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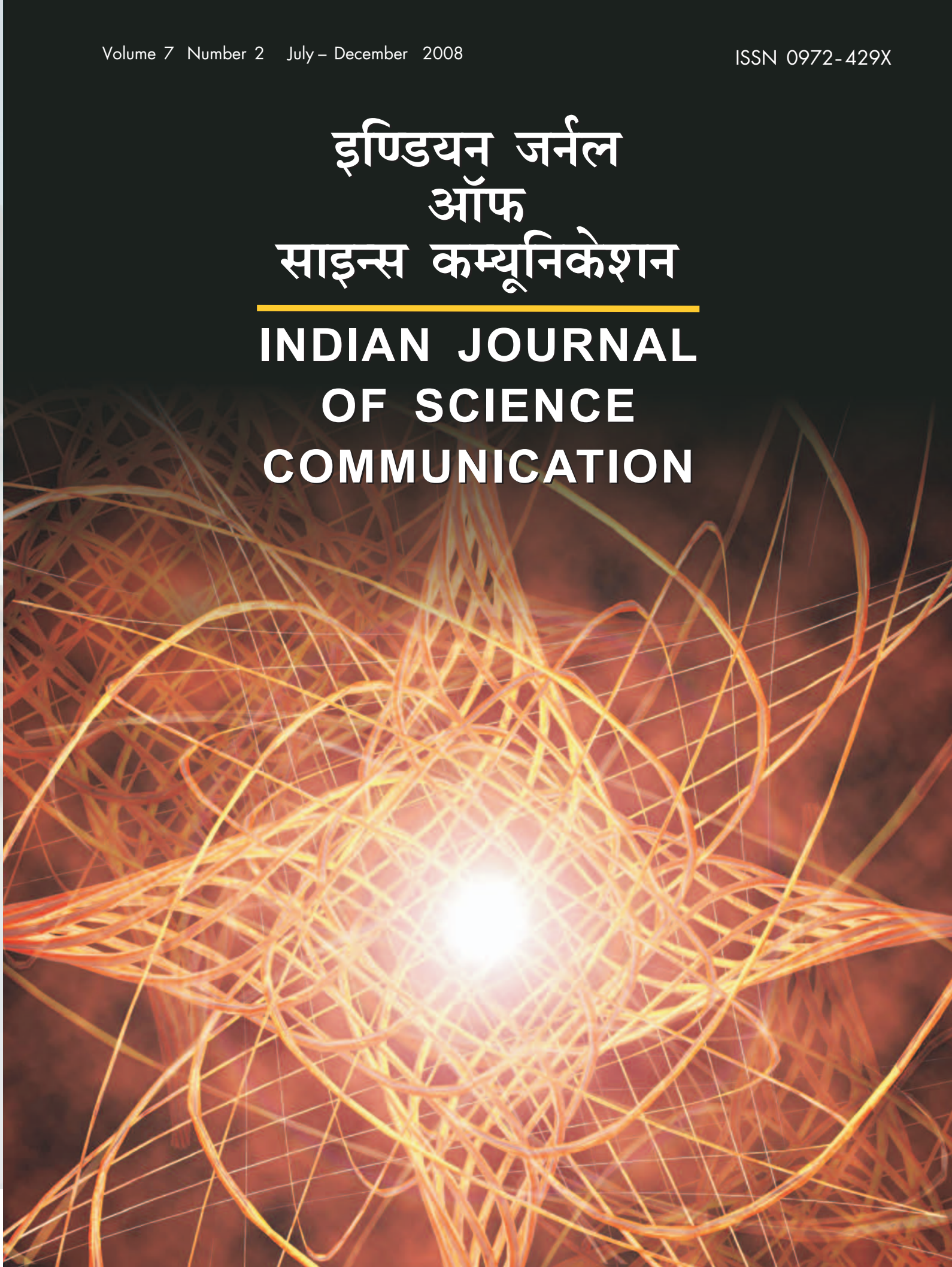

Indian Journal of Science Communication

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Editorial

Science Smiles – A Scientoon Makes It Happen!

The 3rd European Science Open Forum (ESOF 2008) organized during July 18-22, 2008 in Gaudi's most artistic city Barcelona in Spain, has witnessed yet another novel way of communicating science using scientoons, an innovative tool combining science and cartoons together. While communicating science to those, most of who find it boring and difficult; the challenge of a science communicator is how effectively to catch the eyes of his or her audience and impart scientific knowledge with a smile.

India is credited to have evolved Scientoon and a whole host of new knowledge, i.e., Scientoonics, which is considered to be a new branch of science communication. The ESOF-2008 witnessed a scientific session on the subject which was titled ´Scientoonics : A novel way to learn science having fun´. The ESOF has attracted over 5000 scientists, academicians, Nobel laureates, science communicators, journalists, sociologists and students.

Scientoon is a cartoon which is based on some science and technology concept or related development. It not only makes you smile and laugh but at the same time also provides information about new research, subject, data or concept in a simple, lucid and comprehensible manner to the lay audience.

Generally, a cartoon has two elements, a caricature and a satire at the bottom or in the form of a balloon, whereas a scientoon, in addition, has a third element in the form of a box that contains the actual science information, which needs to be communicated. This is how a scientoon is different. One can find a few science cartoons in the mass media similar to any other commonly known cartoon. Such science cartoons primarily intend to comment on some science related issue, make you amused or even aroused, but generally they do not carry any scientific content, and therefore, it is interesting to note that all science cartoons do not qualify themselves to be scientoons.

Good news is that a scientoon is not confined to print media only. We have been able to produce a radio scientoon, puppet or muppet scientoons and multimedia scientoons as well. Efforts are being made to develop theme based scientoon strips, films, books and other software materials suited for a variety of audience, including persons with special needs, such as Braille scientoon for visually challenged.

A scientoon has the potential to serve both the ends, a scientist as well as a common man with almost equal intensity. It can be used in research journals, books, reports, conferences and seminars, etc., to avoid monotony. Similarly, it can also be utilised in popular science lectures, popular science magazines, and newspapers, etc., with same magnitude to attract children, students and lay persons as well.

