GER (20 per cent), it is important to recognise the limitations of the private sector. Disciplines like social sciences, physical sciences, chemical sciences, biological sciences, mathematical sciences, astronomical sciences are unlikely to attract the private sector even though they are very vital in improving a nation's competitiveness through fundamental research and also in inculcating democratic, moral and spiritual values. The state, therefore, should take the lead role in establishing institutions in these areas. While the private sector with philanthropic motives need to be encouraged, others with the sole aim of making quick money should be banned.

Foreign institutions are entering the country in a big way taking advantage of differential and excessive demand for higher education. We cannot afford to turn a blind eye to this phenomenon. Majority of them are going to be mediocre and try to cash in the craze for foreign degrees. While it may not be desirable to close the door for all foreign institutions, we need to evolve such a policy that it attracts only the genuine institutions. Foreign institutions accredited in their homeland should be allowed to offer only those programmes which they offer in their country, and they should be subjected to the same sanctions as applicable to domestic providers. Even the fee charged for various programmes should be determined within the regulatory framework prescribed for all institutions of higher learning.[1]

References

Agarwal, P (2006): 'Higher Education in India: The Need for Change', working paper No 180, Indian Council for Research on International Economic Relations.

Anandkrishnan, M (2004): 'Higher Education in Regional Development: Some Key Pointers', Indo-UK Seminar on Regional Development, organised by UGC.

– (2006): 'Privatisation of Higher Education: Opportunities and Anomalies', paper presented in the national seminar on Privatisation and Commercialisation of Higher Education, organised by NIEPA, New Delhi on May 2, 2006, mimeo.

[1] It is generally the GNP and not GDP that is used to assess the nation's commitment to education as it better represents the capacity to deploy resources. It is the GNP that was used by the Kothari Commission (1964- 66), and also is commonly used in the literature. However, the Tapas Majumdar Committee has used GDP as it was mentioned in its Terms of Reference. The Tapas Majumdar Committee also notes that it makes little difference whether one uses GNP or GDP.

Bhargava, P (2006): 'Knowledge and National Development', paper presented in the National Seminar on the Education Commission organised by NUEPA, New Delhi from December 26-28, 2006, mimeo.

CABE (2005): 'Financing of Higher and Technical Education', report of the CABE Committee, NIEPA, New Delhi.

– (2005a): 'CABE Committee Report on Autonomy of Higher Education Institutions', June.

Carnoy, Martin (2006): 'Higher Education and Economic Development: India and China and the 21st Century', Working Paper No 297, Stanford Centre for International Development.

GoI (1966): 'Education and National Development', report of the National Commission on Education (1964-66), New Delhi.

– (various years): Analysis of Budgeted Expenditure on Education, MHRD, New Delhi.

– (various years): 'Selected Educational Statistics', Ministry of Human Resource Development, GoI, New Delhi.

Gupta, Asha (2005): 'International Trends in Higher Education and the Indian Scenario', Centre for Studies in Higher Education, CSHE-11-05, available at http://repositories.cdlib.org/cshe/CSHE-11-05.

Khemani, Tulika and Narayan, Jayaprakash (2006): 'Higher Education Sector in India: Opportunities and Reforms', Foundation for Democratic Reforms, Hyderabad.

Kumar, Krishna (2003): 'Judicial Ambivalence and New Politics of Education', Economic and Political Weekly, December 6.

NIEPA (2005): 'Report of the Committee on National Common Minimum Programme's Commitment of Six Per Cent of GDP to Education', NIEPA, New Delhi.

Patel, I G (2003): 'Higher Education and Economic Development' in J B G Tilak (ed), Education, Society and Development: National and International Perspectives, APH for NIEPA, New Delhi.

Tilak, Jandhyala B G (2005): 'Post-Elementary Education, Poverty and Development in India', Post-Basic Education and Training, Working Paper Series No 6, Centre for African Studies, University of Edinburgh.

– (2006): 'Private Higher Education: Philanthropy to Profits' in Higher Education in the World 2006: The Financing of Universities, GUNI Series on the Social Commitment of Universities 1, Palgrave, New York and GUNI.

University Grants Commission (UGC) (various years): Annual Reports, UGC, New Delhi.

UNESCO (2006): Global Monitoring Report, UNESCO, Paris.

Source: Economic and Political Weekly, August 4, 2007

Chapter 28

Communication of Science and Technology as an Instrument for Social Inclusion

Leda Sampson, Ildeu Moreira

Abstract In Brazil, it is a constitutional right that every citizen should have access to knowledge. In this context, it is the mission of the Department of Popularization and Diffusion of Science and Technology to make sure that scientific-technological knowledge is accessible to all. Therefore, the Department promotes and supports events and activities related to science communication and diffusion, in order to reach peoples of all ages, cultural backgrounds, social classes and education. In this context, we pay special attention to The National Week of Science and Technology, an effective tool for science communication and promotion of social inclusion in Brazil.

Keywords *Communication, National Week, Popularization, Science, Social Inclusion*

Introduction

Brazil is a large country. Most of the scientific and technological production and dissemination happen in the South and Southeast regions, where the most prominent universities and science centers/museums are located. As a result, only 1% of the population visit a science museum each year. Hence, we face the great challenge of bringing science and technology to isolated regions, where people do not have easy access to such knowledge, and in most cases do not understand the value of science and technology for their lives and for the development of the country. Over the past years there has been an expansion of the actions related to the popularization of science and technology in Brazil, but the structure is still fragile and limited.

In face of this issue, the Department of Popularization and Diffusion of Science and Technology (henceforth "The Department") of the Secretariat of Science and Technology for Social Inclusion (SECIS), promotes and supports science and technology events and activities, giving priority to the poorest or

underprivileged parts of the country, in order to give these vulnerable people an opportunity to learn about science, technology and the scientific development and research in the country. The main purpose is to engage municipalities and local actors so that they will be responsible for designing and implementing activities or events that are most suitable in terms of the local characteristics, such as population (education level, cultural background, etc) and the scientific gaps that exist in their city or region. In supporting local actions, The Department intends to potencialize the learning process and promote social inclusion.

Having this in mind, one of the most important instruments The Department has for science and technology dissemination and popularization throughout the country is the National Week of Science and Technology (henceforth "The Week"). The Week was established in 2004, and its main goal is to mobilize the population, especially children and teenagers, around themes and activities of science and technology, stimulating creativity, scientific thinking and innovation (1).

To implement The Week, each estate has its own local coordination and counts on the active participation of city and estate governments, of education and research institutions and scientific technological entities.

The paper is structured as follows. In Section 2 we present in more details SECIS and The Department, with their main lines of action. Section 3 introduces the National Week of Science and Technology, its history over the years, its activities, its growth and reach. In Section 4 we describe how communication of science can be used as a tool for social inclusion. Finally, in Section 5 we present our conclusions and future steps.

Actions for social inclusion

The promotion of social inclusion has been one of the main lines of action of the Brazilian Government since 2002. When President Lula took over, he committed himself to the improvement of the population's standard of living, to the creation of new jobs and generation of income, with special focus on the underprivileged.

In this context, the Government created, in 2003, the Secretariat of Science and Technology for Social Inclusion at the Ministry of Science and Technology (MCT). The mission of SECIS is to promote social inclusion through actions that make use of science and technology to improve quality of life, stimulate employment and income generation and lead to the sustainable development of the country.

Regarding the strategic priorities of Science, Technology and Innovation (CT&I) for Social Development, SECIS follows two lines of action:

- Popularization of science, technology and innovation and the improvement of scientific education; and
- Diffusion of technologies for social inclusion and social development.

The Department of Popularization and Diffusion of Science and Technology works under the first line of action above. Its role is to promote and support any activities related to science and technology popularization, such as science fairs and olympiads, science exhibitions, museums, science centers, publications, television and radio programs and films. In order to enable these initiatives, The Department acts together with education and research institutes, scientific entities, governmental organs, newspapers, television and radio stations. The Department also works to strengthen scientific journalism.

Two examples of the events supported by The Department are the Brazilian Fair of Sciences and Engineering (FEBRACE) and The Brazilian Mathematics Olympiad of Public Schools (OBMEP).

FEBRACE is a national fair that stimulates the young scientist. It plays an important social role, encouraging creativity and reflection in students, through the development of projects with a strong scientific basis in the different areas of sciences and engineering (5).

The Brazilian Mathematics Olympiad of Public Schools (OBMEP) is directed to public schools, and has the commitment to show the importance of Math for the future of these youngsters and for the development of the country, besides encouraging young talents and giving opportunities for them to pursue scientific careers (2).

The diffusion of science and technology plays an important role for the development of citizenship, where social inclusion is a natural consequence. Also, it greatly contributes for the consolidation of a strong scientific culture, where science communication is one of the most important factors. In this context, the National Week of Science and Technology is the most successful tool The Department possesses to extend its reach towards all those who are eager for scientific knowledge.

The national week of science and technology

The Week was established in 2004, by means of a presidential decree. It intends to show the importance of science and technology in our lives and for the development of the country, and also offer an opportunity for the Brazilian population to get to know and discuss the results, relevance and impacts of scientific and technological research and applications.

All those who are interested may participate in the activities of The Week. The main actors involved are: universities and research institutions; public and private schools; institutions of technological education, centers and museums of science and technology; scientific and technological entities; research support foundations; environmental parks, conservation units, botanical gardens and zoos; estate and city secretariats of science and technology and education; public and private companies; journals, television channels and radio stations; governmental organs; nongovernmental organizations and other entities of the civil society (1).

Among the activities of the Week, there are science tents in public squares; open days in research and education institutions; science fairs; contests, workshops and seminars; scientists going to schools; scientific initiation journeys; scientific excursions; events integrating science, culture and art. In terms of science communication, we can cite the distribution of books and 350,000 copies of the National Week of Science and Technology Journal, the exhibition of films and scientific videos, and the broadcast of science popularization programs on radio and television. Still, 20 DVDs with television programs and scientific diffusion videos from different countries are distributed for public exhibitions in all estates.

Over the years, the Week has seen a substantial growth, both in the number of participating cities and activities developed, as can be seen in Table 1. In 2009, only in Brasília Science Communication Without Frontiers (the capital of Brazil), around 120,000 people visited the stands and exhibitions taking place at the "Tent of Science", a giant tent erected at the heart of the capital during The Week. The fact that The Week reaches continuously more people, all over the country, clearly shows that it represents a very effective means of communicating science and technology to people of all ages, cultures, social classes and education level, with no distinctions.

Every year The Week has a different theme. On its first edition, in 2004, the theme was "Brazil, Look at the Sky!" and in 2005, "Brazil, Look at the Water!".

From 2006, the themes were chosen to go hand in hand with an international or national relevant celebration or date. The Week´s third edition worked with "Creativity and Innovation" to celebrate the centenary of 14 Bis' first flight (the first self-propelled airplane, designed by the Brazilian inventor Santos Dummont). A replica of the plane flew over the Ministry Esplanade in Brasília during The Week. Thousands of educational and diffusion activities paid homage, throughout the year, to the great Brazilian inventor Santos Dummont.

In 2007, the theme "Earth" was chosen to celebrate the International Year of Planet Earth, established by the United Nations (UN). In 2008, The Week was set about "Evolution and Diversity", because of the 150th anniversary of the Theory of Evolution by Natural Selection, by Charles Darwin.

Finally, in 2009, the theme was "Science in Brazil", to bring to the general population knowledge about the science and the technology produced in the country. The International Year of Astronomy was also celebrated; thousands of Astronomy activities were promoted during The Week and over the year, reaching around 2,5 million people (1). Thousands of books, folders and booklets about varied themes (Santos Dummont, Carlos Chagas, Brazilian scientists, Astronomy, experiments, etc) were distributed throughout the country.

Table 1. Growth of The Week over the years

Year	Cities	Activities
2004	252	1,842
2005	332	6,071
2006	370	8,654
2007	390	9,700
2008	445	10,859
2009	492	24,978

Yearly growth of The Week in the country, in terms of the number of participating cities and activities developed (2).

This year, The Week happened from the 18th – 24th of October, and its theme was "Science for Sustainable Development". Beyond promoting the most diverse diffusion activities, it stimulated the debate about strategies and ways to use the Brazilian natural resources and its rich biodiversity sustainably, always aiming at an improvement of the socioeconomic conditions of the population. Science for Sustainable Development showed that science and technology are essential factors for the development with social, economic and environmental quality.

On the other hand, the General Assembly of the United Nations declared 2010 as the International Year of Biodiversity. The UN is stimulating all countries to seek a growth in collective awareness regarding the importance of biodiversity, by means of local, regional and international actions. The Week 2010 was designed to go hand in hand with this international effort.

Among the activities signed up for The Week this year, we highlight: science tents in several capitals of the country, like Brasília and Rio de Janeiro; a large popularization event, scientific initiation and science fair at the Federal University of Santa Catarina; the regional representation of The Week at Rio Grande do Norte reached the interior of the state, with the programs Research goes to School and School sees Science; joint actions in the North region, integrating the Brazilian activities with the Colombian National Week of Science and Technology; the first scientific display in Maranhão; the truck of science of the Catholic University of Rio Grande do Sul went to São Paulo.

Preliminary statistics indicate that in Brasília, for example, The Week was quite successful. Most of the attractions were interactive, with displays of live animals to illustrate the biodiversity of the country, hands-on experiences, videos, workshops on the most diverse themes, all related to biodiversity and sustainable development. Data for other estates and cities are still being computed.

The week as a tool for social inclusion

Brazil is a vast and diverse country, where people from different regions have very different cultural, educational and social backgrounds. The 11th International Conference on Public Communication of Science & Technology 187 Due to these huge contrasts, it is difficult to reach the whole country in equal measure and a considerable portion of the Brazilian population lacks access to scientific and technological knowledge, museums, science centers, research/educational institutions. This, in turn, contributes to the generation and perpetuation of a society that is illiterate in scientific and technological matters.

Historically, several factors are responsible for this long-standing problem. Usually, the interfaces between science and culture are ignored, as well as ethical questions, which leads to a natural disinterest in science and technology. Also, there is no recognition that scientific production is a process that follows a specific method, involving risks and uncertainties. Science and technology are usually pictured as a black box: something of difficult understanding that is very exclusive, infallible and unquestionable. This picture reinforces the belief that science and technology belong in the universities and research institutes, and cannot be used to generate better life conditions to the poor. Added to the small academic valuation of outreach activities, we have, overall, a very restricted appreciation of the importance that science and technology have for social inclusion.

Moreover, in Brazil there is no tradition in planning public policies for science and technology popularization (even less with focus on social inclusion), which results in a very limited amount of funds destined to support or develop outreach activities.

As a consequence of all these factors, the general perception of science and technology in the country is still very incipient. A survey conducted in 2006 (3) showed that either people do not have the habit of going to museums/science centers or these facilities do not exist where they live. When asked why they are not interested in science and technology, most of the interviewees answered that they do not understand it, therefore, they do not read about science in newspapers or books. Finally, people do not care to discuss science and the latest scientific-technological developments of the country because they think they have nothing to do with it. Paradoxically, most of the interviewees think that science brings more benefits than harm to mankind and agree that funds devoted to the scientific and technological development of the country should be increased. The survey interviewed 2,004 adults, men and women, of different education levels, socioeconomic classes and cultural backgrounds.

We conclude, therefore, that science in Brazil is not properly disseminated. Nonetheless, people are aware that this is an important matter for the development of the country, which means that more actions in science and technology popularization would certainly be welcomed. Note that whatever dissemination

movement that existed in the country until now was not directed to poor people, which greatly contributed to their situation of severe social exclusion.

In this context, social inclusion can be reached in three ways: (i) by giving people access to knowledge so that they can understand what is around them and have autonomy to demand solutions for their problems; (ii) by giving people access to knowledge so that they do not feel less important or forgotten by those who had more opportunities in life; (iii) by showing people, particularly children and teenagers, that they can succeed in life and contribute to the development of the country, by following a scientific career, since science is not a black box – it can be understandable by all.

Regarding (i). It is important to start from the principle that the general knowledge of science and technology is part of our society and is the tool to promote the development of the country. Hence, it is essential that this knowledge is available to all, so that people can pose questions, make suggestions and follow the government´s actions and public policies related to science and technology.

The strategic priorities and investments made in science and technology by the government may be determinant for a solid improvement – or not – in the lives of the population. However, the population ignores these facts and feels powerless and disconnected when it comes to making decisions about what science and technology can do for them.

In May 2010, the Brazilian MCT, among others, promoted the fourth edition of the National Science, Technology and Innovation Conference, which analyzed the current situation of the Brazilian Science and Technology System, presented and discussed new proposals to subsidize the creation of a public policy specific for Science, Technology and Innovation in Brazil. This year, among its activities, the Week published and opened for discussion the results of the Conference, giving the population an opportunity to participate in the decision-making process regarding the future of science and technology in the country.

A short version of the "Blue Book", the final document containing all the resolutions and proposals that arised during the 4th Conference, was distributed as a supplement to The Week´s Journal. This document is now available for public consultation, so that everyone can give their opinions and suggestions about the plans that will guide the Science and Technology Policies for the next years.