India's National Council for Science & Technology Communication has been instrumental in taking initiative for promoting this attractive tool of communicating science and introducing it across the country through a variety of science communication programmes and as a result, it has been included in the syllabi of science communication courses in various universities. The latest generation of young scientoonists is now setting their hands to create a range of scientoons to take advantage of this innovative tool for communicating science. It is hoped that they would be able to justly balance between art and science for making a scientoon more effective. ■

Manoj Patairiya

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Scientific Communication Pattern of Cotton Scientists in India

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Abstract

The institutional goal of a science is the extension of certified knowledge. Central and crucial to this process and to the nature and practice of science is a rapid and accurate communication system. The functions of formal communication are a combination of psychological and sociological factors that motivate scientists to participate in the communication process. They may range from the aesthetic pleasure of making new discoveries to more mundane requirements such as the individual's need to gain visibility for his work to enhance future professional and economic status. Within the enormous body of scientific communication, the agricultural sciences represent a relatively small area. With the broad comparative data in mind, an attempt has been made in this paper to examine the role of formal and informal communication system among the scientific personnel engaged in research on cotton in public sector agricultural research institutions and universities. The data collected from 68 cotton scientists reveal that professional journals in discipline / field are the most widely used source of scientific communication by cotton scientists in India. This is followed by professional journals in other fields, reports, seminar papers, farm journals, training manuals, in-house newsletters and brochure/ bulletins in descending order. When confronted with the comparative importance of these publications in advancing the professional and personal goals, cotton scientists in India give maximum importance to foreign journals in their own field followed by foreign journals in related fields, reports and bulletins follow this. Although informal communication with system participants lack formal structure within the cotton research system in India, it is important for its sustenance.

सारांश

विज्ञान के प्रत्येक क्षेत्र का सामाजिक उद्देश्य अधिकृत ज्ञान का विस्तार है। इस उद्देश्य की पूर्ति के लिए द्रुत एवं सटीक विज्ञान संचार प्रणाली की भूमिका महत्वपूर्ण है। औपचारिक संचार की प्रणाली वैज्ञानिक वर्ग को मनोवैज्ञानिक व सामाजिक कारकों पर आधारित तरीकों से ज्ञान-संचार प्रक्रिया से जोड़ती है। ये कारक नई खोज कर सकने के आंतरिक आनन्द से लेकर सांसारिक आनन्द यथा ख्याति प्राप्त करके अपने पेशे में और सम्मान पाना, आदि हो सकते हैं। विज्ञान संचार के समुद्र में कृषि विज्ञान संचार का हिस्सा छोटा सा है। वृहत परिदृश्य को ध्यान में रखकर इस पत्र में यह ज्ञात करने का प्रयास किया गया है कि सरकारी क्षेत्र के कृषि अनुसंधान संस्थानों व विश्वविद्यालयों में कार्यरत वैज्ञानिक समुदाय के बीच औपचारिक व अनौपचारिक विज्ञान संचार की क्या भूमिका है। इस अध्ययन के दौरान 68 कॉटन वैज्ञानिकों से प्राप्त आंकड़ों से पता चलता है कि शोध पत्रिकाएं वैज्ञानिक ज्ञान के संचार के लिए सबसे अधिक प्रयुक्त स्रोत हैं। इसके बाद इतर अनुसंधान क्षेत्रों की शोध पत्रिकाएं, उसके बाद क्रमशः हैं- रिपोर्ट, सेमिनार पेपर, कार्य पत्रिकाएं, प्रशिक्षण पुस्तिकाएं, संस्थागत पत्र तथा बुलेटिन आदि। इन प्रकाशनों की तुलना की बात जब पेशागत व व्यक्तिगत लक्ष्यपूर्ति के संदर्भ में आती है, तो भारतीय कॉटन विज्ञानी अपने विषय के विदेशी शोध पत्रिकाओं को सबसे अधिक महत्व देते हैं और अन्य विषय की शोध पत्रिकाओं, रिपोर्टों व बुलेटिनों का इसी क्रम में महत्व है। अनौपचारिक ज्ञान-संचार का हालांकि हमारे यहां कोई स्थापित तंत्र नहीं है, पर इसका महत्व ज्ञान संवर्द्धन की दृष्टि से आवश्यक है।

Keywords: Communication of agricultural science, Formal science communication, Communication pattern of cotton scientists, Professional journals

Introduction

Communication of scientific and technical information is clearly one of the most important aspects of scientific research for it is the process that leads to its widespread use and ultimate benefits (King et al, 1976:3). It is through scientific communications that scientists receive professional recognition and esteem, as well as promotion, advancement and funding for future research. In fact scientific work becomes 'a work' only when it takes a published form, which can be received, assessed and acknowledged by scientific community (Fox, 1983). Robert Merton, a well known sociologist of science has noted that "the institutional goal of science is the extension of certified knowledge". Central and crucial to this process and to the nature and practice of science is a rapid and accurate communication system. Science

Paper presented at the Regional Workshop on Science Communication - 2006 at Dept. of Mass Communication, Dr. Punjabrao Deshmukh Institute of Management & Research, Nagpur (India) on January 7-8, 2006.

and its communication seem to be inextricably bound together, so that the production and the dissemination of the results of research go hand in hand.

Scientific communications in its various forms involve a significant fraction of the scientist's working life. Studies of natural scientists in United States reveal that they devoted between a quarter and two fifths of each working week to formal and informal scientific communication (Busch and Lacy, 1983 : 73). Formal communication includes various written sources such as journal articles, books and book chapters, technical reports, bulletins, and abstracts. It also may include the reading and exchange of papers at professional meetings. Informal channels are usually oral and include face to face conversation, telephonic exchanges, visit to colleague's laboratories, and personal correspondence. These two mutually dependent types of communication differ in some important ways. Formal communication is in public domain with large potential audience and is permanently stored and retrievable. Whereas, informal communication is usually private, with restricted audience and typically neither permanently stored nor retrievable.

Rapid and accurate formal communication is a fundamental requirement of modern science. First, because scientific research is potentially open to a more wasteful duplication of effort than other types of research, knowledge of new research should be diffused as quickly and widely as possible within the scientific community. Second, formal written communication in journals help keep the scientific community honest because recognition for a new scientific discovery generally is bestowed upon the person who first announce it publicly. Finally, publications in professional journals also plays a major role in the criteria for promotion and appointment. Underlying these important functions of formal communication is a combination of psychological and sociological factors that further motivate scientists to participate in the communication process. They may range from the aesthetic pleasure of making new discoveries to more mundane requirements such as the individual's need to gain visibility for his or her work to enhance future professional and economic status.

Given these important functions and motivation for the formal communication system, its enormous growth in last hundred years is not surprising. Although statistics in the field of scientific documentation are difficult to compile and often inexact, they provide an approximation of this growth. It is estimated that the annual worldwide production of scientific and technical papers is of the order of 2 million papers. The number of scientific and technical journals in the world is estimated to be between 40,000 to 50,000. Despite the rapid increase in the number of papers, however, the annual growth in the number of journals has been estimated at only 5% (Meadows, 1974). A main factor, then, in the growth of scientific literature has been the increasing bulk of journals already in existence. United States has been the leader in the production and use of this enormous body of literature. The journal publications by U.S. scientists have grown substantially during twentieth century. By 1960, the annual production of journal articles was 106,000 and by 1974 it had increased 42% to 151,000 (King et al, 1976). Publication of scientific and technical books in the U.S. has also increased at the annual rate of 327% during the later part of the last century.

Within this enormous body of scientific communication, the agricultural sciences represent a relatively small area. Nevertheless, the journals in this field are also increasing in size and number. A fairly recent estimate suggest that some 250,000 papers are published in these journals each year worldwide, approximately 1,000 papers each working day. Interestingly life sciences which include agricultural sciences, biological sciences and medicine in comparison with physical sciences, mathematics, computer sciences and engineering have experienced the slowest rate of increase in journal articles during the last two decades. Only the social sciences have shown still slower rate of annual increase in journal article production (King et al, 1976).

With this broad comparative data in mind, an attempt has been made in this paper to examine the role of formal and informal communication system in current public sector agricultural research.

Methodology

Participants

The basic data is collected from scientists occupying regular posts and engaged in active research on cotton in Indian Council of Agricultural Research and State Agricultural Universities. Scientists from all major agricultural disciplines participated in this study. The data were gathered through a self administered questionnaire. Of the 108 potential subjects who are working in cotton research in India, 68 scientists

participated in this study. The response rate was 62 per cent. The data were gathered during the winter of 1999.

Measures

Formal Communication : For this study, formal communication is defined as the frequency of resource used to disseminate new scholarly information generated by research. Thirteen kind of resources were identified for formal communication that include 1. Professional journals in own discipline / field 2. Professional journals in other fields 3. Farm journals 4. Newspapers 5. In-house newsletter 6. Radio scripts 7. TV scripts 8. Video film scripts 9. Reports 10. Brochures / bulletins / lea ets 11. Training manual 12. Notes for meeting and 13. Papers in seminar / workshop / conference. Frequency was measured on four point scale from (1) never (2) sometimes (3) often and (4) most often.

Informal communication : Informal communication is defined as the frequency of personal interaction with others regarding their research. To assess the nature and in uence of informal communication for cotton scientists, researchers, besides scientists / faculty within the department / institution, in our study were asked how frequently they make informal communication regarding research with (1) Scientists / faculty from other institutions; (2) Officers from State governments; (3) Officers from central government / agencies; (4) NGOs; (5) Political leaders; (7) Clients / farmers; (8) Farm women and (9) Representative of seed company. The responses were recorded on 1 to 5 range, indicating (1) rarely (2) monthly (3) bi-weekly (4) weekly and (5) daily.

Published resources : Published resources has been defined as the perceived importance of various scientific communication resources used for disseminating knowledge. Scientists in this study were asked how important are the following published resources in your research. 1) Domestic journals in your field ; 2) Domestic journals in related fields; 3) Foreign journals in your field; 4) Foreign journals in related fields; 5) Books and book chapters; 6) Reports and 7) Research bulletins and brochures. The responses were recorded on (1) not important to (7) very important.

Results

Given the central role of formal communication in agricultural research, it is important to explore the preferences for various modes of formal communication as research output. The data presented in Table 1 reveal that professional journals are the most important source of scientific communication used by the scientists. Formal written communication in the form of journal articles help keep the scientific enterprise honest. In informal communication and seminars, scientists are less than rigorous. However, most are more cautious and thorough in publishing their results, in part because they fear that careless work will be zealously dissected and dismantled by other scientists. Secondly, because recognition for a new scientific discovery generally is bestowed upon the person who first announces it publicly.

Table 1: Resources used for formal communication

Resource	Mean Score
Professional journals in discipline / field	3.56
Professional journals in other fields	3.12
Reports	3.00
Seminar / workshop / conference papers	2.92
Farm journals	2.78
Training manuals	2.71
In-house newsletters	2.65
Brochure / bulletins / lea ets	2.68
Newspaper	2.56
Notes for meetings	2.12
Radio script	1.97
TV script	1.92
Video film script	1.27

Mean score based on four point scale (1 = never, 4 = most often
For column differences, p <0.05.

Although scientists depend heavily on professional journals, their first preference goes to the professional journals in their own fields followed by other fields. Characteristically, journals are organised along disciplinary lines. In fact many if not most, major scientific journals are published and edited by disciplinary associations. Our survey revealed that research journals in own field and other fields are most preferred resources of formal communication.

The fact that journal articles are written for one's peers and not for laymen confers upon them a cachet of quality and a certification of the author's membership in the scientific community unattainable through the publication of in-house reports. However, in the field of cotton, the journal publication system is almost paralleled by a system for publishing in-house reports. As one might suspect, given the relatively late development of disciplinary societies in agriculture,

the use of in-house reports to disseminate agricultural scientific information preceded the development of agricultural scientific journals. The trend in the publication of journals and in-house reports are apparent from Table 1. Although available data pertain only to cotton scientists, the trend may probably apply to all agricultural scientists.

Publications in journals and reports are followed by papers in seminars, workshops and conferences. For agricultural scientist seminars, workshops, and conferences offer an opportunity to present his findings to his peer group. Although, some discussions are held on papers and scientists are less than rigorous in examining the methods and results, the seminars, conferences and workshops offer a good opportunity to communicate the results and get immediate feedback from peers.