Besides being an instrument for science popularization, The Week plays an important socio-political role in calling people to provide some feedback to the government as to what their most pressing needs are and what they expect for the future. The more people understand and participate, the more socially included they feel. And the more benefits they obtain from the developments of science and technology.

Regarding (ii). Since it is difficult to build and maintain museums/science centers everywhere in the country, people must have access to alternative science and technology events/activities. This is one of the main missions of The Week:

to reach people who would not have access to scientific-technological knowledge otherwise.

It has been shown that informal events for science learning can stimulate science interest, build learner´s scientific knowledge and skill and help people learn to be more comfortable and confident in their relationship with science (4).

This argument can be verified by confirming that the public response to The Week has been very positive over the years. Its growth, in terms of the number of municipalities involved and activities developed, has been very noticeable, as mentioned in Section 3 and seen Table 1. This means that every year The Week touches more people and extends its reach further into the country. Especially in the North region of Brazil, where access to most of the population is complicated due to the extension of the Amazon Forest, and in the interior of the Northeast region where the poorest people of the country live, The Week brings a new horizon.

These regions are disconnected from the rest of the country and the local populations live in conditions of isolation. It is, therefore, very important to bring science to them, because they have the right to it, and because these actions offer them an opportunity to see their lives through a different point of view – they realize that they can have a better future with science and technology.

As an example, the National Institute of Amazon Research (INPA) promotes events and activities in communities all over the Amazon estate, by means of e.g. online lectures or itinerant exhibitions and displays. It is noticeable that the feeling of self-confidence and social inclusion of these communities are greatly enhanced when they realize that they are part of our society and have the same rights as everybody else (Carlos Bueno, private communication).

Regarding (iii). Science communication is a very important tool to interest people in science, encouraging them to follow scientific careers, therefore building up the human resources needed for the development of the country.

This is a challenge in Brazil, especially because children and teenagers are usually not fond of hard sciences, such as Math and Physics, which originates a serious lack of human resources in these areas, hindering the governmental efforts to promote the scientific and technological development of the country.

Therefore, it is crucial that science is brought to people in an exciting manner. The most effective way to achieve this goal is to create a connection between the science they see during The Week and their everyday lives. Once this connection happens, these people develop positive science-related attitudes, emotions and identities (4), feeling stimulated to pursue more, thus strengthening the scientific-technological culture in the country.

When local actors promote and develop scientific-technological events and activities, it is easier to create a bond with the local population. Direct access to phenomena of the natural physical world is fundamental in this context, where basic aspects of daily life are framed in light of associated scientific ideas (4).

We conclude this Section by reenforcing the many aspects of The Week. It can be used as a tool to reach isolated people and help them develop a connection with scientific and technological knowledge; as a tool to demystify science to people of all backgrounds; as a tool to interest people in science and encourage them to follow scientific careers; and as a tool to disseminate opportunities through which people can express their problems and what they expect from the government and their policies.

All these aspects are complementary and, together, they bring lasting social inclusion. When the population sees science and technology as an asset and not as liability, they can demand the use of the available knowledge to improve their lives. The cycle is closed when people have the chance to be heard, when they can use the knowledge they acquired to bring pressing issues to focus and demand immediate solutions.

Concluding remarks

Since its first edition in 2004, The Week has been very successful, counting on a growing participation of the general public, institutions and municipalities. This shows that we are moving in the right direction; promoting local scientific events increases interest, proving that science is more accessible to learners when it is portrayed in contexts that are relevant to them, as indicated in (4). It is worth mentioning that the success of this initiative stimulated other countries (Colombia, Uruguay, Bolivia) to create their own Science Weeks. However, there is still a lot to be done.

Among the main challenges are a greater involvement of the community and research institutions, a more effective integration with the educational system and the widening of the activities at the popular sector levels. Besides, the quality of the public communication that happens during The Week has to be continuously improved, providing more interactivity, stimulating the exchange of cultures, and shortening the relationship between science and technology and the reality of the population, always bringing to focus discussions and debates about the relevance and the ways of science and technology in local, regional and national scales.

Statistics show that The Week reaches around 5% of the Brazilian population. Since the results for 2010 are still being computed, it is possible that this number is higher today. In any case, the goal for 2022, the year of the bicentenary of the Brazilian independence, is to reach 100% of the municipalities in the country, a total of 5,500

Even though the reach of The Week is still far from ideal, a new public opinion survey conducted in 2010 indicates that the scientific perception is increasing in Brazil. From 2006- 2010, although still small, the number of people frequenting museums and science centers nearly doubled. The population, in general, is more interested and participative.

Thanks to the innovative efforts of The Department and the Secretariat to support local activities throughout the country, people in underprivileged regions of Brazil have access to knowledge that, until now, had been neglected to them. Hence, The Week is a very effective and democratic tool to bring science and technology to all Brazilian citizens, contributing to lessen the social exclusion problems we face and to minimize the gaps left by the still small number of outreach activities and events carried out in the country.

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References

National Week of Science and Technology: http://semana.mct.gov.br/index.php/content/v iew/3223.html

Ministry of Science and Technology, 2010, Plan of Action for Science, Technology and Innovation for National Development: Main Results.

Ildeu Moreira & Luisa Massarani, 2006, Survey: Public Perception of Science and Technology in Brazil, private communication.

National Research Council, 2009, Learning Science in Informal Environments: People, Places and Pursuits. Committee on Learning Science in Informal Environments. P. Bell, B. Lewenstein, A. W. Shouse & M. A. Feder (Eds). Washington, DC: The National Academies Press.

FEBRACE official site, http://febrace.org.br

Source: Proceedings of the 11th International Conference on Public Communication of Science & Technology, New Delhi, December 06-10, 2010

Chapter 29

Minimum Science for Everyone

Narender K. Sehgal

The words "science" and "communication" and the term "science communication" have assumed,-or-have been given, several meanings and images. It may be worth while spending some time on definitions and delineate, from among these, the ones to be dealt with at some length in this piece.

The word science, in common mass media perceptions and in terms of the ready images it conjures in people's minds- built up no doubt by projections in the mass media over the years- has come to be overwhelmingly associated with its technological manifestations. The science which is at work (in terms of its basic principles and methodology) all around us in whatever we do, touch or experience has unfortunately not been projected in or by the media in any significant way or manner, or on a scale perceptible enough to allow common images to emerge.

Dictionary meaning

Common images apart, science has been defined by an English dictionary as "knowledge of facts and laws based upon observation and arranged in an orderly system. I am sure there are many definitions of the word, some more elaborate, more articulate and sharper than others. A few instances should suffice.

One definition is that science is the totality of systematically expounded, empirically confirmed, generally acceptable knowledge. It can also be taken to denote a set of specific methods employed to certify knowledge, and a flow of knowledge arising out of the application of these methods. Science also is, and needs to be understood and seen as, integral to nearly every pan and aspect of our lives as individuals, as a society and as a nation.

Let us take the word communication next. This word has now become so expansive in its sweep that perhaps only a treatise would be able to do justice to all its meanings and manifestations and to tie innumerable possibilities. The whole area of education in all its forms and hues, and the very processes of teaching and learning, several aspects of knowledge and technology transfer, the problem of banishing illiteracy, and indeed very many aspects of the entire development process hinge on the effectiveness of communication employed.

Many aspects

That being so, the different aspects of communication, such as the mode, the means, the method, the medium, the software, the communicator, the hardware and the various characteristics of the recipient(s) of communication assume importance in their own right, in terms of what they together add up to.

Also, communication can be one to one, one to many, one-way, face to face, personal, impersonal, through a medium, or through a combination of media (electronic, non-electronic, folk and others) and in one or more languages, at different levels, for different purposes, and aimed at a variety of objectives.

The term science communication would literally mean communication of science. Science communication would require something scientific or relating to science to pass back and forth between the recipient(s) and the depending on who the communicators and the recipient(s) are, as also what the nature and level of science involved are. For instance, science communication can be between: (i) a scientist and another in one's own specialization; (ii) a scientist and the students of science; (iii) a scientist and the scientific community at large (generally through publications in scientific journals, presentation of papers at seminars, symposia, conferences); (iv) a scientist and science policy makers and science administrators (to seek support or to justify new initiatives, or for continuing activities, generally through project proposals, and presentations of the same at review meetings); (v) a scientist and the educated, or the scientifically literate class of people (through science magazines, mostly in English, containing semi-technical material; or subject-specific books or magazines like those on electronics, health, environment and so on, again largely in English, though now some have started appearing also in Hindi and some 01 the regional languages; plus through science museums, planetariums, exhibitions and others); (vi) a scientist and the common people at large many of whom may be illiterate (through popular science magazines and books in Indian languages, radio and television programmes, slide-cum-lecture demonstrations and a variety of other means); (vii) a science teacher and his/ her class; (viii) a science reporter/ writer and his/ her readers; (ix) a science producer and his/her listeners/ viewers; (x) a science speaker and his/ her audience; (xi) a science performer, actor, demonstrator, and the like, and his/ her audience; and perhaps between others.

For purposes of this article, we would be restricting ourselves to a few categories of science communication mentioned above list. The word science in what follows would be used in its widest possible meaning to cover related, aspects *of* technology, engineering, industry, basic and applied research and development, and also its social, societal, economic and other manifestations.

Different means

In each of the categories of science communication mentioned above the basic objectives of communication would be different and the methods, means and strategies employed would, accordingly, also be different.

We propose to deal with at some length here, the one single basic objective in very broad terms would be to stimulate scientific and technological attitudes, scientific thinking' and scientific temperament among more and more people. While in its philosophical, pedagogical and conceptual nuances each of these concepts may have different connotations, they all have a common denominator in the method and values of science. And since it is in science and technology areas/ activities more than in any other area of human endeavour that one can expect to find the method and values of science at work, one also includes popularization of science and technology as an important parallel objective, as a matter of strategy.

Scientific temper

In line with our basic objective of stimulating scientific attitudes among more and more of our citizens, the stress and overwhelming emphasis in this category of science communication would have to be more on the method and values than on the content of science. But this certainly does not imply that the content of science is not important; it most certainly is, but one is only indicating the relative emphasis that the two need to be given in science communication.

Before we go further, it may be worth examining why and for what purpose we need science communication of the kind we have just outlined above and would be discussing at some length in this article.

First of all, scientific temper and humanism are constitutional obligations of all citizens (Article 51h). That apart, with the ever-increasing role and importance of science and technology in just about every aspect of the country's economy and in our lives and everyday living, the level of scientific literacy and science awareness among our people needs to be raised very substantially. "Without that, the country cannot hope to harness the full potential of science and technology for its overall development, or for raising the living standards of the vast majority of our citizens.

More importantly, unless we can bring about an organic weaving of the method and values of science into our social and cultural fabric, all our investments in science and technology despite the good work of our scientists and technologists would not get converted into tangible benefits for a large majority of our people. Thus, the basic need for science communication and its purpose arise out of a national mandate and do not as such require any fresh justification.

Having defined our words and terms, we can safely take on the topic of this article. I intend dwelling very briefly on the past and a little more on the present. Based on this I will try foreseeing what might be in store in years to come.

Limited reach

Science communication in the past that is all a few decades or so ago was limned to popular lectures, some popular writing (magazines and books), a handful of museums and planetariums, and perhaps a few exhibitions here and there. Though, there were exceptions, much of this activity look place employing the English language. Also, on the whole, the number of people reached through such activities and efforts was an insignificant fraction of the population.

Take the case of the Vigyan Parishad, Prayag. It was founded in 1913 and started a popular science magazine in Hindi called *Vigyan* in 1915. To this day this magazine is coming out regularly every month, reportedly not having missed a single issue.

Associated with it all these years have been some of the most illustrious names in Indian science through articles contributed by them. The Parishad has also brought out a whole lot of books in Hindi on topics of practical importance or utility for literate common people. Several of its publications have got reprinted more than once. In terms of numbers, however, the print orders have been small, around 500 to a few thousands.

The magazine *Vigyan* at present has a print order of less than a thousand. It is not quite clear why a century old magazine has not been able to gain popularity and find subscribers at least in the Hindi-speaking states. If it had, the print order would have been running into lakhs. Perhaps, no concerned attempts have been made by the Vigyan Parishad to aim for such a goal. Of course, an effort entirely different in nature, character and scale would have been required for the purpose. Then there is the case of the popular science magazine in Bengali started by Prof. S.N. Bose at Calcutta in the mid 1940s called *Bijnan-O-Bijnan,* it has also been coming out uninterruptedly since then but has a print order of less than 5,000.

Quite possibly, there are other examples of such efforts by individuals fired by a missionary zeal who may have written books, articles, poetry, even scientific novels, or science fiction, which got into print in different languages, either through their own efforts/resources, or through largesse from well-off visionaries during the freedom struggle. But in all such cases, the numbers have been pitifully small (let the quality of their content not worry us for the moment).

Images of science

We have already made a mention of the images of science that our mass media have created over the years, borrowing and drawing heavily from foreign sources. However, the complementary images of science that would have been far more helpful to the vast majority of the Indian people, relating more closely to their immediate environment and their everyday life, have not been given much prominence or promoted with any comparable seriousness. This also holds true of science communication.

To the majority of those who are in decision-making positions in the country at various levels, science communication would immediately mean science museums, planetariums and mobile vans, exhibitions in places like Pragati Maidan displaying the latest gadgets or models of ships, rockets, atomic reactors, or the like; or popular lectures by famous Indian or foreign scientists in a school/ college/ university department; or showing science films available from foreign embassies in schools and colleges.

Also, in their frames of reference, the most obvious places that would come to mind for such activities are the capital cities or other big towns because all the infrastructure required would be readily available; the language to be used would of course be primarily English, because that to them is the international language for doing anything with science.

The picture described above has not changed a great deal as far as the mass media arc concerned. Nevertheless, an undercurrent has been building up over the past few decades seeking to create and establish parallel, more relevant indigenous images of science and science communication. Even if the latter do not totally displace the existing images they would certainly be welcome complementary additions and help present a more balanced picture.

Before going on to discuss this parallel undercurrent, I would like to do some plain-speaking on certain common beliefs relating to science popularization and science communication in the current Indian context, keeping in view the existing ground realities.

One, we all talk of taking science to the people, or to the proverbial common man, All planetaria, all science museums and science centres get built in the name of the common man or the people. But who visits the handful of such institutions located in our metropolitan cities and larger towns? Who arc the people who participate in programmes and activities organized by these and other scientific and technical institutions ? The answer invariably would be students, other educated groups and generally those belonging to elitist sections of our population.

Ground realities

The ground realities are different. Nearly 30 percent of our population is still illiterate and remains totally untouched by our education system. Of the remaining 70 per cent, students of all kinds and varieties constitute a very small minority. Those able to comprehend and feel comfortable with English form no more than 5 percent of the population.

Two, institutional and/ or non-automatic exhibitions which consist of stalls of different institutions (displaying charts, static and working models relating to their respective activities/ products services"), visited by large crowds of people, do not either help popularise science or promote scientific understanding or scientific attitude among the common people.

Science exhibitions or fairs arc also organised every year in schools, where models prepared by students under the guidance of their teachers are displayed More often than not, the models on display have little or no relationship with what the students learn at school or do in the course of their science practicals. Indeed this yearly affair is generally looked upon by schools, teachers and students as an isolated exercise that one has to go through and be done with somehow.

To top it all, a good number of the award-winning models are often found to have been prepared by professional model-makers. The way the whole thing is carried out is making science perhaps very unpopular to both students and teachers.

Three, English language magazines like the NISCAIR, CSIR publishes *Science Reporter* mainly caters to those who are already interested in science. This is also true of the popular lectures delivered in most cases by eminent scientists at schools, colleges, universities, etc.

Parallel approach

Science and technology have in some form been incorporated in Indian culture and tradition and can find traditional approach for mass communication in modern times as well. On the other hand folk forms are far more suitable for our social fabric and culture. (a) These activities and programmes must go beyond students and schools (and colleges) in their aim; (b) stress on learning by doing and on low and no-cost activities which employ communication and easily available local materials, including those lying around the house unused, or ready to be thrown away; (c) use of local language as the medium of communication between the communicators and receivers of communication; (d) a conscious effort to make the communication as much of a two-way process as the medium being-employed would permit, in fact, those methods and media which allow more of this should be preferred; (e) a basic assumption that the communicators in the process of science communication also have a lot to learn from those who they would be trying to reach or communicate with even in the case of those who might be illiterate in common parlance; (f) science communication on the whole and in the overall Indian context includes a critical examination and assessment on a scientific basis of our age-old traditions in different areas (viz a geniture, health, education, etc.) to see what and which ones need to be retained as such or with modifications and which to be jettisoned altogether, before entirely new or parallel things (especially those that have originated elsewhere) arc sought to be promoted by way of dissemination of in formation, etc.

Basic reason

The superstitions, blind faith in supernatural powers, miracles/eats by self-styled godmen should also be handled without preconceived notions, with an open mind and in a manner which will encourage people (who believe in or practice them) to

discover the basic reason behind and the scientific basis of such things. Once such a process is indicated, they may be induced consequently to critically examine and review their own ideas, beliefs etc by asking questions and seeking answers till they are satisfied.