Research articles and reports and seminars are followed by farm journals which are basically meant for extension functionaries and farmers. These communications are written in simple languages, messages are applied in nature and circulations are quite high. Farm journals are followed by training manuals which are used as background material for training of extension workers or farmers. In-house newsletter and brochure / bulletins published by organisation are also used to communicate the scientific information. The reach of these resources are limited and results are not scrutinised by the fellow scientists.

Next in importance of resources of scientific communication comes writings for mass media like newspaper, writing for radio, TV, and video films. These mediums are mostly used by scientists who are engaged in applied research.

Considering the importance of publications for communicating the scientific information on research, we have looked at the comparative importance of various resources as perceived by the scientists (Table 2). The data indicate that foreign journals in own field comes out as the most important published resource followed by foreign journals in related fields. It is always prestigious to publish in foreign journals because they have a very rigorous process of screening the articles, print quality is better and circulation is wider.

Books and book chapters come next to foreign journals followed by domestic journals in own field and domestic journals in related fields. Reports and bulletins come as the least important published resource for research.

Table 2: Perceived importance of published resources

Resources	Mean score
Foreign Journals in own field	6.82
Foreign journals in related fields	6.29
Books and book chapters	5.73
Domestic journals in own field	5.33
Domestic journals in related fields	4.27
Reports	4.11
Bulletins	3.22

Mean score based on five point scale (1= not important, 7 = very important) For column differences, p <0.05.

While the formal communication system is highly visible and central to the research process, the informal network is more difficult to observe but equally important. Although informal systems by definition lack formal structure within the research system, the informal network may consists of a rich system of interrelations. In addition, an increasing number of social researchers have concluded that people and not formal channels of communication are more effective for transmitting scientific information (Kelly et al, 1977). Indeed Garvey and Gottfredson (1977) in a study of two thousand scientists reported that most scientists (63%) had pre publication knowledge of journal articles and that the most likely source of this information was face to face contact. In our study cotton scientists have reported that the frequency of their communicating about their research with scientists from other institutions is somewhat less than monthly (Table 3).

Table 3: Scientists' frequency of communication regarding research with system participants

System Participants	Mean score
Scientists from other Institutions	2.22
Clients or farmers	1.69
Representative of seed company	1.49
Officers for state governments	1.48
Officers from central government	1.39
Pesticide / seed dealer	1.33
NGOs	1.22
Farm women	1.11
Political leader	1.03

Mean score based on five point scale (1= rarely, 5 = Daily) For column differences, p < 0.05.

The data reveal that cotton scientists do not seem to interact with anybody outside their own system, less than bi-weekly regarding their research. The relative frequency of scientist's informal communication with clients or farmers comes somewhere less than monthly. This indicates that cotton scientists do not find it difficult to evaluate the relevance of their research directly with the client system. It is followed by officers from State Government, officers from central government, representative of seed companies, pesticide / fertilizer / seed dealers, NGOs with whom interaction comes to almost rarely. Communication with farm women is also rarely, so does with political leaders.

Conclusion

Mutually interdependent formal and informal scientific communication systems are integral to agricultural research. Cotton scientists in India identify modes of formal communication particularly professional journals as essential resource used for communication of scientific findings which is a key to the reward structure. The professional journals are from their own disciplines and other related fields also. Plant breeder may publish in mainstream plant breeding journals as well as other fields like genetics, entomology or plant pathology. Internal reports have also emerged as the widely used resource for formal communication. However, electronic mass media like radio, TV and video film scripts are least used resources for scientific communication. The comparative importance of these resources as perceived by the scientists reveal that foreign journals in their own field as well as in related fields emerge as the most important published resources, followed by books and book chapters. Our data indicate that book chapter is perceived as more important resource of scientific communication than domestic journals.

Informal interactions about research are very important for the development of agricultural science since client group is vast in number with diverse needs. In spite of its perceived importance, scientific communication among agricultural scientists is relatively infrequent, highly specialised and insular.

The outlet for scientists work is dominated by domestic disciplinary journals but scientists perceive foreign journals as the more important resource for communication of research findings. Informal communication about research is relatively infrequent and limited primarily to contact with scientists in one's own department. Scientists report that communication with outside scientists is less frequent. Discussions with broader range of participants in the research system such as clients, farmers and extension staff are limited to rarely and may in future be further constrained by financial limitations. Nevertheless, the nature of specific scientific communication is closely related to the ways in which science is conducted. For example, scientists who communicate more frequently with extension workers and farmers are more likely to be concerned with clients' needs and demands, feedback from extension and marketable final products. Clearly, agricultural scientists are faced with forms of scientific communication and sources of in uence that move them in different and potentially contradictory directions.

The formal and informal sources of scientific communication have important implications for the process and products of science. Effective agricultural research policy must address the importance of the scientific communication system, its integral relationship and the goals and products of agriculture and agricultural research, and the potential con icts in the present system.

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प्रारंभिक शिक्षा में बच्चों को विज्ञानोन्मुख बनाना

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सारांश

प्रारंभिक शिक्षा का मुख्य उद्देश्य बच्चों के व्यक्तित्व एवं चरित्र का सर्वांगीण विकास है और विज्ञानोन्मुखीकरण इसका एक महत्त्वपूर्ण पहलू है। यहां औपचारिक तथा अनौपचारिक विद्यालयों में आये अनुभवों के आधार पर विज्ञानोन्मुखीकरण के लिए अपनायी जाने वाली पद्धतियों की चर्चा की गई है। विज्ञानोन्मुख वातावरण बनाने के लिए दो अनिवार्य पूर्व-शर्तें बतायी गयी हैं: (क) शिक्षा का माध्यम मातृभाषा या स्थानीय भाषा हो और (ख) विभिन्न वस्तुओं एवं प्रक्रियाओं के प्रत्यक्ष अनुभव और करके देखने को प्रोत्साहन दिया जाये। इन दो शर्तों की व्याख्या करके पूर्व प्राथमिक एवं प्राथमिक शाला के विभिन्न विषयों के पाठ्यक्रम और पाठ्य-पद्धतियों की समीक्षा की गई है। पूर्व-प्राथमिक शाला में बच्चों की सहज अन्वेषी प्रवृत्ति को बढ़ावा देने के लिए गतिविधियां सुझायी गयी हैं। प्राथमिक विद्यालय में भाषा, गणित, विज्ञान एवं सामाजिक अध्ययन जैसे विषयों के अध्यापन में विज्ञानोन्मुखता लाने के लिए पद्धतियों की चर्चा की गई है।