Over the past few decades, due to concerted efforts by dedicated individuals, and organisations, this parallel approach has attracted an increasing number of adherents both among the common people and among communicators, cutting across several divides, including the rural/urban one. There now are enough examples of successful experiments and innovations on a small/tiny scale (virtually from all comers of the country), and also a few larger ones, so that we should have little difficulty in attempting things on a much larger scale—in fact, large enough to have an impact nationally—on a regular and continuing basis.

While the road ahead is long and strewn with hurdles, there arc positive developments on the science communication horizon, both in the formal sector (exhibitions,' lectures, planetariums, museums. science magazines, etc.) as well as in the parallel non-formal sector (involving the work of voluntary groups, use of non-electronic, folk media, Jathas, awareness campaigns, and in general field-based, participation-intensive activities involving large numbers of common people)." In addition, there has been a very hopeful and potentially beneficial development in the form of increasing intermingling of these formal and non-formal sectors in pursuit of common goals.

In whatever way one chooses to interpret it, it is a fact that the glamour for the establishment of planetariums, science museums and mobile vans has definitely increased among the state governments, who are willing to spend crores to establish such institutions in their capitals or in other bigger towns.

While more and more academicians and professionals from science, technology, engineering and industry are participating in science communication activities as individuals, there has been very improvement in the pattern of institutional/ organisational participation and involvement.

Science programmes

It is with the coming of the NCSTC (the National Council for Science and Technology Communication) on the science communication scene in the mid-eighties that science popularisation activities in the country received a fillip. NCSTC has generated, developed, catalysed and supported a whole range of programmes, both in the formal and non-traditional sectors, involving a very large number of voluntary and order agencies.

These programmes also involve the training of communicators in different languages and for different media; development, production and dissemination of software for different media; support to popular science magazines in different Indian languages; creation of an S&T communication data-base; publication of *Strote,* a science and technology feature-service to cater to the needs of the

Hindi press, especially the small and medium-sized newspapers; establishment of activity-based field projects involving large numbers of people; installation of annual national awards in science popularisation; designation of February 28 as National Science Day; and more.

Bharat Jan Vigyan Jatha (BJVJ), an unprecedented communication event organised by over two dozen voluntary agencies from all across the country brought together by NCSTC. The event was held throughout the country during September 10 December 1987. It directly reached over a crore of Indians through different S&T communication activities employing local languages and in the process, identified many groups of people around the country no were interested and eager to participation and carry out science popularisation activities.

The second is the widely acclaimed 13 part film serial in Hindi on the history of science and technology in the Indian subcontinent, titled *Bharat Ki Chhap* which was nationally telecast on Doordarshan on Sunday mornings between April 30 and July 30 during 1989.

The third is the unique radio serial of 13 parts done jointly with All India Radio, titled *Vigyan Vidhi.* The nationwide broadcast of this serial, with each episode built around the story of Evolution of Man. The programme was broadcast by nearly all AIR stations on Sunday mornings in 16 major Indian languages. While the content in all language versions was the same, each one of them was an original production in its own right (of course with the same signature tune). That is not all; this programme, incorporating a new approach, was an attempt at integrated broadcasting.

More than 1,40,000 children in the age group 10 to 14 had been registered as dedicated listeners. Some episodes were pre-tested among rural and urban children of the intended age group before final production.

Another unique aspect of the programmes was the preparation of the audience through well-designed wall-charts, which were sent to them sufficiently in advance and provision of do-it-yourself kits to all the registered listeners through which they could do several experiments and engage in scientific activities themselves. These activities were aimed at developing in children some of the inherent scientific abilities like observation, data gathering, experimentation, hypothesizing and verification, quantitative measurement and description, logical reasoning, consistency, objectivity and so on.

The present science communication scene in the country is potent and seething with possibilities. Participation of people in science communication programmes and activities already cuts across politics, religion, ideology, culture, geography, media, per capita income, literacy levels, and even sex and age.

The future certainly looks bright and full of hope, and all signs point to science communication becoming a very natural and integral part of the communication scene in coming years with vigorous efforts already underway at networking of existing science communication agencies and at nucleation of activities and agencies at places where they do not exist, it is only a matter of time before the

mass media (like newspapers, radio and television) arc forced to take note of the coming changes and strong undercurrents which are sure to grow into a flood.

I would like to stress a basic point. No matter how great our scientists are or how outstanding their work and achievements, unless we can significantly raise the level of scientific literacy among our common people the benefits accruing from science and technology will never flow to them to raise their standard of living.

Minimum science

Similarly, on a different plane, a scientifically illiterate nation like ours can never hope to fully or optimally harness science and technology either in economic terms or in terms of its overall development.

We need to develop and give practical shape to the concept of "minimum science for everyone" with that at least the primary objective of science communication, i.e. of making our people scientifically literate, would become definitely well enough to allow good focusing of efforts as well as quantitative evaluation of their impact. Some initiatives in this direction have already been taken, but achieving the ultimate objective will take time and lot of doing and active participation of a number of other agencies.

Source: Communicator 2000 AD, Commemorative volume

Chapter 30

Perception of Graduate Programmes in Public Health about Public Science Communication

Carlos Antonio Teixeira, Paulo Rogério Gallo

Abstract This chapter focuses on the concepts that coordinators of Brazilian graduate programs in public health have about public communication of science. Communication to peers, communication including general society without necessarily a treatment of language employed in the information transmission and communication expressed in public language representing at the same time a challenge and also an obligation to scientists and to researchers, were the categories found in the analyses of answers to a questionnaire. Apparently, it indicates that the public communication of science does not constitute at this moment a policy of communication adopted by Brazilian graduate programmes in Public Health, though as an argument to encourage public understanding of health issues, it should be improved in that direction in near future

Keywords *science communication, public communication of science, representations of public communication of science.*

Introduction

This paper is contextualized within the framework of scientific communication in its source of public discourse directed to lay public. It shows the results of preliminary data analysis obtained in a doctoral research, which aims to discuss the public communication of science in Public Health Graduate Programmes (PHGP) recognized by the Coordination of Improvement of Higher Education Personnel (CAPES), which is linked to the Brazilian Ministry of Education. It is based on the theoretical framework of content analysis of Bardin (2002) to categorize the conception that PHGP coordinators have of public communication of science.

Drawing on the considerations made by Ziman (1981), scientists are aggregated not only in a scientific community, but they form an intellectual community regardless of an institution. This community without necessarily telling physical

facilities creates bonds between its members through communication, information and knowledge.

Science depends upon the printed word, which is according to Ziman, essential both for recording results that will be references to the Invisible College members, as well needed by offering an opportunity to debate and to improve the scientific data.

Scientific communication is vital for the maintenance and development of science, due to its relevance in the very heart of the science since it monitors the scientific progress. Until the seventeenth century Scientific Revolution, the science communication founded expression in books, which at that time were the only way to make new scientific ideas accessible. The emergence of specialized journals in the sequence, allowed agility in conveying ideas and it was essential to modern science, which is not only highly cooperative, but also highly competitive.

One of the subthemes of scientific communication is informal communication and the popularization of science, used, according to Ziman, to disseminate scientific knowledge to a larger scientific community and for an enlightened society. However the most recent conception of science popularization understands it as a public communication extended to society in general, transmitted in plain language.

Scientific communication in its format for the popularization of science aimed at the lay public, although it represents a problem of communication within the scientific community, according to Ziman is neither, however, trivial task nor new.

Ziman points scientific journalism as an expression of scientific communication. Although this process conveying scientific information sharing the same source of other media that form the scientific communication, like letters, books, journals and informal communications, specifically declared intentionality to the ordinary citizen.

Such intermediation in the process of scientific communication in the context of a public communication is not something that takes place without communication "noise", because "(...) the language in which most modern scientific ideas are expressed and explained takes years to be learned and cannot be paraphrased with a view to an easier understanding" and due the fact that "it is virtually impossible to expatiate about the most basic new findings, for people who do not even have the rudiments of prior knowledge about the subject" (Ziman, 1995, pp.133). This shows why the relations between scientists and journalists sometimes are conflicting.

Hartz and Chappell point at the document Worlds Apart, published in 1997 with the results of research conducted with 1,400 scientists and journalists, other difficulties that could be reduced if: a) scientists and journalists seek the path of dialogue, b) scientists receive training with journalists and journalists receive training with scientists, to learn

how to communicate with each other, c) the scientific community trains communicators to speak for different scientific disciplines, d) the journalists increase their understanding and training in the sciences, e) the editors of scientific papers demanded that the authors would include summaries of their results written in plain language, f) the journalists use peer-reviewed scientific papers to guide their writing of science texts, and g) all scientific disciplines were used by Internet resources and websites to develop communication, similarly so doing the media.

Brazilian researchers, in turn, also found communication problems that interfere in the relationship between scientists and public communicators of science with resulting difficulties for effective public communication of science.

Boni (1992), for example, studied the degree of diffusion of science and technology in non-specialized publications by the staff at the State University of Londrina. Seventy-three teachers were interviewed, 45 (61.64%) of them had sought a mean of mass communication to disseminate their works. Magazines were the most often used channel (39 teachers), followed by newspapers (14 teachers), TV (seven teachers) and Radio (five teachers).

Teachers interviewed by Boni pointed out, however, negative aspects with regard to the public communication of their works in mass media communication, such as lack of specialist journalists in science and technology in the labor market and the fact that journalists are unable to transmit scientific information properly.

Garcia and Barrichello (2003, pp.107), using data obtained in a study about perception of public science communication, carried out with scientific researchers, indicate that 47% of researchers had already some kind of problem in disseminating their research by the media. The main problems were identified as: a) Change in the sense of information (30.4%) b) Inaccuracy of language (25%), c) Exchange of information (14%) d) Superficiality (8.5%); e) Lack of background (7%), f) Numerical inaccuracies (6.2%), and g) Sensationalism (5.4%).

In health sciences area the difficulties with public communication can be observed on the results of research sponsored by King's Fund and BBC network communication, conducted in England between the years 2000 and 2002.

Three BBC programs: TV (BBC News at Ten O'Clock, and News-night BBC Radio 5 Live) and three English newspapers of great circulation (Daily Mirror, Daily Mail and Guardian) had their journalistic coverage in health and health risks studied in detail. As a result it was published the book *Health News: Risk, Reporting and Media Influence* (2003).

The research showed the dissatisfaction of the public health professionals and of those responsible for implementation of public health policies in England that was considered by the researchers a lack of media coverage on topics that are considered by those agents as really relevant to public health.

The health professionals surveyed felt that the media in their interest to present news distorts public perception by focusing on rare cases instead of communicating more frequently issues such as obesity and smoking, which kill more than the rare diseases that TV and newspapers report.

The correspondent for BBC Radio Roger Harrabin, *King's Fund* health policy Director Anna Coote, and the researcher and freelance Jessica Allen, researchers that published their findings in a book, they declare that don´t accuse the media of exaggerations or misinterpretations, but while journalists always seek to present new news, should not forget that information circulating in the media influence both opinion leaders and the public, and that the public may have their behavior influenced by news in ways that affect their health.

Eventually, Bubela and Caulfield who searched 627 articles published between January 1995 and June 2001 in daily newspapers in Australia, Canada, USA and England, contained in the database "Dow Jones Interactive and Canadian News Disk" and relays information related to genetic research found that most newspaper articles accurately convey the information obtained in peer-reviewed scientific papers published in journals.

Bubela and Caulfield´s survey revealed that 63% of newspaper articles did not contain exaggerations or errors, 23% were found as slightly exaggerated and only 11% were considered moderately or highly exaggerated.

The article published by Bubela and Caulfield in the prestigious Canadian Medical Association Journal also indicates that journalists are in danger of being led by scientists to the exaggeration of some journalistic articles published in the mainstream media in the genetic research area, because there is a tendency on the part of researchers and scientists to overestimate the benefits of genetic research while underestimating its costs and risks.

C by her turns complements the Bubela and Caulfield's statement (2004, pp. 1399) that most people take note of issues related to genetic research through the media, stating that "lay people get from the media a substantial amount of information about health and related topics" (Condit 2004, pp. 1415).

It cannot be concluded as a negative influence of the media as if it were a kind of fulfillment of the theory of Tabula Rasa. Figueredo (2000), for example, opposes the idea of a conspiracy theory regarding the influence of the media, referring to studies that show certain limitations of that influence and recognize the public's ability to filter information from the media. Media messages, according to Figueredo, are selectively processed and compared with other sources.

These considerations were made in order to induce a reflection on the part of graduate programs about the possibilities of a public communication of research results, they produce using the resources of mass media.

Materials and methods

The findings, related in this chapter, with the Brazilian coordinators of PHGP are part of an exploratory and analytic study that has a qualitative approach. This study seeks to understand the concepts that Coordinators of Graduate Programs in Public Health recognized by the Coordination of Improvement of Higher Education Personnel (CAPES) maintained by the Brazilian Ministry of Education have about public communication of science

The study is part of the doctoral project in development at the School of Public Health, University of São Paulo (FSP-USP) - Research Protocol number 2072, approved by the Ethics Committee for Research (May, 5/6, 2010).

The analysis was based on the answers given by 31 (of 43) Coordinators to the question: "For you what is public communication of science". This question was included in a semi-structured questionnaire applied during the Forum Coordinators held between 05 and 06 May, 2010 at the FSP-USP.

The results and discussion about the responses of coordinators were organized taking into account the referential analysis content of Bardin (2002).

The conceptions of public science communication were divided into categories defined a posteriori and object of analysis of two researchers. For ethical reasons, it was preserved the identity of persons involved.

The objective of analysis content, according to Bardin, is to achieve a deeper meaning, given by the speaker of a particular produced text. This methodological approach offers an understanding of the discursive plan linking language and society that are interspersed by the ideological context.

The messages given by the authors call for an interpretation, whose ultimate meaning arises as a result of an observation and careful analysis. The analysis content provides techniques and objectives that promote the realization of the true meaning of the text.

During the analysis procedures of coordinators' responses to the question about the conception of public communication of science, sued a first step, the "floating reading", i.e., the first reading of the texts produced by the deponents. Validated hypotheses were raised in the following steps of the application of the analysis content method. The formulation of hypotheses allowed the creation of criteria for classification of results. Categories of meaning were created and processed in sequence to the intersection of the responses and the observed frequencies.

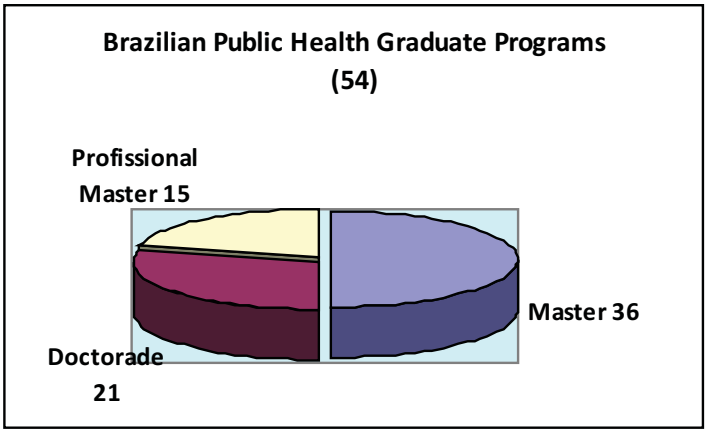
According to the methodological presupposition of content analysis, the text reveals the context, which means that text production is revelatory of personal opinions and beliefs of the subject.

Results

There are in Brazil 54 graduate programs in Public Health recognized by CAPES that are offered at 35 higher education institutions, 29 public universities and six private institutions. In these programs, 36 courses of Master, 21 PhD and 15

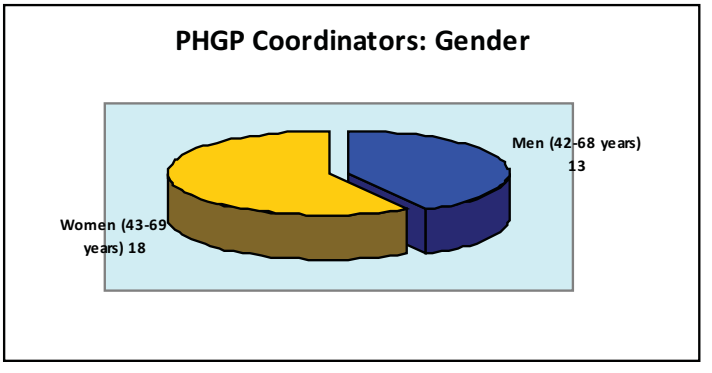
Professional Masters are offered (Table 1). The PHGP have from one to 36 years of recognition by CAPES.