Abstract

The main objective of elementary education is all-round development of children's personality and character, and science orientation is an important aspect of this. Some methods to be adopted for science orientation are discussed on the basis of experience gained in formal and non-formal schools. Two essential pre-conditions are laid down for making an environment conducive to science orientation: (a) the medium of instruction be the mother tongue or the local language, and (b) encouragement be given to direct experience of various objects and processes and to learning by doing. After explaining these two pre-conditions, a review's made of the curricula and teaching methods in pre-primary and primary schools. In the pre-primary school, activities to encourage the natural exploring tendencies of children are suggested. In the primary school, methods to inculcate science orientation in teaching of language, mathematics, science and social studies are discussed.

Keywords: Science orientation, Scientific temper, Learning by doing

भूमिका: विज्ञानोन्मुखीकरण का अर्थ एवं महत्व

इस प्रपत्र में प्रारंभिक शिक्षा के क्षेत्र में आये अनुभवों एवं चर्चाओं के आधार पर बच्चों को विज्ञानोन्मुख करने के बारे में कुछ विचार प्रस्तुत किये जा रहे हैं। यहां स्पष्ट करना आवश्यक है कि मोटे तौर पर विज्ञानोन्मुखीकरण के दो प्रकार के अर्थ हो सकते हैं:

(क) बच्चों को 'विज्ञान' नामक विषय विशेष की मूल अवधारणाओं, सिद्धांतों और प्रयोगों से परिचित कराना तथा उनमें विज्ञान एवं प्रौद्योगिकी के संसार में हो रही नवीनतम खोजों तथा पद्धतियों के प्रति सजगता लाना; और

(ख) बच्चों में वैज्ञानिक मनोवृत्ति का विकास करना; उनके पूरे व्यक्तित्व में विज्ञानसम्मत तथा तर्कसम्मत व्यवहार का समुचित पुट लाना।

उपर्युक्त दोनों पहलू आपस में जुड़े हुए भी हैं और अलग-अलग भी हैं। दोनों का अपना-अपना विशिष्ट महत्व है और दोनों के विकास के लिए अलग-अलग उपाय भी हैं। दोनों का अर्थ बिल्कुल एक नहीं है, इसके प्रमाण के रूप में तो यह तथ्य रखा जा सकता है कि बहुत से वैज्ञानिकों का व्यक्तित्व भी कुछ हद तक विज्ञानोन्मुख नहीं होता। उस हद तक उनमें पहलू (ख) का विकास नहीं हुआ, जबकि (क) का हुआ है। दूसरी ओर, कोई अनपढ़ या शिक्षित व्यक्ति भी जिसने विज्ञान न पढ़ा हो, ऐसे व्यक्तित्व वाला हो सकता है जिसे विज्ञानोन्मुख कहा जा सके।[1] पहलू (क) का सीधा संबंध मुख्यत: 'विज्ञान' नामक विषय के अध्यापन से है, जबकि (ख) का संबंध सभी विषयों के अध्यापन तथा विद्यालय के पूरे वातावरण से है।

प्रस्तुत प्रपत्र में पहलू (ख) अर्थात् पूरे व्यक्तित्व को विज्ञानोन्मुख बनाने, से संबंधित विचार किया जायेगा। यह अनेक विचारकों की चिंता का विषय है कि हमारे देश के लोगों में, शिक्षित वर्ग में भी और विज्ञान शिक्षित वर्ग में भी, विज्ञानपरक मनोवृति की कमी है।[2] इसके कारण सामाजिक प्रगति का मार्ग अवरूद्ध हो गया है। इसके कारण न केवल प्रत्येक व्यक्ति के अपने विकास, प्रगति एवं उपलब्धियों में कमी आ जाती है, अपितु सामाजिक तनाव भी पैदा होते हैं। लोगों के व्यक्तित्व के विकास में प्रारंभिक शिक्षा की महत्वपूर्ण ही नहीं, अपितु निर्णायक भूमिका है। अत: प्रारंभिक शिक्षा में इस ओर ध्यान देना अत्यावश्यक है कि बच्चों के व्यक्तित्व में उनके विचार, संचार और कार्य के ढंग में विज्ञान तथा तर्क का समुचित पुट आये। इसके लिए न केवल 'विज्ञान' सहित प्रत्येक विषय के शिक्षण की विषयवस्तु तथा पाठ्य-विधियों पर, अपितु पूरे विद्यालय के वातावरण पर ध्यान देने की आवश्यकता है।

नीचे विज्ञानोन्मुखीकरण के लिए उपयुक्त वातावरण बनाने के लिए दो आवश्यक शर्तों तथा उन्हें पूरा करने की विधियों की चर्चा की जायेगी।

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फिर प्रत्येक विषय पर अलग-अलग विचार करके विज्ञानोन्मुखीकरण की संभावनाओं और समस्याओं को दिखाया जायेगा।

शिक्षा का माध्यम

अनौपचारिक एवं औपचारिक प्रारंभिक शिक्षा में गत 10 वर्षों के अनुभव के आधार पर हमारा मत है कि विज्ञानोन्मुखीकरण की दिशा में पहली मूलभूत शर्त है कि प्रारंभिक शिक्षा में शिक्षण का माध्यम मातृभाषा या स्थानीय भाषा हो। यह बात अपने आप में इतनी स्पष्ट है कि सामान्य परिस्थितियों में इसे स्वत: स्पष्ट माना जाता है और इसे कहने या इस पर बहस करने की कोई आवश्यकता नहीं पड़ती। जब जगदीशचंद्र बसु, प्रफुल्लचंद्र रे, रामन, चंद्रशेखर और विश्वेश्वरैया स्कूल में पढ़ते थे, तब प्रारंभिक शिक्षा मातृभाषा या स्थानीय भाषा के माध्यम में ही होती थी। परंतु हाल के दशकों में हमारे पूरे देश में 'अंग्रेज़ी माध्यम' के प्रति मोह बढ़ता गया है। यहां तक दूर दराज के गांवों में भी, जहां अंग्रेजी का व्यवहार नहीं के बराबर है, लोग अपने बच्चों को अंग्रेज़ी माध्यम वाले विद्यालय में भेजना चाहने लगे हैं। राष्ट्रीय भावनाओं के आलोक में तो इस प्रवृत्ति की आलोचना की गई है, परंतु विज्ञानोन्मुखीकरण के संदर्भ में इस मुद्दे पर पर्याप्त विचार नहीं हुआ है।

यह ध्यान देने योग्य है कि विज्ञानोन्मुख होने का अर्थ है पदार्थों, प्रक्रियाओं, तथा तथ्यों के साथ परिचित होना, उनको ध्यानपूर्वक देखना, उन पर चर्चा करना, विश्लेषण करना, और तर्क तथा प्रयोग के सहारे निष्कर्षों तक पहुंचना। इन विधियों के लिए यह अनिवार्य है कि बच्चों का प्रकृति के साथ, एक-दूसरे के साथ, पुस्तकों के साथ तथा शिक्षक के साथ मुक्त संवाद स्थापित हो सके। बच्चा अपने मन में भी विचार और तर्क कर पाये। इन सभी प्रक्रियाओं में भाषा की भूमिका निर्णायक रहती है। बच्चा जिस भाषा / भाषाओं से परिचित है, उसे किनारे करके केवल अंग्रेज़ी को संवाद का माध्यम बनाने का एकमात्र परिणाम यही हो सकता है कि संवाद ही ठप्प हो जाये, विचार की प्रक्रिया विकसित ही न हो, तर्क करने का ढंग सीखने की शुरूआत ही न हो, सभी विषयों की पढ़ाई कुछ शब्दों और प्रश्नोत्तरों को रटने तक सीमित रह जाये।

सचमुच, देखने में यही आ रहा है कि अंग्रेज़ी माध्यम में पढ़ने वाले अधिकतर बच्चे कक्षा में 'यस, सर' या कुछ अन्य रटे रटाये वाक्यों को दुहराने के अतिरिक्त कुछ नहीं कह पाते। कही हुई और पढ़ी हुई बातों को समझने में भी यही लाचारी दिखाई देती है। प्रकृति और समाज की प्रक्रियाओं के प्रेक्षण और विश्लेषण की बात तो बहुत दूर है, ये सभी बच्चे माता पिता की सहायता के बिना अपनी पुस्तक भी नहीं पढ़ सकते, गृह कार्य भी नहीं कर सकते और परीक्षा की तैयारी भी नहीं कर सकते। कक्षा, पाठ्यक्रम और पाठ्य पुस्तक के दायरे के बाहर ये विद्यार्थी स्थानीय भाषा में बात करते पाये जाते हैं और उसी में उनकी बुद्धि का विकास होता है, परंतु उसमें स्कूली प्रक्रिया की कोई भागीदारी नहीं होती। विश्वविद्यालयों के अध्यापकों का अनुभव है कि ये विद्यार्थी जब उच्च शिक्षा के लिए आते हैं तो किसी भी विषय की मूलभूत अवधारणाओं और कुशलताओं की दृष्टि से बहुत कच्चे मालूम होते हैं। (उदाहरण के लिए संदर्भ[3, 4] देखें।)

कड़ी चयन प्रक्रियाओं से छंट कर आने वाले और परीक्षाओं में 80-90 प्रतिशत अंक पाने वाले विद्यार्थियों के बारे में भी अक्सर यही कहना पड़ता है कि उनके मस्तिष्क में जो बहुत से तथ्य और शब्द ठूंसे हुए हैं, उनमें कोई अंतर्संबंध नहीं है। स्पष्ट ही, इस दयनीय स्थिति का प्रारंभिक शिक्षा के माध्यम के साथ गहरा संबंध है।

स्थानीय भाषा को माध्यम बनाने मात्र से इस समस्या का निवारण नहीं हो सकता। अन्य बहुत से कदम उठाना भी आवश्यक है, जैसा कि नीचे विस्तारपूर्वक बताया जायेगा। परंतु इन सब कदमों को उठाने की तैयारी तभी हो सकती है जब बच्चों को अपनी सहज स्वभाविक भाषा में आदान प्रदान करने की सुविधा रूपी पहली शर्त पूरी की जाये।

यूं उच्च शिक्षा में तो लंबे समय से अंग्रेजी भाषा शिक्षा का माध्यम रही है, विशेषत: विज्ञान तथा संबंधित विषयों में उसके कुछ ऐतिहासिक कारण भी हैं और वर्तमान की दृष्टि से अपने गुण-दोष भी हैं, जिनकी समीक्षा करना यहां संगत नहीं होगा। यहां तो हम हाल के दो चार दशकों में पनपी उस प्रवृति की ओर ध्यान दिलाना चाहेंगे जिसके तहत 'शिक्षित' लोगों के बच्चे अंग्रेजी माध्यम की बेड़ी पहनने को मजबूर हैं, जबकि शेष बच्चों में जो अपनी भाषा के माध्यम से आगे बढ़ सकते थे, हीनता का भाव भर दिया गया है।