Table 1. Brazilian Public Health Graduate Programs



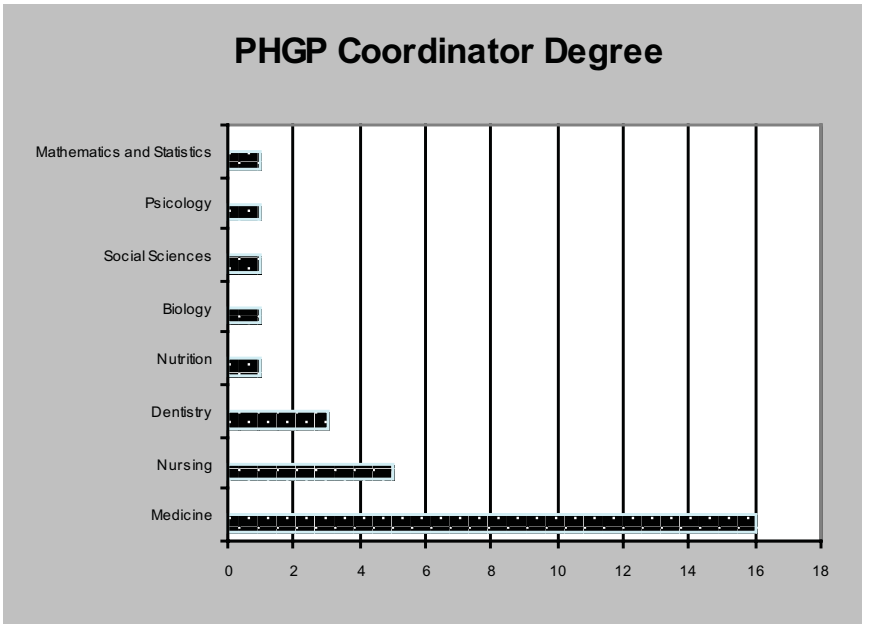
The 54 PPGSC are run by 43 coordinators. Of these, 18 are female and 13 male, aged between 43 to 69 years (women) and 42 to 68 years (men) - (Table 2).

Table 2. PHGP Coordinators: Gender



The PHGP coordinators have the following college degrees: Medicine = 16 (eight men and eight women), Nursing = 5 (women), Dentistry = 3 (two men and one woman), Nutrition = 3 (three women), Biology = 1 (Man), Social Sciences = 1 (woman), Psychology = 1 (man) and Mathematics and Statistics = 1 (man) - (Table 3).

Table 3. PHGP Coordinator Degree

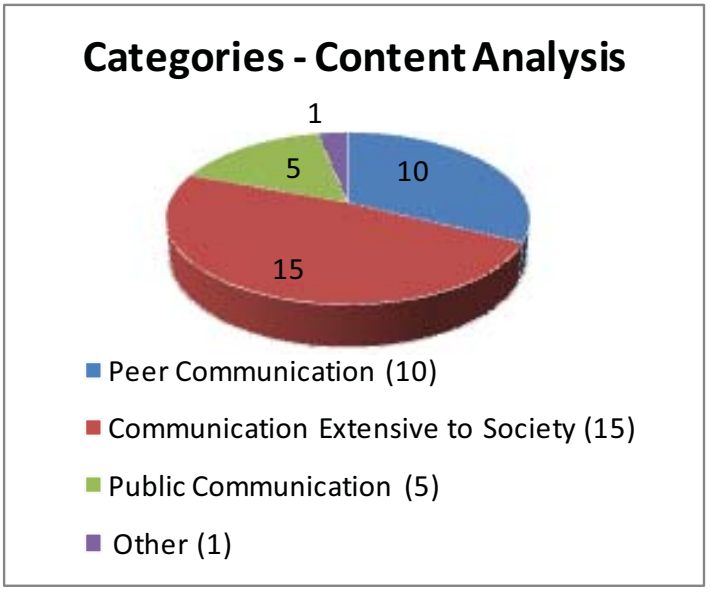


The questionnaire made possible to verify how long the deponents have been working as a program coordinator. This time ranged from one month to eight years. At the time of the collected data, nine coordinators had recently been sworn into office and were running the coordination from one to eight months (one for a month, two for three months, one for four months, two for six months, one for seven months and one for eight months). Twelve coordinators have been in the position between one and eight years (one for one year, two for one and a half year, two for two years, 10 for three years, two for four years, one for five years, one for five and a half year, one for six years and two for eight years).

The PHGP coordinators work in 37 different lines of research. The predominant line of research is Epidemiology (six from 31 coordinators).

In regard to the analysis content of coordinators' responses to the question about the conception of public communication of science, we have the following: Ten Coordinators issued responses identified as Category 1: Peer Communication - Communication between peers. Fifteen coordinators had their answers included in Category 2: Communication extensive to society - non specified language. The responses of five coordinators were included in Category 3: Public communication – accessible language. It was not possible to relate the response of one coordinator in one of the three established categories during the process of content analysis, so that response was included in a category identified as "Other" (Table 4).

Table 4. Categories – Content Analysis



Considerations

Regarding the information coming from the first part of the questionnaire, it is noteworthy that there is no concern in this study to analyze its meanings and implications.

It should be noted that on gender representation in the coordination of PHGP the number of women (18) is higher by 16% the number of men (13). The ages of women and men are similar, between 43 and 69 years for women and between 42 to 68 years for men.

Most coordinators (52%) are graduated in medicine, and only two coordinators, who have graduation one in Social Sciences and the others in Mathematics and Statics were not more directly related to the health field at graduation studies.

It was not a subject of specific analysis either the period of time that the coordinators are in the position of administrative leadership - eight years the maximum time, or the time that numbers of years the programs have recognition. We highlight the fact that three programs have been recognized for over 30 years, seven programs have been recognized for less than 20 years and more than 10 years and 10 programs have been recognized for less than 10 years.

In this study based on content analysis, what was really sought out to highlight the concepts that coordinators have of public communication of science.

The public communication of science understood as a communication that must be extended to the wider society is the prevailing (15 responses). Although this conception advance over the second prevailing conception, which restricts

the public communication of science to the communication among peers (10 responses), the narrative of the deponents does not show the significant fact that the extensive communication to society should be expressed in a language format that the lay public could understand, and it is just when the lay people are able to decode scientific information which may be appropriate and start to gain significance.

Although the response of just one of the deponents could not be included in any of the three conceptions of public communication of science, it was considered significant because it reinforced the result of the analysis of the responses previously presented in categories one and two, emphasizing the idea that apparently PHGP coordinators do not have a conception of public communication of science more concatenated to the concept of knowledge society and scientific culture.

Finally five coordinators understand the public communication of science in a more significant sense. The analysis of their responses allowed including their conception of public communication of science in the third category, because they understand this kind of communication as a translation of scientific language code to an accessible language directed to the wider society.

In addition, in this third category of analysis is included the understanding that these five coordinators have about the responsibility that scientists and scientific researchers have in sharing with the society, in an understandable language, the results of their research work.

It should also be observed that in this category of analysis was included the idea that the practice of the public communication of science, although understood as an obligation, also represents a challenge for the researcher. Particularly about this opinion one can deduce the need to insert, with urgency, in graduate programs in general and in PHGP in particular, the debate about the public communication of science.

As this present study is part of a doctoral research in progress which discusses the public communication of science in PHGP, it is expected that the results that will be obtained in the sequence, with more data, would contribute to the discussion about this peculiar form of communication of science.

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References

BARDIN, Laurence. Análise de conteúdo. Trad. Luís Antero Reto e Augusto Pinheiro. Lisboa: Edições 70, 2002. 3ª ed).

BONI, P.C. Difusão de Ciência e Tecnologia: A experiência da Universidade Estadual de Londrina. Dissertação de Mestrado. São Bernardo do Campo: Universidade Metodista de São Paulo, 1992.

BUBELA, T.M. CAULFIELD, A.T. ―Do the print media 'hype' genetic research? A comparison of newspaper stories and peer-reviewed research paper. Canadian Medical Association Journal. Apr. 27, 2004; 170.

CHAPPELL, R. e HARTZ, J. World's apart: how the distance between science and journalism threatens America's future. Nashville: First Amendement Center, 1997.

CONDIT, C. Science reporting to the public: Does the message get twisted? CMJA; 170(9): 1415-1416.

FIGUEREDO, M. Mídia, mercado de informação e opinião pública. In: GERMAN, C. et al. *Informação & democracia*. Rio de Janeiro: Editora da UERJ, 2000, p. 39-46.

GARCIA, S. de C. BARRICHELLO, E.M. da R. Mídia Impressa: a percepção de jornalistas e pesquisadores sobre a divulgação científica. In: SILVEIRA, Ada Cristina Machado da. Divulgação científica e tecnologias da informação e comunicação. Santa Maria: FACOS-UFSM, 2003.

HARRABIN, R.; COOTE, A.; ALLEN, J. Health in the news: risk, reporting and media influence. London: King's Fund, 2003.

ZIMAN, J. A força do conhecimento. BH: Itatiaia; SP: Edusp, 1981.

Chapter 31

Brazil's 'Fome Zero' Strategy

Vinod Vyasulu

Introduction

In the last two decades, many Latin American countries have used cash transfers as a major element of poverty reduction strategies[1]. Of these, Brasil has the largest cash transfer programmes to the poor in the world and this has now grown into a broader strategy for poverty and inequality reduction. It is considered to be successful: manuals have been written to help other countries set up such programmes[2]. A report (March 2009) of the International Labour Organisation documents this success.

The cash transfers began in the mid 1980s in Campinas in Sao Paulo, and in the Federal District of Brasilia. Cristovão Buarque, the former Governor of Distrito Federal (Brasilia), is considered the father of the program. These are big and powerful municipalities and the example caught on, spreading to around 70 municipalities in the next few years. They were expanded greatly in scope and scale in the last decade to provide a measure of social security for the poor in a highly unequal society. Both poverty and inequality have been reduced in Brazil. What can India learn from this experience? This paper hopes to begin a debate on this subject

This paper is organised as follows. Section II describes the cash transfer programs Brasil has implemented. Section III explores some of the immediate and long term impacts of these programs. Section IV looks at lessons for India.

This section describes the fome zero strategy, which consists of different components, one part bring conditional cash transfers to the poor, and the other actions designed to fight inter-generational transmission of poverty.

What are cash transfers?

Since poverty is lack of income, the federal government transfers cash, to families in poverty, to help them meet basic needs, if the family agrees to send children to school and to get them vaccinated. The amount depends on the family income

[1] For example, Argentina, Chile, Guatemala, and Mexico. The Mexican Progresso has morphed to Oportunidades. This paper limits itself to the Brazilian experience.

[2] FAO Regional Office for Latin America and the Caribbean, reference below.

and the number of members in the household. For women and children, there are conditional cash transfers for specific actions. If the child is taken to a health centre for regular checkups and inoculations, a certain amount is transferred. If a woman goes to an institution for delivery, there is another such transfer. These are monitored by the Social Assistance Reference Centre that has been set up in municipalities of high risk areas[3].

One part of the fome zero strategy, called bolsa familia—family grant—is *a direct income transfer* to benefit families earning a monthly income of not more than R$ 120 per member in any municipality in Brasil. The objective of the income transfer is to enable the poorest families to combat hunger and poverty and at the same time promote these families access to health, education, and social welfare public services[4]. Families that participate in the programme are screened on the basis of the Federal Government's Unified Social Services Register—the *cadastro unico*—and receive a monthly benefit ranging from R$ 20 to R$ 182, depending upon the family's per capita income and on the number of children and adolescents in the family. It is paid out through a magnetic smart card, issued in the name of the wife or mother in the family (97% of the cases). Brazil has made excellent use of Information Technology for delivery of such services.

Poverty criterion

Brazil does not use a poverty line as India does. The IPEA—Instituto de Pesquisa Econômica Aplicada, (www.ipea.gov.br)—has established an extreme poverty line at (Brazilian real, R$) 62; this is one-fourth of the minimum wage. This gave a figure of 14.6% of the population in extreme poverty. It calculates full poverty at twice the extreme poverty line, or R$124, and this gives a figure of 33.6%. This is roughly the estimates the Government works with.

How are the poor identified?

The federal government maintains the database, called cadastro unico, in which the details of all the eligible households are available, and from which the poor are identified. Over the years the Government has worked on improving the cadastro, using modern electronic technology effectively. It now has an accurate record of all the families that participate in the fome zero strategy. To help municipalities and incentivise them to work with the federal government, the MDS has designed a Decentralised Management Index (IGD) to measure quality of implementation and to ensure regular and automatic transfer of funds. Municipalities now use

[3] Action is *not* taken against families that fail to meet the conditionalities. They are counselled by MDS staff. The reasons for not meeting the conditionalities are examined and an attempt to solve them is made. Warnings are given, but money transfer is not stopped. (Personal communication by several people I met).

[4] Taken from the Social Development: Summary Guide, published by the MDS in 2008.

this database for monitoring the families and for planning social services. This *cadastro unico is at the heart of the implementation of fome zero.*

The handling of funds from the Federal Government (MDS) is the responsibility of the state savings bank, the Caixa Economica Federal[5]. The Caixa also issues the smart card for the recipient which bears a unique Social Identification Number, NIS, based on the cadastro.

Why cash transfers?

Brasil is one of the most unequal counties in the world, with a large number of people living in extreme poverty[6]. Governments elected after 1988 have been concerned with this issue and began to experiment with cash transfers of different kinds to reduce poverty. During the Presidency of Fernando Henrique Cardoso, his wife, Ruth Cardoso, a well known anthropologist, played an important role in ensuring that federal funds were transferred directly to municipalities, rather than be routed through provinces, as had been the practice earlier. This reduced complications and delays in the receipt of funds by municipalities[7]. She was also successful in persuading legislators that the transfers should go to the woman in the family.

Consolidation and expansion of cash transfers

Towards the late 1990s and in early 2000, the Workers' Party—PT—whose candidate, popularly known only as Lula, was making his fourth bid for the Presidency, set up several groups of independent scholars and experts to design a feasible programme of poverty reduction that they would implement if elected. The results of these committees, which built on the lessons learned from earlier efforts, came to be known as the umbrella Fome Zero (zero hunger) strategy. It is composed of four coordinating axes: access to food (the cash transfer part), the strengthening of family agriculture, income generation and social organization, mobilization and control.

The Lula Government which took office in 2003 has intensified this programme of cash transfers by expanding them and implementing the fome zero—zero hunger—strategy. Several ministries, with the Ministry of Social Development and Fight Against Hunger (MDS) as fulcrum, coordinate more than 30 actions at all levels of government. "We hope not only to insure better access to basic goods

[5] I understand that now the second public sector bank, the Banco do Brazil, also participates in this programme.

[6] This is term they use. Hunger in the sense of no access to food may not be that accurate for Brasil. In the Amazon, people are poor, but there is no lack of food. The lack of income is the problem

[7] The transfer of funds went through stages—first from the federal government to the province; then from the federal government to the municipality; now they go directly to the household.

on the part of the most vulnerable groups, but also to invest in the qualification of people, through improvement in their health, nutrition and education…Social and economic inclusion of the poor is one of the urgent points in the political agenda of our country, where policies directed at the poor also intend *to create the conditions necessary to enable these individuals to rise above their current condition in a sustainable manner*…It is also paramount to invest in competence, effectiveness and transparency of management, thus ensuring that the goals of public policy can be met."[8](Italics added). The Ministry's budget in 2010 is US$ 13.7 billion—an increase of over 300% from 2003. Increasing the minimum wage has been an important component of this strategy for reducing poverty. Since 2004, this minimum wage has increased in real terms by more than 200%[9].

Background

When the end of the military dictatorship was negotiated in the early 1980s and work on a new Constitution began, this experience played an important part in the design of a welfare state. The 1988 constitution is federal, and guarantees citizens certain basic rights. Municipalities have been important in Brazil, with elections being held even when the country was under military rule. The Federative Republic of Brazil, formed by the indissoluble union of the states and *municipalities* and of the Federal District, is a legal democratic state[10]. This is a major difference with India[11].

For example, after 1988, a universal health system (SUS) was put in place. The Union, States and municipalities have developed a sophisticated system of money transfers. In the case of social security, Brazil has a SUAS. For education Brazil has the FNDE—National Fund for Development of Education. The system that transfers funds to municipalities was not an invention of any specific government but something that was required by the new constitution. Poverty is not an acceptable reason for people not accessing these services provided by the state. Cash transfers are meant to provide the minimum income needed to help them do so.

Legal basis for CCTS

An interesting aspect of policy from 2003 has been the fact that these programmes have now been enshrined in law. They are no longer simple executive decisions.

[8] Patrus Ananias de Sousa, Minister for Social Development and Fight Against Hunger, in the Introduction to the Evaluation of his ministry's policies, 2007.

[9] Some economists regard this as the most important contributor to the reduction in poverty.

[10] Article 1 of the 1988 constitution, italics added. Further, " All power emanates from the people, who exercise it by means of elected representatives *or directly*, as provided by this Constitution." Civil society plays a very important part in social policy making and monitoring in Brazil.

[11] Although I must note that most of our leaders in 1947 started in municipalities—Nehru in Allahabad, Patel in Anand, Rajiji in Salem etc. See forthcoming paper by Arkaja Singh, CBPS.

A series of laws have been passed since 2003 to provide a framework for social protection policies so that later governments cannot go back on these commitments without Parliamentary sanction. The law establishing bolsa familia provides for 'complementary actions'. These include improving schooling of children, vocational training, and support for job and income generation. This support is provided by municipalities. There is also an inter-ministerial committee that includes Education and Health to ensure efficient management at all levels. In 2010, Constitutional amendment no 64 included The Right to Food in Article 6 of the Brasilian Constitution. In an essential sense, these laws have made these cash transfers more or less permanent, not subject to change with changes of government.

There are two aspects to the Zero Hunger strategy. One is the immediate relief from poverty. The second is the prevention of the inter-generational transmission of poverty (partly) through investment in people's qualifications—education. This is where complementary actions come in.

Immediate relief

In 2003, earlier programmes of cash transfer were re-examined and consolidated and expanded. Four different schemes were integrated into one major one for more effective administration as all catered to the same social group. This would also leverage synergies from jointly promoting education, health and nutrition.

To date, over 12.4 million families (or about 49.5 million people or 26% of the population) across the country have participated in this programme. The total amount spent is about 0.5% of GDP. It has been estimated that there are about 15 million families that are poor in the country[12]. By extending this to about 3 million more people, the entire eligible population would be covered.

Fighting inter-generation transmission of poverty

To support the local economy, there are a series of complementary schemes. These are part of the Social Assistance Organic Law, LOAS. The objectives of the Food Acquisition Programme—PAA—are to promote family agriculture throughout the country, and to form basic stocks. The programme operates through the purchase of food and livestock products produced by rural family farmers registered with the National Programme for Strengthening Family Faming—Pronaf. This may go up to R$2500 per farmer per year. This limit is raised yearly and currently stands at R$3,500. No tendering is needed if the prices are not higher than those in the regional markets. Some varieties of this programme are:

- Direct purchase from family agriculture (CDAF). Food from family farms is purchased by Conab-The National Company for Food Supply, without a

[12] Personal communication from Raul de Mota Silvera Neto in Recife. The work referred to is that of Ricardo Paes de Barrios.

tender process and this is donated to the social assistance programme in the area.

- Special Anticipated Purchases from Family Agriculture (CAEAF). This is a guaranteed prior purchase from farmer families registered with Pronaf.
- Local Direct Purchases from Family Agriculture (CDLAF) This is aimed at improving family agriculture and how and where it is sold. It is meant to promote the local economy by directly meeting the supplementary feeding demands of the regions' social programmes. This is done through direct agreements between MDS and states and municipalities.

There are other complementary programmes. For example:

Continuous Cash Benefit—BPC: payment of one minimum Brasilian salary—minimum wage—to people 65 and older and to the handicapped who cannot work, and whose family income does not exceed one-fourth the minimum salary.

Child Labour Eradication Programme—PETI. This is meant to take children and adolescents out of forced labour by (a) Direct income transfer by MDS by smart card, to families with children involved in such labour (b) provision of socio-educational activities with MDS co-financing, organised by the municipality and (c) family social follow up.

Food Banks Programme. These are set up in municipalities with a population of 100000 or more. They accept food donations and, combat food waste in urban agro-systems and distribute the food to the locally food insecure.

Popular Restaurants. These are set up in municipalities of over 10,000 people as a collaboration between MDS and local governments. They have a capacity of serving at least 1000 healthy meals per day at R$ 1 per meal for those who must eat away from home because of work[13]. Some also provide breakfast and other healthy foods at half a real.

Cisterns Programme. This is a simple technology for storing rain water and mitigating water shortage problems in the semi-arid regions of the country. This and other local development programmes have been evolving over time, the basic objective being support to the local economy by supporting local production and consumption.

In sum, the Fome Zero is an umbrella strategy under which a large number of complementary actions can be implemented by putting cash in the hands of the poor family and encouraging them to not only buy food but also access and use available public services. It has built upon the reforms under the earlier Presidency of Fernando Henrique Cardoso which proved the concept and provided the base for fome zero. The specific complementary activities undertaken are based upon a region's need. They range from local purchases for local needs to running popular restaurants to encouraging water harvesting. The cadastro, or data base, which has been improved and now contains useful information, is the starting point for

[13] Recently, a visiting team from the Delhi Government was taken for lunch in a popular restaurant in Belo Horizonte.

local planning by municipalities. The legal structures of social protection at the municipal level design programmes on the basis of needs locally assessed. These are then brought under the fome zero umbrella strategy, and various options of funding are available, from grants by MDS to co-financing arrangements. Different ministries and levels of government, work together to implement each of these actions, with horizontal integration in the municipality. The integrated approach looks at all dimensions of the issue of poverty and hunger and aims to alleviate immediate hunger and provide the base for a productive life later.

There is no corruption in the implementation of bolsa familia. Not one of the many people I met, and they were of various persuasions, felt there was corruption in the implementation of fome zero. There could be some irregularities here and there, but in such a large programme, these were negligible. Officials at the MDS spoke of attempts to submit duplicate accounts etc, which were identified on the basis of data in the cadastro unico and rectified. Audits are regular. The money reaches those it is meant for, in time. They spend it on essentials[14]. Those who receive the transfer are indeed the poor. It is possible that some who were poor did not receive the money as they were not registered in the cadastro. This has to be improved upon.

The cash transfers have not only served to reduce poverty, they have also contributed to a reduction in inequality as shown by the Gini ratio[15].

The population below the poverty line decreased from 28.17% in 2003 to 19.31% in 2006; 14 million came out of the poverty situation; a reduction of 31.4%. Brazil has already met the MDG of reducing extreme poverty by half, and the Government has extended the target to a quarter.

Between 2001 and 2007, the Gini coefficient, derived from the National Household Survey, declined from 0.593 to 0.552.

Between 2001 and 2008, the income of the poorest 10% grew six times faster than the income of the richest 10% of the population.

From 2003 to 2008, child malnutrition fell by 73% and child mortality decreased by 15.3%.

There have been a number of studies around the time the programmes were expanded in 2003. These were to set the stage—formulation of programmes type. They could at best provide some kind of a baseline.

A round of studies took place around 2005 and these were published a few years later. However, since 2005-6, there have been many changes. The world has gone into a recession. This may not have been drastic in Brazil but it has had an impact. The Brazilian government expanded cash transfers in part of a strategy to mitigate the effects of such global recession.

There is now a huge literature on bolsa familia. Much of it is positive in its conclusions about success of the programme. There has been a decrease in

[14] I asked if it was diverted to alcohol (as we would expect in India), but was told it was not.

[15] Information on poverty reduction provided by MDS in a presentation dated 23/04/2010.

regional inequalities. The north east, which is the poorest region of Brasil, and where half the country's poor live, has benefitted from this programme. This has been an important contributor to the reduction of both poverty and inequality. Scholars are now examining the differential impact by gender and region, to suggest improvements where needed[16]. This is work in process.

What seems clear is the programme has been successfully implemented. There is little doubt in Brazil among scholars that the bolsa familia has succeeded in meeting its goals of reducing poverty.

Education. Brasil currently spends about 4.2% of GDP on education. As a percentage of total government expenditure, it is 10.8%. A large part goes to higher education[17]. There are huge regional disparities. Private schools are considered to be better, and people would like to send their children to them, rather than public schools. Scholars feel this is the crux of the Brasilian dilemma. The bolsa familia is taking children to school, but here they run into a *supply constraint*. School quality is poor and consequently the quality of education is poor. There is also a problem of violence in some of these schools.

The bolsa familia has succeeded in getting both boys and girls to school. It has had some impact on reducing child labour. Girls have come into the market, from just working at home. Boys may continue to work, but with schools open for four hours a day, they also go to school. But unless the supply constraints are eased, further progress is unlikely. And the problems go beyond financing. There is a shortage of trained and competent teachers who will need to be paid fairly. The social status of teachers is today low. If the pent up demand released by the fome zero strategy is to yield results, then this is a constraint to be immediately tackled.

This may or may not be a problem at the university level today. I mention this because of the observations of Richard Feynman[18] many years ago. "I finally figured out that the students had memorised everything, but they did not know what anything meant." Some university professors I met confirmed this problem even today. It is then much more than a simple financial issue.

Access to school is a *necessary* condition for education, but it is *not a sufficient* one. The quality of schools remains a challenge. Scholars I met feel that this has been the big failure of Brazil.

Health. The universal health-care system set up in 1988, based on the rights defined in the new Constitution has two components: one public and one private. Government-funded services are provided through the decentralized Sistema Único de Saúde (Unified Health System, SUS), which relies on financing and management from federal, state, and municipal governments. SUS funds everything from annual checkups and free drugs to complex surgeries and health

[16] See Clarissa Gondim Teixeira, below.

[17] I am not sure whether this is a higher vs primary education issue or a problem of general under-funding of education.

[18] Richard P. Feynman: **Surely You're Joking, Mr. Feynman: Adventures of a Curious Character**, Bantam, New York, 1986.

prevention education. (But I understand there are long and frustrating waits for treatment, and concerns about quality). In addition, businesses and individuals can purchase health care (which is expensive) through private insurers, regulated by the Agência Nacional de Saúde Suplementar (National Supplementary Health Agency). Those who opt in to such a system receive a tax rebate for these expenses.

Financing for the public health care plan has been a concern. Brazil's federal, state, and local governments all raise revenue to help pay for health care. Taxes on individual income, property, goods and services, and social security (at the federal level) are used to fund health. Yet even as Brazil has secured multiple sources of funding, the cost of universal health care is quickly outpacing the revenue needed to sustain it. The World Health Organization estimates that health expenditures in Brazil have risen from 6.7 percent of GDP in 1995 to 7.5 percent in 2006. The Government may face a problem in increasing the SUS budget because this could affect other anti-poverty programs. As a core aspect of the 1988 democratic Constitution, SUS cannot be shut down. With social protection enshrined in law, there is little flexibility in a situation of fiscal strain.

There is also the larger question. For a long term impact, there must be no supply side constraints. This is an issue in education. In health this *may* have been tackled. Expensive treatments—catastrophic expenses like dialysis—are provided by the SUS to everyone. Waiting for treatment may be bad, but not having access at all to treatment is far worse. Improvements will be welcome.

There are some concerns that have been expressed. One is with the approach of the fome zero strategy; what effect will this commitment of the state have on people, in terms of a culture of dependency on the government? While evidence has been produced by the MDS to show that the bolsa familia programme has not taken people out of the job market, or made them work less, this is at a survival level. Given the supply side constraints, and current legal obligations, Brazilian scholars are concerned that the programme will run for ever; that it will become a dole the population is dependent upon. When will such charity end? Under what conditions should it end? Should not the country be thinking about this now?

A second has been the kind of picture of poverty projected in the recent communications of the Government. The poor are shown as noble and strong, who live in a society that is supportive. It is made to appear that poverty is a desirable situation. They argue that no one is poor by choice. The behaviour shown is that of individuals who must survive in a hostile and difficult environment. While it is essential to help the poor out of that situation, it is wrong to project poverty as noble and dignified.

Third, the fact that all this has been enshrined in a set of laws will make things difficult at a time when the macroeconomics of the country are weak. Brazil did not suffer much in the recent recession, but it did have an impact. At that time the fome zero served to sustain consumption of the poor and was useful. But financing such programmes remains a concern in the long term for fiscal economists.

Brazil experimented with a tax on bank transactions to part finance the fome zero—a Tobin type tax, but this has been rejected by Congress, (CPMF, – CONTRIBUIção PROVISORIA SOBRE MOVIMENTAçÕES FINANCEIRAS) and the burden has shifted to the general revenues.

Can Brazil continue to sustain and expand fome zero? Given that the bolsa familia part—the cash transfers—now cost only 0.5% of the GDP, which is growing at around 5% per year, (and the expansion is to cover at most 3 million more households) this may not be a financial problem. But education, most people are agreed, needs more resources, financial and other. Health will also need more resources, to improve *the quality of the services* available. These two already account for around 12% of GDP.

In Brazil, the tax to GDP ratio is 38%. The total expenditure is 40% of GDP. This implies a fiscal deficit of 2% which economists fear will go up, given the automatic increases in wages the law mandates and the growing pension requirements. These are committed expenditures. Some argue that the growing middle class should lead to some growth in direct tax revenues. In a few years, Brazil should be exporting oil, and that should bring in extra revenue. But this is at the moment a matter of hope. Clearly there is some fiscal pressure that will build in the coming years. Expansion of fome zero, and the easing of supply constraints may have to be at the cost of some other sector. Political choices have to be made. The new President will have to take a call on this next year.

A policy that works in one context may work in another only if the context is similar too[19]. While both Brazil and India are welfare states, there are also major differences, starting from the Constitution of each country[20]. There are institutional differences that must be addressed *before* India thinks of such strategies. Some of these are:

The working of inter-governmental relations

This is an area where India has a lot to learn from Brazil. In the recent elections to Parliament, the candidates seeking election to the Lok Sabha, fought on issues of garbage clearance, water supply and the like. These are municipal issues. The job of MPs is to legislate; this was one thing they were silent about. Members of the state Assemblies also talk of transfers and local matters, when their job is to make policies for the state. Thus local representatives are denied their space; local government in India is a sham. And unless local government—which we

[19] Recognised by Devesh Kapur, Partha Mukhopadhyay and Arvind Subramanian in 'More for the Poor and Less for and by the State: The Case for Direct Cash Transfers' in *Economic and Political Weekly*, April 2008. After a detailed discussion of past experience, they make a case for introducing cash transfers in India and recommend a modest start.

[20] Discussed in my brief review, Participatory Budgeting in Brazil: A View from India, available in www.internationalbudget.org.

denigrate by calling self government[21] works, such policies which require higher level guidance and local integration cannot work. Many studies have shown that integration of programmes at the local level is the missing link in India's development policy. Each level of government has its role and we must let it play that role. In this we need to find our way back to normalcy from where we are today.

Vertical planning and horizontal integration

This is an extension of the point above. We cannot do away with the large vision, with the mobilisation of resources and technology at the national and state levels. This does not mean an automatic top down vertical implementation by ministries, as is the case in India. We must let local governments free to plan their work rationally at their level. Freedom to reallocate budgets, freedom to choose what schemes to implement and what to postpone or reject, must be given to local governments. Even in the NREGA, evaluations have shown how 'guidelines' become rigid law. The request to frame *guidelines for the use of untied funds* in Karnataka[22] illustrates what I mean.

Supporting local economies

The Brazilian programme to guarantee local agricultural purchase for the use of local institutions, like school meals, is one we can learn from. Why cannot gram panchayats or municipalities do this in their jurisdiction? It would mean, for example, that subsidy would not be restricted, as now, to rice, wheat and sugar, but would include cereals like ragi, jowar and bajra, and pulses grown across the country. This would have ecological and other positive consequences[23]. It is a far cry from a Food Corporation of India that buys food in one corner of the country to send to another, and in the meantime deals with storage, transport and related problems. It is a far cry from the public distribution system that all agree has not worked. Here it is local purchase of local produce, consumed locally. A rational approach we must learn from. My guess is that the administration here will find this hard to believe. It is the mindset issue.

Use of information technology

India has a reputation as the back office of the world. Yet, our use of information technology in governance is poor. We could say this is because a core-requisite

[21] The Congress led the struggle for 'swaraj' in India, but we do not call the national government the Self Government of India. The use of the word Self before Government suggests some kind of inferiority. For a history of the use of this term see Arkaja Singh, forthcoming paper from CBPS.

[22] Articulated when we were examining public expenditure in Karnataka recently.

[23] Discussed by S Varadachary in his H C Mehta Memorial lecture at the H C M Rajasthan State Institute of Public Administration, Jaipur, in March 2010.

of e-governence is governance itself! But the way in which the Cadastro is maintained and used, the way in which electronic transfer of funds takes place[24], shows the scope for the use of technology in human development projects. The side effect of such use is to curb corruption in the flow of funds. We have only now set up the Adhaar project to give each of us what may be called Nandan numbers; Brazil has achieved this many years ago, and it uses it to good effect. The health system has a solid IT backbone[25]. Brazil provides us with an example of what we could do very quickly if we so choose.

Transparency and civil society

In India, the government, perhaps as a result of our colonial heritage, works in secret. Our ministers take an 'Oath of Secrecy'[26]. The newly enacted Right to Information Act has begun to dent this system of secrecy, but it is a long battle that citizens and civil society face. In some cases, like the Mahatma Gandhi Rural Employment Guarantee Act, social audits have been included in the law. This is a right we have to fight for each time. Such openness of information will be an essential pre-requsite for any kind of success of an Indian fome zero. Civil society, in addition to formal audits, must act as a watch dog in such a strategy. Brazil can show us the way in this.

By way of conclusion

A case can be made for a cash transfer system in India. In the existing situation of an incomplete transition to a multi-level structure of government, with insufficient clarity on inter-governmental relations, especially among the elected representatives, and an overarching set of civil services fighting for turf at union and state levels, it will be difficult for India to design suitable cash transfer and related programmes. Brazil's experience shows that cash transfers, when implemented properly are at best a necessary condition for poverty alleviation. Supply side constraints have to be removed if the increased purchasing power is not to lead to unbridled inflation that will hurt the poor badly. India's investment in health, for example, is so low that it cannot handle more demands being made on the system. Creating such demand without measures to meet it would be irresponsible indeed.