यहां ध्यान दिलाना आवश्यक है कि अंग्रेजी से हिंदी या बंगला या तमिल में अनुवाद कर देने मात्र से भाषा की समस्या हल नहीं हो जाती। सरकारी स्कूलों में जो पाठ्य पुस्तकें पढ़ाई जाती हैं, उनकी भाषा को औपचारिक रूप से भले ही मातृभाषा / स्थानीय भाषा कह दिया जाये, उससे वह उद्देश्य पूरा नहीं होता जिसकी यहां बात की जा रही है। यदि पुस्तक बच्चे के साथ संवाद स्थापित न कर सके तो उसकी भाषा का नाम कुछ भी होने से क्या अंतर पड़ता है? अक्सर ये पुस्तकें विश्वविद्यालय स्तर के विद्वानों द्वारा मूल रूप से अंग्रेजी में तैयार की जाती हैं। एक तो मूल पाठ में ही औपचारिक परिभाषाओं और विद्वता प्रदर्शन की भरमार रहती है। दूसरा, यांत्रिक ढंग से किया गया अनुवाद अक्सर नीरस, ऊबड़-खाबड़ और कहीं-कहीं भ्रामक व ग़लत होता है। स्वाभाविक ही, इन पुस्तकों के साथ बच्चों का *'जीवंत संवाद'* नहीं बन पाता। शिक्षक क्योंकि इन्हीं पुस्तकों को विद्यार्थियों के गले उतारने के प्रयास में लगे रह जाते हैं (भले ही वे स्वयं ही पुस्तकों की विषय वस्तु को न समझ पायें), अत: वे स्वतंत्र ढंग से भी बच्चों के साथ ऐसा संवाद स्थापित नहीं कर पाते जिसमें से वैज्ञानिक मनोवृत्ति पनपे। इसके विपरीत, हाल के वर्षों में बच्चों के योग्य पाठ्य पुस्तकें तैयार करने का कार्य कहीं-कहीं हुआ है, जैसा 'एकलव्य' द्वारा मध्यप्रदेश में[5]।

करके देखना

विज्ञानोन्मुख वातावरण बनाने की दूसरी मूलभूत शर्त है बच्चों को अपने हाथ पैरों तथा ज्ञानेंद्रियों से विभिन्न कार्य करने का पूरा अवसर देना। विश्वविद्यालय का विद्वान भले ही पुस्तक पढ़ने मात्र से बहुत कुछ समझ सकता है, परंतु बच्चों को विज्ञानोन्मुख करने में गतिविधियों, क्रिया कलापों, प्रदर्शनों व ठोस उदाहरणों की केंद्रीय भूमिका है। इसका कारण यह है कि बच्चा स्कूल से ही सूक्ष्म की ओर प्रगति

कर सकता है। वह मूर्त वस्तुओं और घटनाओं से ही अमूर्त सिद्धांतों तक पहुंच सकता है।

नीचे विभिन्न स्तरों पर विभिन्न विषयों के शिक्षण के ठोस उदाहरण लेते हुए बच्चों को विज्ञानोन्मुख करने की विधियों की चर्चा की जायेगी।

पूर्व प्राथमिक शिक्षा में विज्ञानोन्मुखीकरण

शिक्षाविदों के अनुसार पूर्व प्राथमिक शिक्षा में कहानी, गीत, खेल, चित्रकारी, रंग भरना, भ्रमण, मिट्टी से खेलना, अन्य हस्तकला, ब्लाक जोड़कर वस्तुएं बनाना आदि गतिविधियों पर ज़ोर देना चाहिए।[6] दूसरी ओर, वास्तव में पूर्व प्राथमिक शालाएं प्राय: विद्यालयों का ही पुछल्ला बनी हुई हैं। अधिकांश शहरी स्कूलों के पूर्व प्राथमिक खंड में साक्षरता और पाठ्य पुस्तकों तथा बंधे बंधाये प्रश्नोत्तरों का अंग्रेजी में रटने पर ही ज़ोर दिया जाता है। यह व्यवहार विज्ञानोन्मुखीकरण की विपरीत दिशा में है। बच्चों के सर्वांगीण विकास तथा आगे आने वाली स्कूली शिक्षा की तैयारी के लिए ऊपर उल्लिखित गतिविधियां आवश्यक हैं। ऐसी गतिविधियों को कराने के क्रम में कुछ अनुभव प्राप्त हुए हैं जो विज्ञानोन्मुखीकरण की दृष्टि से विशेष रूप से विचारणीय हैं।

पहली बात तो यह है कि बच्चे स्वभाव से ही अन्वेषी होते हैं और खोज करते रहते हैं। मुख्य रूप से दो रूपों में यह जिज्ञासा प्रकट होती है। एक तो वे अपनी अनुभूति में आने वाली हर वस्तु और प्रक्रिया के बारे में प्रश्न पूछते हैं - क्या, कौन, कहां, कब, कैसे, क्यों, कितना आदि। उदाहरण के लिए, नदी में पानी कहां से आता है? उसमें कोई कैसे 'डूब' जाता है? दूसरा, वे वस्तुओं को देख कर, छूकर, उनके साथ बार-बार व्यवहार करके, व्यापक निष्कर्षों तक पहुंचने की कोशिश करते हैं। उदाहरणतया, बच्चा रेडियो के विभिन्न बटनों/घुंडियों को दबा/घुमा कर देखना चाहता है कि इससे क्या होता है। इन सहज प्रवृत्तियों को बचपन में घर और विद्यालय दोनों में दबा देने का यह परिणाम है कि बाद के वर्षों में विद्यार्थी अपने अध्ययन में न प्रश्न पूछता है और न समझता है, बस चुपचाप 'नोट्स' लेता जाता है इसी प्रकार प्रयोगशाला में भी प्रयोगिक सामग्रियों तथा यंत्रों को विभिन्न प्रकार से हिला-चला कर देखने में रूचि नहीं लेता। अत: यह आवश्यक है कि शिशु वाटिका में बच्चों के बाल सुलभ प्रश्नों के यथोचित उत्तर दिये जायें और उन्हें तरह-तरह की प्राकृतिक और मानव निर्मित वस्तुओं एवं यंत्रों के साथ व्यवहार करने का अवसर दिया जाये।

दूसरा अनुभव यह आया कि कहानी सुनने के क्रम में बच्चे किसी-किसी बात को ठीक से समझ नहीं पाते और उसे *करके देखना* चाहते हैं। उदाहरणतया, 'शेर कुएं में डूब गया' सुन कर उनको जिज्ञासा होती है कि वह कैसे डूब गया? डूब गया यानी क्या? इसी प्रकार दो बिल्लियों और बंदर वाली कहानी सुन कर बच्चे स्वयं देखना चाहते हैं कि तराजू के पलड़ों में रोटी के टुकड़े रखने से कैसे पलड़े ऊपर नीचे हो जाते हैं। जब वे इस बारे में प्रश्न पूछते हैं, प्राय: सही और नपे तुले शब्दों में अपने मन के भाव को प्रकट नहीं कर पाते। चाहे वे इसे स्पष्ट कह पायें या नहीं, वे यह चाहेंगे कि डूबने/तैरने वाली चीज़ों के साथ खेलें, तराजू के साथ खेलें (इस आयु में खेलना या खोज करना लगभग एक ही बात है।) शिक्षक यदि उन्हें अपनी जिज्ञासा शांत करने के लिए उपयुक्त सामग्रियां दें (जो बड़ी कक्षाओं के बच्चों द्वारा विद्यालय में भी बनाई जा सकती हैं) तो वे नई खोज के आनंद को प्राप्त करते हैं।