India also must wait for the unique identity and database—which will still be far from the kind of cadastro Brazil has—before thinking of such strategies. India has a long way to go in using information technology and electronic transfers. Brazil could do what it did for these reasons.

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[24] It could be that Brazil unfortunately has not heard of the Treasury, that notorious institution in India!

[25] See, for example, http://www.infoq.com/articles/Brasilian-Healthcare-System.

[26] Interestingly enough, the President of India does not have to take this oath of secrecy on assuming office.

Useful websites

www.mda.gov.br, www.fomezero.gov.br, www.mct.gov.br,
www.transparencia.gov.br, http://www.presidencia.gov.br/ingles/

Material from the Ministry Of Social Development and Fight Against Hunger, Govt of Brazil, Brasilia

DVD: Fome Zero, also in English, MDS

Handbook on Fome Zero, MDS

Social Development: Summary Guide, Government and Society Working Together, 2008

Presidency of Brazil: Building Up The National Policy and System for Food and Nutrition Security: The Brasilian Experience, Conesa, IICA, FAO. Brasilia, November 2009.

Journal of the Ministry, Brasilia: Social Development, Edition 1, Year 1, August 2009.

Evaluation of MDS Policies and Programs—Results. Organisers: Jeni Vaitsman and Romulo Paes-Sousa. Brasilia, DF, 2007.

Vol 1: Food and Nutritional Security.

Vol 2: Bolsa Familia Program and Social.

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References

International Labour Organisation, "Bolsa Familia in Brasil: Context, Concept, Impacts," Geneva, March 2009.

International Labour Office, Social Security Department, New York, "A new deal for people in a global crisis - Social Security for all: Making the economic, financial and fiscal case", powerpoint presentation, by Michael Cichon, February 2009.

Note from Human Rights Council resolution and the report of the independent expert to the UN General Assembly (A/63/274). EXPERT MEETING ON HUMAN RIGHTS AND CASH TRANSFER PROGRAMS, 26-27 FEBRUARY 2009.

Ariel Fiszbein and Norbert Schady *with* Francisco H.G. Ferreira, Margaret Grosh, Nial Kelleher, Pedro Olinto, and Emmanuel Skoufias, "CONDITIONAL CASH TRANSFERS: REDUCING PRESENT AND FUTURE POVERTY", A World Bank Policy Research Report, 2009.

Walter Belik and Mauro Del Grossi, 'Brazil's Zero Hunger Program in the Context of Social Policy', Paper prepared for the 25th International Conference of Agricultural Economists in Durban, South Africa, August 2003.

Clarissa Gondim Teixeira, 'A HETEROGENEITY ANALYSIS OF THE BOLSA FAMÍLIA PROGRAMME EFFECT ON MEN AND WOMEN'S WORK SUPPLY' IPC Working Paper 61, Brasilia, March 2010.

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Chapter 32

Public Communication, Social Inclusion and Accessibility Issues in India and Brazil

Subhan Khan

Abstract The term 'Social inclusion' has come in a wide use during the past one decade or so. 'Social inclusion' means different things to different people and it also varies in contextual situations. However, one thing that is common is that it refers to involvement of a common man in overcoming a socio-economically disadvantageous situation like poverty and social-denigrated position like declining participation and access or rupturing social bond, i.e. solidarity. In this context, the vision of a socially inclusive society basically means a society in which all its social-beings feel valued and have equal opportunity to participate in the activities of that society.

The public communication (PC) plays an important role in achieving social inclusion. The vision of social inclusion essentially means that all the members of a society have equal access to resources, opportunities and capability building. They can learn by participating in education and training programmes and can work by participating in employment programmes and in voluntary works. They can have connections with people using different mass communication methods and using their local community's resources. They can also have a voice so that they can influence decisions that affect them.

Introduction

Secondly, the term accessibility is generally used to describe the degree to which a product, device or service or for that matter environment is available to the maximum number of people. It can also be viewed as the ability to access and get possible benefits of some system or entity. It is often used to focus on people with disabilities or special needs and their rights of accessing to entities, often through use of assistive technologies. However, it must not be confused with usability which describes the extent to which a product, device or service can be used by specified users to achieve designed goals. It may be noted that in the context of

both the countries, viz. India and Brazil, integrated and judicious use of terms like social inclusiveness and accessibility makes much sense.

In both India and Brazil, social inclusion and accessibility along with public communication in relation to science and technology have much relevance as it is highly desirable that individuals and communities in both nations have the ability to fully participate in societal activities to control their own destinies, taking into account a multiplicity of factors related to socio-economic and cultural resources. This paper describes the intersection of public communication and social inclusion or exclusion which is prominent concepts in the European discourse. Social Inclusion, accessibility and public communications are issues limited not only to possession of adequate shares but also of contribution to the resolving of both individual and collective problems of life. However, a risk is always anticipated when the concepts put uncertainties about whether the notion of exclusion/inclusion describes the complex nature of social advantage/disadvantage. Further, these issues go beyond the socio-economic parity but are not equal to it as there are many other ways also by which the disadvantaged members of the society can have bursting participation and inclusion even if they lack an equal share in resources. The term 'social inclusion' gained wide currency within the European Union especially after the Maastricht Treaty of 1996 and thereafter the general European trend has been to conceive social exclusion as distinct from income poverty, wherein poverty is a distributional outcome, whereas exclusion is a relational process of declining participation, solidarity and access. The present paper discuses the issues of public communication, social inclusion and accessibility with specific reference to scientific and technological interventions in a comparative mode in India and Brazil.

It is observed that a great deal of discussion on 'new technologies and social parity' has been focused on some oversimplified notions like "digital divide." A considerate and logical analysis of the digital divides that incorporates evidences from both affluent and poor nations has been made by Mark Warschauer (2003). It categorically demonstrates that it is the social context, far more than the hardware that shapes the access to new technologies. According to him, the modern belief that new technologies hold the key to human progress seems to be sacrosanct and his compelling critique of technophilia offers a welcome remedy to this view where he emphasizes that new technologies are neither causes nor cures, rather shifting the emphasis to the social context in which such technologies appear. In this way, he provides renewed energy for a re-evaluation of the relation between 'technology and social inequality'.

On the other hand, 'Exclusion' is shaped by various forces such as barriers to the job market, limited support networks, and special difficulties in negotiating social provisions, children not succeeding in the education system, isolation from one's society and residing in a locality marked by extreme physical disadvantages with a social environment which drags the residents to lock into the position of

an 'outsider'. In this way, reducing social exclusion has become a goal with wide appeal across the societal spectrum.

Technology and Social Inclusion/Exclusion moves beyond the limited view of haves and have-nots to analyze different forms of access to information and communication technologies and drawing on theory from social sciences like sociology, psychology, economics, political science, education, information and communications etc.

Mark Warschauer (2003) examines the ways in which differing accesses to technology contribute to the socio-economic inclusion and he takes a global perspective, while presenting case studies from developed as well as developing countries, including India and Brazil, besides others.

Indeed, there is an in-built complication which social exclusion shares with all concepts through which we try to represent the social world, namely, it is a metaphor. One view about social exclusion may not be 'what does it mean rather what do we mean by it'. However, now-a-days, the central theme for social inclusion in any society emphasizes the capability to admittance, acclimatize, and generate information using communication technologies. In this context, focus on social inclusion shifts the discussion on "digital divide" from gaps, to be overcome by providing equipment to social growth challenges, to be addressed through the successful incorporation of technology into a community. Here, what is most important is not the physical availability of public communication technologies including computers and the internet, etc., but rather people's capability to make use of those technologies to engage in meaningful community practices. The availability of access to and use of public communication technologies in low-income neighbourhood and the relationship between information and communication technology (ICT) and social inclusion, needs to be examined.

Warschauer (2003) has contested the concept of a 'digital divide', used by the U.S. National Telecommunications and Information Administration to refer to the gap between those who do and do not have the access to computers and the Internet facilities and this notion of a 'digital divide' *per se* and its logical implications, i.e. social problems can be addressed through providing computers and Internet facilities. Providing three strong examples, viz.(i) Hole-in-the-Wall experiment, (ii) An Information Age Town, and (iii) A Model Computer Lab., he has pointed out how such a notion seems increasingly difficult, for which an alternative framework has been suggested by him viz. intersection of ICT and social inclusion.

Several studies have shown that physical resources or public communication technologies alone are not sufficient to fill the gap of digital divide per se, rather relevant digital content in the local language are equally important. In this context, human resources are one of the most crucial factors affecting social inclusion/exclusion. Similarly, knowledge can be advanced through the use of technology but not merely through the provision

of hardware equipment. Public communication technologies intersect with the struggle for new knowledge and better education, but not always in the ways that benefit the marginalized learners. Hence, mere deployment of a technology is in no way a guarantee towards providing more equal opportunities, insertion, and admittance but will depend in large part on the mobilization of people to demand that technology be used in ways that serve societal interests.

Steady developments in public communications in both, India and Brazil, are now witnessed in the use of multimedia including audio-visual as symbolize by film, radio, television, etc. However, it is in the computer-based multimedia, such as in the World Wide Web (www), that a mix of textual and audio-visual elements has become superior. Audio-visual constituents on the www correspond to not just an add-on to the text but a changed symbolic mode organized increasingly on the opinion of display rather than recitation. Multimedia have already come to dominate the world of business and are assuming increasingly important role in government, non-government, and private sectors. Now-a-days, the creation of multimedia also necessitates a complex range of semiotic, technical, and designing skills and understandings, and differential admittance to these skills and knowledge will be one important divider between the "interact" and the "interact" in future economy and culture.

Till the year 2000, the percolation of mass media, in particular, televisions and telephone lines was comparatively slow in India as compared to Brazil and this may be mainly attributed to the policies followed in these two countries. As per UNDP (2000) report, the number of television sets per 1,000 people in 2000 was quite high in Brazil, (316) as compared to India, (69) only. Similarly, teledensity, measured by the number of main telephone lines per 1,000 people was also quite high, (121) in Brazil than in India which was 22 only. With respect to public communication, the access to information and technology plays a decisive role in social inclusion in the modern world. However, literacy plays a critical function in having an access to information.

India is one of the high-flying nations among the developing countries in the sector of information technology, though the Internet, which was first introduced in India in 1995, has reached only a minute fraction of its population due to incidence of low teledensity, high poverty and language barrier. In Brazil, for example, an Internet-based 'teacher training' programme was launched under the distance education programs for the overseas to reach educators outside the major cities. When this program was run for the first time, then by the end of the programme 46% of the participants had dropped out, and for the remaining participants, much of the discussions online were related to the technical problems (Collins and Braga, 2001). In the later sessions, occasional face-to-face meetings were mixed with the Internet-based program, and a 24-hour in-person online help service was

added. As a result, the dropout rate decreased to 8% and the content of the interaction was focused much more on the academic issues.

Public communication technologies are particularly important for the social inclusion of those who are marginalized for other reasons. For example, the disabled can particularly make a good use of information and communication technologies to overcome the problems caused by lack of mobility, physical limitations, or societal discrimination. It is found in almost all the research studies that social relations are shaping the access to information technology too like other technologies. Irrespective of the size whether at the micro level or macro level, pre-existing social capital can have an important authority on the capability of every individual and every group to use such a technology. A judicious mix/ combine use of internet technology with a broad range of other new and old media provide ideal opportunities for the promotion of social inclusion and accessibility through the use of public communication, both in India and Brazil.

References

Darana Souza and Danuta Chmielewska, 2011, Public Support to Food Security in India, Brazil and South Africa: Elements for a Policy Dialogue-Working Paper Number 80, April, International Policy Centre for Inclusive Growth (IPC-IG), Poverty Practice, Bureau for Development Policy, UNDP, Brazil.

Jason Marczak, Nina Agrawal, Gustavo Nigenda, José Arturo Ruiz, and Ligia de Charry ,Addressing Systemic Challenges to Social Inclusion in Health Care: Initiatives of the Private Sector , Americas Society.

Mark Warschauer, 2003, Technology and Social Inclusion, Rethinking the Digital Divide, MIT Press, Cambridge, Massachusetts, London, England

Kress, G. 1998. Visual and verbal modes of representation in electronically mediated communication: The potentials of new forms of text. In: Page to Screen: Taking Literacy into the Electronic Era, Ed: I. Snyder, Rutledge, London, pp. 53-79.

UNDP (United Nations Development Programme). 2000. Human Development Report 2000: Human Rights and Human Development.<http://www.undp.org/hdr2000/home.html>.Retrieved, February 23, 2002.

Collins, H, and D. Braga. 2001. Interação e interatividade em duas modalidades de ensino de leitura na Internet. Paper presented at the Brazilian Congress of Applied Linguistics, Belo Horizonte, Brazil.

African American Community: A case study of a community technology centre in the dual city. In Community Informatics: Shaping Computer-Mediated Social Networks, Eds: L. Keeble and B. Loader, Rutledge London, pp. 177-204.

Askonas, P., and A. Stewart, (Eds.) 2000. Social Inclusion: Possibilities and Tensions. Hound Hills, Macmillan, England.

Wallsten, S. J. 2001. An econometric analysis of telecom competition, privatization, and regulation in Africa and Latin America. Journal of Industrial Economics, 49 (1): 1-20.

Chapter 33

Comparing Post-colonial Civilisational Experiences: Brazil and India[1]

(Comparando Experiências Civilizacionais Pós-Coloniais: O Brasil E A Índia)

Dilip Loundo

As transformações ocorridas nas últimas décadas foram pródigas em promover importantes revisões em alguns dos paradigmas e conceitos que dinamizaram as ciências sociais durante o século passado. No que tange a estudos comparativos, a terminologia relativa a inserções geopolíticas, econômicas e civilizacionais – por exemplo, as antinomias 'primeiro mundo/terceiro mundo', ´norte/sul´ e ´centro-periferia´ - mostra-se cada vez mais impotente para a compreensão dos processos em curso.

Curiosamente, a dicotomia ´oriente-ocidente´ parece resistir como estruturação ôntica fundada em princípios de cisão cultural. Esta pretensa ´bipolaridade civilizacional´, radical e enraizada que remonta ao período de expansão colonial do século dezenove, imiscuiu-se, de forma complexa, com a situação do pós-guerra condicionando, definitivamente, o nível de articulação entre os espaços de vigência da Guerra Fria e os espaços marcados por distintos padrões de desenvolvimento e industrialização. Sua sobrevivência à dissolução da ´bipolaridade ideológica´ deixa claro, por um lado, que o imperialismo soviético (diria mesmo russo) não se tratava de uma 'resistência oriental' e que a chamada ´vitória do capitalismo´ era, afinal, a vitória de uma racionalidade técnica ou melhor, tecnológica, como correlato dos princípios filosóficos da individualidade monádica.

O ´outro´ do ocidente era o que convencionou chamar de ´sociedades periféricas´ onde o padrão de racionalidade parecia resistir às exigências do pragmatismo materialista. É certo que a América semi-européia, i.e., a América Latina, achava-se relativamente purgada de tais constrangimentos e distanciava-se do oriente geográfico enquanto um ocidente atrasado. Ainda assim as duas regiões – a América Latina e o oriente – irmanavam-se no que Walter Mignoli chamou de ´diferença colonial´, i.e., a submissão a uma temporalidade linear onde colonialismo, tradição e subdesenvolvimento aderiam como estigmas destinais

[1] A previous version if this article was published in Loundo D. (ed.). *Diálogos Tropicais: Brasil e Índia*. Rio de Janeiro: EDUFRJ, 2003.

em contraposição ao discurso da modernidade, progresso e desenvolvimento. (MIGNOLO, 2000:262-3)

É inegável que as transformações recentes na história da humanidade, em particular a aceleração da chamada globalização, repercutiram sobremaneira sobre essa estrutura dicotômica do pensar. A tese proposta por Samuel Huntington de um 'conflito de civilizações' (HUNTINGTON, 1993) retrata bem a implosão da bipolaridade civilizacional oriente-ocidente e a proliferação localizada e multivalente de focos de tensão entre culturas específicas. Por outro lado, os esforços teóricos de intelectuais como Edward Said – em particular, em sua obra Orientalismo (SAID, 1990) - e escola crítica que floresceu seguindo os trilhos por ele estabelecidos, foram pródigos em apontar para uma dimensão de artificialidade que embasa tal construção dissociativa.

Não há, por outro lado, como descartar o relativo caráter produtivo que a antinomia ´oriente-ocidente´ adquiriu não só como conceito instrumental que dinamizou políticas e condicionou percepções em ambos os lados mas também, e em particular, como referência de auto-percepção reativa que impulsionou grupos libertários nas regiões do chamado ´oriente´. Basicamente, entretanto, ela não teve o poder de alterar profundamente as articulações culturais no nível profundo e, portanto, passa a constituir um fator a mais entre outros não menos relevantes.

Brasil e Índia emergem neste contexto como referências paradigmáticas. Para usar a terminologia sob avaliação, são dois ´sules´ separados pelo abismo civilizacional ´oriente-ocidente´, agravado até recentemente por uma inserção distinta na Guerra Fria. A filiação ao sul aparece como uma espécie de reconciliação de elementos aprioristicamente separados, com o que se limita o alcance das análises comparativas. Cabe indagar, de saída, a pertinência de tais categorias em face da real inexistência de homogeneidades nos espaços geograficamente delimitados. No que tange à Índia, por exemplo, a revelação ainda no final do século XVIII da filiação do sânscrito e das modernas línguas indianas e de certas estruturas simbólicas de organização do espaço social ao universo indo-europeu - como o demonstram os estudos de George Dumézil (1961) – poderia sugerir uma filiação a espaços civilizacionais comuns. E de fato, um estudo ainda que introdutório das categorias do pensar vigentes nas fontes gregas e romanas, levaria à conclusão de que, por exemplo, o discurso filosófico e religioso da Índia encontra-se fundamentalmente mais próximo da tradição européia do que da tradição chinesa ou árabe. O padrão de diálogo mantido entre esses espaços nos tempos que se seguiram à campanha de Alexandre – tão bem refletido nos testemunhos literários da época, como por exemplo em Plutarco (1999) – não nos aponta para qualquer fosso dialético mas para uma sintonia cultural onde há afinidades e diferenças.

No que tange ao Brasil, a pertinência originária ao ocidente é igualmente tênue e relativa. Do ponto de vista do projeto que comandou a expansão colonial, o Brasil é – me perdoem o aparente absurdo - muito mais ´oriental´ do que ´ocidental´. Não somente porque o mapeamento deste espaço geográfico se fez

em meio a um compromisso na direção do oriente, mas fundamentalmente porque a colonização do espaço ´esvaziado´ se deu através de um imaginário tomado pela expectativa da Índia que subliminarmente agia em prol da re-construção do oriente no Brasil. Coube a Gilberto Freyre o mérito de apontar para este fato que ele designou de 'componente asiático na formação da identidade brasileira'. (Freyre, 1953)

E é justamente nas matrizes básicas da formação da identidade brasileira que vamos encontrar os elementos menos ocidentais. E tudo começa na própria Europa que está longe da homogeneidade que a construção hegemônica sugere. De fato, como sustentou cabalmente Leopoldo Zea (1990:97-115), as nações ibéricas sempre representaram um espécie de ocidentalidade de segunda categoria em face de uma situação de hibridez étnica e racial que não se conformava com os padrões de pureza e alvura anglo-saxónica. E mais importante, esse europeu semi-ocidental teve ainda de se haver no novo mundo com uma multiplicidade étnica e cultural que subsumimos equivocadamente sob os conceitos de ´índio´ e africano´. O novo cultural gestado na confluência de tais matrizes só muito dificilmente poderia se confundir com um transplante de ocidentalidade para os trópicos, como parece ser, num certo sentido, o caso dos EUA.

Desse modo, o objetivo deste ensaio é justamente tentar olhar Brasil e Índia independentemente da visão apriorística de uma filiação a pólos distintos, antinômicos e até mesmo mutuamente excludentes. Não se trata, assim, de comparar uma cultura oriental e outra ocidental mas uma cultura antiga e uma cultura nova, ambas a enfrentar duas questões fundamentais da modernidade, viz., (i) a formação do estado-nação e a (ii) inserção num universo dito globalizado. Ao reduzir a antinomia 'oriente-ocidente' a um fator heurístico entre muitos outros, acreditamos que poderemos visualizar, de forma mais sólida e perene, semelhanças e dessemelhanças, identidades e diferenças. Esta purificação metodológica abrir-nos-á as portas para descobrir a Índia no espelho antropológico do Brasil e descobrir o Brasil no espelho antropológico da Índia. Acredito que até mesmo as avaliações econômicas sobre as afinidades entre os ´sules´ Índia e Brasil adquiririam mais substância e objetividade, como o atesta o pioneirismo comparativo de Ignacy Sachs.

O ponto que gostaria de elaborar refere-se à problemática fundamental das identidades culturais e da forma pela qual tais identidades são representadas pela imaginação coletiva. É um domínio típico da sociologia da cultura enquanto hermenêutica antropológica das representações simbólicas de um grupo. Gostaria de tomar como ponto de partida a sugestão de Roberto DaMatta de uma abordagem comparativa entre Índia e Brasil a partir do conceito de sociedade tradicional que ele define como a preeminência de uma estrutura holística onde o todo se sobrepõe às partes. (DAMATTA, 1997:18-25) Ao assim fazê-lo, Roberto da Matta nos remete para um espaço antropológico que guarda relativa autonomia com relação ao padrão conceitual oriente-ocidente. Com efeito, a classificação da Índia como sociedade tradicional e do Brasil como sociedade semitradicional, não

é orientada por qualquer sobredeterminação historicista. Não só porque o método que emprega é estruturalista como também porque a aplicação do conceito no caso de uma cultura nascida a partir de expansão ultramarina de orientação pretensamente modernizante, seria absolutamente paradoxal.

A problemática da tradicionalidade em Roberto da Matta consagra-se, ao invés, como uma problemática muito peculiar da modernidade: uma problemática onde elementos não-europeus – ou não eurocêntricos - se articulam, de formas e intensidades diversas, com uma herança herdada do velho continente ou seus representantes, como resultado dos encontros culturais do período colonial.

Brasil e Índia apresentam uma situação fascinante para os estudos de antropologia comparativa. São sociedades complexas de enorme magnitude territorial e populacional e que se consagram, do ponto de vista histórico, como antípodas de nascimento: a Índia, uma das mais antigas civilizações da humanidade e o Brazil, uma das mais jovens. Mas, ao mesmo tempo, apresentam uma característica comum notável: um conteúdo de unidade que articula, intrinseca e organicamente, uma diversidade cultural. Em outras palavras, são sociedades que apresentam dois desdobramentos fundamentais: (i) uma dinâmica de inclusividade, uma permeabilidade cultural que é, a um só tempo, matriz de constituição genética e matriz de interação histórica com agentes externos; (ii) uma dinâmica do imaginário, como estrutura essencial de articulação das diversidades que confere plasticidade e profusão iconográfica. Nasce aqui uma predisposição natural ao diálogo inter-cultural que emerge não como uma circunstância histórica a requerer a aquisição suplementar de aptidões ou a suscitar resistências, mas como um evento que reenforça e garante a própria continuidade e sobrevivência da cultura.

Fica claro que Índia e Brasil distanciam-se, qualitativa e operacionalmente, da dinâmica européia de formação do estado-nação, i.e., de entidades politicamente centralizadas a partir da homogenização que consagra o indivíduo abstrato como fundamento. Entretanto, a absoluta necessidade histórica de incorporar a noção operativa de estado-nação como condição de existência na modernidade, representou um teste a mais na disposição de inclusividade. A creatividade desta manifestou-se na constituição daquilo que Roberto Datta chamou de ´institucionalização do intermediário´ (DAMATTA, 1994:147), i.e., de formas alternativas de sociabilidade, de caráter aditivo e não excludente ainda que tensas, onde um conjunto de relações pessoais estruturais, subsumidas por ideologias religiosas (Índia) ou político-culturais (Brasil) de caráter diferenciador (subculturas, etnias ou castas), engloba um sistema legal moderno, individualista, modelado e inspirado na ideologia liberal e burguesa.

É bom lembrar que as etapas mais decisivas para a construção efetiva de um estado-nação no Brasil e na Índia são fenômenos relativamente paralelos no tempo e guardam relação com os projetos de industrialização. No Brasil, o parto da independência só alcança concretude com o modernismo e o projeto conservador de Getúlio Vargas e, na Índia, com a independência política e o

projeto de Jawaharlal Nehru. Em ambos os casos o que facilitou essa possibilidade foi a instrumentalização de um princípio de unidade ´à priori´ que, ainda que originalmente estranho à centralização política e ao individualismo abstrato, tirou proveito destes enquanto qualificações adicionais que pudessem contribuir, como afirma Bhudev Mukhopadhyay, para a conscientização progressiva da estrutura original de interdependência e organicidade em que funcionavam os elementos de sua diversidade. (KAVIRAJ, 1995) Este estado-nação alternativo fundamenta nacionalismos periféricos que não podem ser reduzidos a ´comunidades imaginadas´ (ANDERSON, 1983) a partir de modelos importados.

Para compreender a autonomia e creatividade do imaginário alternativo como instrumento de preservação das diferenças é necessário lembrar que as ´áreas periféricas´ Brasil e Índia se desenvolveram à margem da dialética do pensar europeu que resultou no expurgo epistemológico da função imagética e cujas referências fundamentais são o protestantismo enquanto crítica à mediação religiosa e Kant enquanto climax dialético (no sentido Hegeliano) da fundamentação filosófica do império da razão. O criticismo Kantiano revela sua opção iconoclasta na omissão do fundamento subjetivo da dedução transcendental enquanto fundamento de todas as construções empíricas e metafísicas (KANT, 1983). Kant rejeita a imaginação como faculdade-chave na constituição da realidade e como locus de uma intencionalidade que seria ela mesma um acordo com a manifestação da coisa-em-si e na qual a razão acionaria um esquematismo a serviço da construção imagética. Como diz Heidegger, "Il aperçut l'inconnu et fut contraint de reculer. Ce n'est pas seulement que l'imagination transcendental lui fît peur, c'est que dans l'entretemps, il est de plus sensible au prestige de la raison pure comme telle" (HEIDEGGER, 1981:223). A razão pura emerge, assim, como ontologia vazia que embasa e subsume a construção de todas as imagens possíveis, relegando a função imaginativa a um plano subalterno. As ciências sociais que nela se inspiram têm por base dogmática uma sociedade que se constitui enquanto contratualismo iconoclasta de subjectividades (ou indivíduos) em substituição ao teleologismo imagético de personas.

Ao invés, o tradicionalismo ou semitradicionalismo de Índia e Brasil, respectivamente, apresentam uma propensão espontânea à produção de imagens como estruturas de mediação social que refletem a ânsia de totalidade das diversas partes. Ao permitir a re-ligação das partes com o todo e, conseqüentemente, das partes entre si, a profusão iconográfica assume um valor simbólico e vertical. Simbolismo e verticalidade são indicadores de uma função cognitiva que é, ao mesmo tempo, uma função criativa. Cognitiva porque se propõe a desvelar, teleologicamente, a totalidade coletiva como raison d'être, destino e fundamento da funcionalidade dos atores sociais. E criativa porque permite a representação dessa totalidade através de uma pluralidade de símbolos que se adequam à segmentação múltipla das partes.

Vejamos rapidamente o caso da Índia. Quais os elementos da ´unidade sem uniformidade´ que caracteriza a Índia? O mito que simboliza este processo

aparece nos Vedas. O hino purusasukta (´homem primordial´) fala da origem dos diferentes elementos subculturais a partir da partição do cosmos antropomorfizado. (Rgveda: 1986:602-3, X/XC) Uma ordenação abstrata baseada nos princípios do dharma (lei natural, dever), karma (retribuição das ações), samsāra (roda da existência) – organiza, organicamente, as diversas comunidades de pessoas da mesma descendência, de tal forma que não lhes subtrai a particularidades originárias e ainda assim lhes fornece um esquema mais amplo de inserção ordenada, interdependente e hierárquica. O sistema de castas quadripartite (varna) constitui uma simplificação de um processo complexo de conectividade entre subestruturas étnicas, linguísticas, geográficas e ocupacionais (jāti). Trata-se, como nota M. Srinivas em seus estudos da Índia rural, de uma diferenciação (ou des-igualdade) com solidariedade, de uma unidade em meio às clivagens culturais e sociais que nem por isso suprimem a mobilidade. (SRINIVAS, 1987:20-59) Esta acomodação originária de diversidades - muitas vezes reduzida ao encontro de arianos e dravidianos – consagra uma supra-etnicidade ou, ainda, uma etnicidade de subetnicidades que se estabilizou com relativa continuidade em termos raciais.

A ´trans-nacionalidade´ indiana repousa, assim, num princípio de complementaridade das diferenças, que viabiliza a preservação destas enquanto subculturas. O caráter amplo desta formulação é dado por Bakim Chandra Chaterjje quando, ao discutir a noção de religiosidade na Índia, acaba encontrando uma definição que se aproxima do conceito de cultura: "the cultivation and exercise of all our bodily and mental faculties". (CHAUDURI, 1997:12) O ser humano é ponto de partida e de chegada, tanto no plano da pragmática dos desejos (ritual) quando da auto-realização da unidade da consciência que os fundamenta (filosofia). O substrato filosófico é representado pelo não-dualismo da escola Vedanta que postula uma não-diferença (viz., a pura consciência) que nutre e sustenta, no plano ontológico (trans-objetivo e trans-subjetivo), a multiplicidade imagética do empeirikós. (LOUNDO, 1992) O imaginário enquanto mediação torna-se manifesto através da presentificação ritualística de divindades que disputam a preferências dos segmentos sociais sem, contudo, excluir as demais (divindades): elas são instrumento, e não destino. Não há aqui espaço para a reificação imagética ou dogma.

Este ´inclusivismo' religioso - como lhe chamou Paul Hacker (1983) – de caráter instrumental fornece o modelo genêrico de inserção com preservação de autonomia relativa, dos elementos adventícios que se originaram, entre outros, dos encontros culturais da Índia com o universo islâmico e cristão. Os requesitos étnicos da estruturação diferenciadora não favoreceram, especificamente, a incorporação de pessoas, i.e., a miscigenação, mas, essencialmente, a incorporação de idéias, valores, costumes, dogmas, rituais e iconografia nos grupos socialmente afetados ou 'convertidos'. A criação de novas segmentações subculturais sobrepôs-se às pre-existentes de forma complexa gerando uma comunidade islâmica e cristã internamente diversificadas e unificadas pelo novo imaginário incorporado. Com isso, descarta-se qualquer possibilidade de homogeneidade

como correlato do termo 'hinduísmo': ou ele é sinônimo de 'indianismo' ao apontar para uma cultura que comporta uma pluralidade de religiões originadas ou não no subcontinente, ou ele se refere à pluralidade de religiões originadas especificamente no subcontinente. Antes, portanto, de denotar um fenômeno religioso, o termo reflete uma dimensão de culturalidade que abarca a relação homem-deus (e sua superação) como parte de um quotidiano, de uma rotina de imanência e sociabilidade. Em síntese, a noção homogeneizante de ´religião hindu´ trata-se, como nota Nirad Chaudari, de um vazio de conteúdo. (Chauduri, 1997:1-24)

A construção de uma ideologia nacionalista que incorporasse, adicionalmente, o princípio de individualidade moderna que se requer à centralização política do período pós-independência foi um longo processo. Parece-me correto, como afirma Partha Chatterjee, que o nacionalismo declarou o 'domínio do espiritual' como um território de unidade que é específico da formação cultural indiana e que, portanto, não é objetivamente determinado pela reatividade ao domínio colonial, a fim de modelar uma modernidade não-ocidental. (Chatterjee, 1994:6) É problemática, entretanto, a tentativa, aí sim reativa, de situar tal espiritualidade na ´comunidade imaginada´ do hinduísmo enquanto pretensa uniformidade religiosa. A invenção colonial de um conceito monolítico de ´hinduísmo´ enquanto maioria política, em contraposição às minorias ´estrangeiras´ muçulmana e cristã, entre outras, fere a tradição de diversidade. De fato, não há nem pode haver nos conflitos ditos religiosos na Índia qualquer radicalidade tradicional, qualquer 'fundamentalismo' étnico e muito menos qualquer 'conflito de civilizações'. Não só porque a plurietnicidade e plurireligiosidade originária o proscreve, mas também porque, como já observamos, a incorporação do islamismo e do cristianismo, entre outros, deu-se dentro do espaço humano local e segundo os parâmetros tradicionais da cultura indiana.

Justo seja afirmar que a Constitutição indiana em sua versão creativa do conceito de secularismo não o concebe como relegação da religiosidade a mera curiosidade individual, mas como um terrritório de articulação livre e co-existência pacífica entre os diferentes grupos diferenciados por fatores éticos, religiosos, linguísticos ou de status. Ainda assim a inclusão, entre tais grupos, do hinduísmo como religião unitária é certamente uma matéria de preocupação. Nesse jogo "sutilíssimo e único de compensações" como diria Cândido Mendes, "onde a mobilidade social amortecida salvou o país das ondas do consumismo" (MENDES, 2000), a democracia parece uma conquista salutar pois adquiriu o papel único de prover mecanismos de articulação entre subculturas. Não obstante a distinção tradicional entre poder político (local) e status (social) de subculturas, a centralização política tem tido eficácia limitada em situações onde as diferenças comportam manifestas injustiças sociais.

Qual é, por outro lado, o sentido da ´unidade sem uniformidade´ que caracteriza a identidade brasileira? O mito que a dimensiona no sentido de uma narrativa das origens é encontrado em dois documentos literários fundamentais do modernismo:

o Manifesto Antropofágico de Oswald de Andrade (ANDRADE, 1970) e a obra de Gilberto Freyre Casa Grande e Senzala. (FREYRE, 1954). Poderia, ainda, incluir Macunaíma de Mário de Andrade como versão ficcional do Manifesto. Considerando o processo de formação colonial, o método de articulação genético das diferenças é dado pelo modelo antropofágico. Diferentemente e até em contraposição ao método indiano cuja integração é acompanhada da preservação relativa dos elementos originários, o método antropofágico opera devorando a pluralidade étnica e racial dos elementos europeus, africanos e índios.

A síntese ou sincretismo de etnias e culturas está na origem de uma nova entidade cultural que se caracteriza pela construção de uma etnicidade não-étnica, e portanto, destituída, na prática, de qualquer continuidade racial. A única exceção são as microetnias indígenas cuja imponderabilidade, lamentavelmente e para citar Darcy Ribeiro, "não afeta o destino nacional". (RIBEIRO, 1995:22) Ainda assim, e aqui se resgata o sentido de diversidade, a síntese não se deu de forma homogênea. Pelo contrário, ela engendrou gradações diferenciadas, as subculturas brasileiras, que se distribuem regionalmente e que conformam o que Darcy Ribeiro classifica como 'os diferentes Brasis': o Brasil crioulo, o Brasil caboclo, o Brasil sertanejo, o Brasil caipira e o Brasil sulino. (idem)

A diversidade que conforma variantes de uma síntese de matrizes possui, como seria de esperar, marcas exteriores das etnicidades originárias. Aqui é iorubá, ali tupi-guarani e acolá lusitana. Tais referências não se manifestam de forma autônoma, mas são subsumidas pela semântica da síntese e suas variantes. A unidade da síntese tem em sua retaguarda uma história em comum marcada, fundamentalmente, pela 'subversão' do processo escravocrata e que se manifestou, sobremaneira, na 'disposição' à misceginação enquanto ´fábrica de-culturalização´ que tudo digeriu, inclusive a matriz européia dominante. Com isso, há por assim dizer todas as raças e todas as etnias em cada indivíduo, ainda que em diferentes intensidades e proporções que geraram solidariedades subculturais baseadas no compadrio e regionalidade. Sem referências étnicas originárias, a método antropofágico brasileiro apresenta uma característica a mais que o distingue do caso indiano no que tange à incorporação de elementos adventícios: ele digere não só valores, idéias, imagens mas também indivíduos. Assim se constituem novas variantes do sincretismo básico como bem o demonstra a formação do Brasil sulino a partir das correntes de imigração do final do século XIX e século XX.

Um fator complexificador deste processo é a herança em contramão da diferenciação hierárquica que caracteriza o próprio sistema escravocrata e que gerou sistemas de solidariedade inter-regional absolutamente negativos. É importante notar que a discriminação escravocrata jamais se constitui em fundamento tradicional ou histórico de qualquer diversidade cultural ou étnica. Muito pelo contrário, como o caso do Brasil o mostra exuberantemente, ele representou uma postura racista de efeitos etnocídicos. É, no fundo, uma falsa diferenciação, uma falsa diversificação e, até mesmo, uma falsa hierarquia.

Aqui portanto é necessário fazer uma distinção fundamental. O elemento de tradicionalidade presente na classificação de Roberto da Matta do Brasil como sociedade semitradicional não deveria ser confundido com a hierarquização e discriminação escravocrata. Ele se radica nos elementos mediterrâneos, latinos e, também, nas heranças africanas e ameríndias. A mera superposição estrutural de uma ordem tradicional e de um princípio de individualização moderna talvez não peculiarizasse o adjetivo ´semitradicional´: a Índia também o seria. O que me parece específico neste adjetivo é justamente a presença do complexificador escravocrata como um elemento peculiar da modernidade periférica, que se imiscui de forma socialmente perversa com as diversidades legítimas a ponto de lhes dificultar a manifestação.

A proliferação imagética que a ordem das diversidades subculturais favorece manifesta-se, em gradações distintas, no sincretismo religioso, no folclore popular, nos rituais e surperstições, nas associações clubísticas e carnavalescas. O carnaval, por exemplo, não sugere apenas uma busca compensatória de dissolver as diferenças herdadas do sistema escravocrata mas também a expressão dos elementos diferenciadores da diversidade sincrética e de seus revestimentos étnicos. Esta diversidade é responsável pela expansão heterogênea dos dois elementos mais decantados da unidade brasileira, viz., a língua portuguesa e a religião cristã. Como nota Richard Morse, sua funcionalidade é fundamentalmente distinta do seu contexto europeu originário: é terminologia de unidade e fundamento de diversidade, mecanismo que articula a interdependência entre subculturas. (MORSE, 1990:23-86)

Além das ideologias das matrizes não-européias, dois outro fatores genéticos concorrem para liberdade iconográfica que o modernismo consagra: são as disposições barrocas e literárias de fundo romântico que aderem ao espírito brasileiro. Um barroco relativamente liberto dos núcleos hierárquicos da Igreja (e da Inquisição) – como é o caso da religiosidade laica e integrativa da sociedade mineira – teve a função de exaltar o espaço físico e humano local a partir de referências religiosas. Há no barroco um panteísmo da imagem que incorporou inclusive motivos de origem asiática. O espaço da literatura, com seu espírito de ´objetividade romântica´ (pós-modernismo), legou às ciências sociais, como ressalta Gilberto Freyre, contribuições importantes na 'liquidação do processo colonial'. (FREYRE, 1987:143-4) Isso porque ele projetou através de narrativas ficcionais e ensaísticas, espaços aparentemente imaginados ainda que subliminarmente reais, que impulsionaram diversas formas de nacionalismos positivos. (SOMMER, 1990)

A construção de um ´imaginário nacional´ para a formação do estado-nação não se deu no vazio, embora seja corrente a afirmação de que o estado precede a nação. Não me parece ser este o caso desde que se considerem as peculiaridades multiculturais dessa formação. O princípio de unidade que as subsume é real. É certo que as formulações pré-modernistas e pré-industrialistas não chegaram a produzir implicações políticas. Por outro lado, as que lhe seguiram incorreram na

acentuação de uma homogeneidade inexistente, pois as elites tinham em mira o controle do imaginário das massas, de forma a amortecer a diversidade e obscurecer as discriminações herdadas. Mas aqui há um fenômeno que correu paralelo e à revelia das mesmas elites: a incorporação das massas no processo industrial teve o condão de eliminar, na prática, heranças escravocratas, garantindo assim, indiretamente, a liberação das expressões genuínas das diversidades subculturais.

Antes de concluir, gostaria de deixar claro que não foi preocupação deste ensaio problematizar os desequilíbrios sociais que se imiscuem, e muitas vezes se amparam, na diversidade cultural legítima. Fica, entretanto, o fato de que Brasil e Índia apresentam uma multiculturalidade de origem que orienta o diálogo com o ´outro´, e que se fundamenta num princípio ativo de unidade que vai além de uma ´federação de culturas´. Estas ´comunidades de destino´ - para usar uma categoria de Otto Bauer (Anderson, 1996:4) - que resistem à uniformização e à monotonia, não vêem no estado-nação um ponto destinal mas um momento de modernidade cuja articulação suplementar e alternativa com estruturas pre-existentes de caráter heterogêneo e diversificado pode, quem sabe, se mostrar peculiarmente apta para a modernidade da globalização caso esta caminhe, como aponta Sérgio Rouanet, para a particularização das culturas como parte de projeto universalístico, i.e., "(which) seek(s) autonomy for all human beings, with differences compatible with the universal principles of justice being respected". (ROUANET, 1998: 484)

Termino com uma referência a Michel Maffesoli. No ensaio "Considérations Epistémologiques sur la Fractalité", ele afirma que "en référence à de nombreuses situations historiques, on peut postuler un équilibre qui puisse reposer sur l'hétérogène, sur l'éclatement… L'équilibre de l'hétérogénéité (du fractal), harmonie conflictuelle s'il en est, repose sur l'interdépendance entre les divers éléments du cosmos, micro et macro, tout comme sur celle qui est à l'oeuvre au sein de la personne elle-même". (MAFFESOLI, 1994) Ao referir-se a "nombreuses situations historiques", é possível que Maffesoli não tivesse em mente qualquer dos paradigmas aqui apresentados. Ainda assim, acredito que Brasil e Índia constituem testemunhos emblemáticos dessa possibilidade du fractal.

Bibliografia

ANDERSON, Benedict (1983). *Imagined Communities: Reflections on the Origin and Spread of Nationalism.* London: The John Hopkins University Press.

(1996). "Introduction". In Balakrishnan, Gopal. *Mapping the Nation.* London: Verso, pp. 1-16.

ANDRADE, Oswaldo (1970). "Manifesto Antropófago". In *Do Pau-Brasil à Antropofagia e às Utopias.* Rio de Janeiro: Civilização Brasileira, pp. 11-19.

APPADURAI, Arjun (2000). "Anxieties of Tradition in the Era of Globalisation". In Larreta, Enrique (org.). *The Making of Time and Possible Futures.* Rio de Janeiro: Unesco/ISSC/Educam, pp. 59-67.

BÉTEILLE, André (1997). "Caste in Contemporary India". In Fuller, C. J. (org.). *Caste Today.* Delhi: Oxford University Press, pp. 150-178.

CAMPBELL, Colin (1998). "The Easternization of the West: Reflexions on a New Theodicy for a New Millenium". In Larreta, Enrique (org.). *Ethics of the Future.* Rio de Janeiro: Unesco/ISSC/Educam, pp. 286-311.

CHATTERJEE, Partha (1994). *The Nation and Its Fragments: Colonial and Postcolonial Histories*. Delhi: Oxford University Press.

CHAUDHURI, Nirad (1997). *Hinduism a Religion to Live By.* Delhi: Oxford University Press.

DAMATTA, Roberto (1994). *Conta de Mentiroso.* Rio de Janeiro: Rocco.

(1997). *Carnavais, Malandros e Heróis.* Rio de Janeiro: Rocco.

DAS, Veena (1987). *Structure and Cognition. Aspects of Hindu Caste and Ritual.* Delhi: Oxford University Press.

DHARAMPAL-FRICK, Gita (1995). "Shifting Categories in the Discourse on Caste: Some Historical Observations". In Dalmia, Vasudha & Heinrich Von Stietencron (orgs.). *Representing Hinduism: The Construction of Religious Traditions and National Identity.* New Delhi: Sage Publication, pp. 82-100.

DUMÉZIL, George (1961). "Les trois fonctions dans le RigVeda et les dieux indiens de Mitani". *Bulletin*, t. 47, pp. 265-298.

DURANT, Gilbert (1975). *Les Structures Anthropologiques de l'Imaginaire.* Paris: Sirac.

DUMONT, Louis (1992). *Homo Hierarchicus: o Sistema de Castas e suas Implicações.* São Paulo: Edusp.

FREYRE, Gilberto (1953). *Aventura e Rotina*. Rio de Janeiro: José Olympio.

(1954). *Casa Grande e Senzala.* Rio de Janeiro: José Olympio.

(1987). *Vida, Forma e Cor.* Rio de Janeiro: Record.

HABERMAS, Jurgen (1996). "The European Nation-State: its Achievements and Limits". In Balakrishnan, Gopal. *Mapping the Nation*. London: Verso, pp. 281-294.

HACKER, Paul (1983). "Inklusivismus". In Oberhammer, Gerhard (org.). *Inklusivismus: Eine Indische Denkform*. Wein: Institut fur Indologie der Universitat Wein, pp. 11-28.

HEIDEGGER, Martin (1981). *Kant et le Problème de la Métaphysique.* Paris: Gallimard.

HOLANDA, Sérgio Buarque (1959). *Visão do Paraíso.* Rio de Janeiro: José Olympio.

(1971). *Raízes do Brasil.* Rio de Janeiro: José Olympio.

HUNTINGTON, Samuel (1993). "The Clash of Civilizations". *Foreign Affairs,* n. 72, june, pp. 22-49.

KANT, Immanuel (1983). *Crítica da Razão Pura*. São Paulo: Abril Cultural.

KAVIRAJ, Sudipta (1995). "The Reversal of Orientalism: Bhudev Mukhopadhyay and the Project of Indegenist Social Theory". In Dalmia, Vasudha & Heinrich Von Stietencron (orgs.). *Representing Hinduism: The Construction of Religious Traditions and National Identity.* New Delhi: Sage Publication, pp. 253-279.

LÉVY, Pierre (1999). "The Universal without Totality: Essence of Cyberculture". In Larreta, Enrique (org.). *Media and Social Perception.* Rio de Janeiro: Unesco/ISSC/Educam, pp. 191-208.

LOUNDO, Dilip (1992). *The Role and Function of Reasoning (*tarka*) in Shankaracharya's Advaita Vedanta.* Dissertação de Doutorado, University of Bombay (mimeo).

LUDDEN, David (1996). "Introduction. Ayodhya: a Window on the World". In Ludden, David (org.). *Making India Hindu. Religion, Community and the Politics of Democracy in India.* Delhi: Oxford University Press. pp. 1-23.

MAFFESOLI, Michel (1997). "Considérations Epistémologiques sur la Fractalité". In Condé, Susan. Fractalis, la Complexité Fractale dans l'Art. Paris: La Différence.

MENDES, Cândido (2000). "A Índia que se Esconde". *Jornal do Commercio*, 25 de Fevereiro.

MIGNOLO, Walter (2000). "Coloniality at Large: Time and the Colonial Difference in Time". In Larreta, Enrique (org.). *Time in the Making and Possible Futures.* Rio de Janeiro: Unesco/ISSC/ Educam, pp.237-273.

MORSE, Richard (1990). *A Volta de MacLuhanaíma.* São Paulo:Companhia das Letras.

NANDY, Ashis (1990). "The Politics of Secularism and the Recovery of Religious Tolerance". In Das, Veena (org.). *Mirror of Violence: Communities, Riots and Survivers in South Asia.* Delhi: Oxford University Press, pp. 69-93.

PLUTARCO (1999). "Alexandre e César". In *Vidas Comparadas*. Rio de Janeiro: Ediouro.

RIBEIRO, Darcy (1995). *O Povo Brasileiro: a Formação e o Sentido do Brasil.* São Paulo: Companhia das Letras.

RgVeda (1986). Delhi: Motilal Banarsidass.

ROUANET, Sérgio (1998). “Discursive Ethics between Globalisation”. In Larreta, Enrique (org.). *Ethics of the Future.* Rio de Janeiro: Unesco/ISSC/Educam, pp. 477-496.

SAID, Edward (1990). *Orientalismo.* São Paulo: Companhia das Letras.

SOMMER, Doris (1990). “Irresistible Romance: the Foundational Fictions of Latin America”. In Bhabha, Homi (org.). *Nation and Narration.* New York: Routledge, pp. 71-98.

SRINIVAS, M. N. (1987). The Dominant Caste and Other Essays. Delhi: Oxford University Press.

VON STIETENCRON, Heinrich (1995). “Religious Configurations in Pre-Muslim India and the Modern Concept of Hinduism”. In Dalmia, Vasudha & Heinrich Von Stietencron (orgs.). Representing Hinduism: The Construction of Religious Traditions and National Identity. New Delhi: Sage Publications, pp. 51-81.

ZEA, Leopoldo (1990). Discurso desde la Marginación y la Barbarie. México: Fondo de Cultura Económica.

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The Symposium 'Building Knowledge Networks' is a remarkable initiative of India and Brazil to promote opportunities of sharing experiences and knowledge between the institutions, people and experts involved. The Institute of Biosciences welcomes all the participants and wishes a very productive event. We are sure that new ideas will appear and partnerships established.

Carlos Eduardo Falavigna da Rocha
Director
Institute of Biosciences, University of São Paulo

The public involvement and engagement with science may offer a multilateral diffusion of such knowledge that empowers people with the ability to take informed, analytical and rational decisions to overcome day-to-day problems. I am sure, the dialogue on public communication of science will go a long way to arouse millions of science enthusiasts to bridge science-society gap in two fast emerging nations.

Prof. (Dr.) Kamal Kant Dwivedi
Former Adviser & Head, National Council for Science & Technology Communication
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This initiative brings together specialists of various fields of research in science, technology, communication and culture from both countries for the first time at USP. I welcome this initiative and am very glad to see many well-known colleagues from our field of knowledge participating in the plenary sessions and workshops. I congratulate the organizing committees and wish all the delegates a very enriching experience in establishing knowledge networks between USP and various institutions and universities in India.

Prof. (Dr.) Sandra Margarida Nitrini
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Brazil and India have many similarities and challenges. Agriculture has been the base of the economy of the two countries. The culturally rich and diverse composition offer many opportunities for working together. Science communication is one of such important areas, where common grounds can be explored and experiences shared for reaching solutions. I am delighted to know that experts from different fields are coming closer for developing science communication strategies and I wish the initiative a success.

Dr. R.D. Sharma
Former President
Indian Science Writers' Association