बच्चों के विज्ञानोन्मुखीकरण में *भ्रमण* का विशेष महत्व है। बच्चे विद्यालय की चारदीवारी से बाहर निकल कर प्राकृतिक, तकनीकी एवं सामाजिक पर्यावरण के साथ साक्षात्कार करते हैं। पेड़ पौधों, पशु पक्षियों, पानी के स्रोतों, आकाश, बादल, लोगों, विभिन्न पेशों आदि के साथ परिचय करते हैं। वे विभिन्न पेड़ों के पत्तों को पहचानते हैं, धूप और हवा के शरीर पर प्रभाव को समझते हैं, आदि। विज्ञान की विधि के कई पहलुओं पर तो कार्य पूर्व प्राथमिक स्तर पर ही शुरू हो जाता है, जैसे वस्तुओं का वर्गीकरण, कार्य कारण संबंध पहचानना, प्रयोग आदि। इन विधियों का नाम लिये बिना भी कार्य किया जाये तो आगामी वर्षों में इन्हें अपनाने की तैयारी अवश्य हो जाती है, क्योंकि वस्तुओं और प्रक्रियाओं के साथ भली भांति परिचय होने पर ही वर्गीकरण, सामान्यीकरण आदि कार्यों में जान आ सकती है।

वास्तव में पूर्व प्राथमिक शिक्षा की हर गतिविधि को विज्ञानोन्मुखीकरण का माध्यम बनाया जा सकता है, बशर्ते कि शिक्षक इसके बारे में सजग-सचेष्ट हो। उदाहरणतया, चित्रकला में किसी भी वस्तु के विभिन्न अंगों को अपने वास्तविक आकार, आकृति, रंग, क्रम आदि में बनाने के प्रति सजगता लाई जा सकती है। जैसे किसी बच्चे ने घर का चित्र बनाया और उसमें खिड़की नहीं लगाई तो शिक्षक कह सकता है कि इसमें हवा कहां से आयेगी, या घर के भीतर बैठा बच्चा बाहर चिड़िया को कैसे देखेगा?

प्राथमिक विद्यालय में विभिन्न शैक्षिक विषयों का प्रतिपादन

प्राथमिक विद्यालय में विभिन्न विषय पढ़ाने का उद्देश्य बच्चे पर ज़बर्दस्ती विद्वत्ता का बोझ लादना नहीं, बल्कि उसके शरीर, मन, भावनाओं तथा बुद्धि का समुचित विकास और सही दिशा देना है। हिंदी, अंग्रेज़ी, गणित, विज्ञान, सामान्य, ज्ञान, सामाजिक अध्ययन आदि अनेक विषय यहां पढ़ाये जाते हैं। साक्षरता जैसी कुशलता देने के अतिरिक्त इन सब विषयों की भूमिका माध्यमों के तौर पर है– ये सभी माध्यम हैं जिनसे बच्चे का विकास होता है, बुद्धि पैनी होती है और सामाजिक सजगता बढ़ती है। विज्ञानोन्मुखीकरण इसी व्यक्तित्व विकास, बुद्धि के पैनेपन तथा सजगता का एक महत्वपूर्ण पहलू है। इस दृष्टि से देखें तो पाठ्य पुस्तकों को बांटते जाना और बंधे बंधाये प्रश्नोत्तरों को रटते जाना, जो कि अधिकतर विद्यालयों की मुख्य गतिविधि बन गई है, लगभग निरर्थक कसरत है। नीचे कुछ विषयों के शिक्षण में कुछ अनुभव-जन्य विधियों की चर्चा की जायेगी।

1. भाषा

भाषा शिक्षण में शुरू से ही विज्ञानोन्मुखीकरण के अनेक अवसर मिलते हैं। जैसे, वर्णमाला की पहचान कराने की पुरानी प्रचलित विधि यह है कि 'क से कबूतर' 'ख से खरगोश', आदि बंधे-बंधाये फार्मूले बच्चों को रटवाये जाते हैं। इसकी अपेक्षा यह बेहतर रहेगा कि प्रत्येक अक्षर का संबंध उसकी *ध्वनि* के साथ जोड़ा जाये। इसके लिए 'ध्वनि-वाचन' नामक गतिविधि की रचना की गई है जिसके अंतर्गत बच्चे अपने परिचित शब्दों में से प्रत्येक का प्रथमाक्षर पहचानते हैं, और इसकी उल्टी क्रिया भी करते हैं, अर्थात् प्रत्येक अक्षर से शुरू होने वाले अनेक शब्द स्वयं खोजते हैं। इसमें अक्षरों का क्रम क, ख, होना आवश्यक नहीं, कोई भी अक्षर पहले आ सकता है। इसी दिशा में विभिन्न शिक्षकों ने अन्य बहुविध खेलों का निर्माण किया है जिनको बच्चे बहुत आनंदपूर्वक खेलते हैं। इस प्रकार वे न केवल पढ़ना लिखना अधिक जल्दी और भली-भांति सीखते हैं, अपितु अक्षर और ध्वनि का सामान्य संबंध समझ जाने के कारण अनायास ही विज्ञानोन्मुखी भी होते हैं।

इसी प्रकार भारतीय लिपियों की वर्णमालाओं का आवर्त सारणी (Periodic Table) जैसे ढांचा भी उच्च प्राथमिक कक्षाओं में विज्ञानोन्मुखीकरण का एक सशक्त माध्यम बन सकता है। जैसा कि तालिका-1 में दिखाया गया है, इस सारणी में प्रत्येक पंक्ति मुख में एक उच्चारण स्थान दर्शाती है और प्रत्येक स्तंभ (कालम) उच्चारण में किये जाने वाले प्रयास के विभिन्न पहलू दर्शाता है। तालिका-2 में शिक्षा के विभिन्न स्तरों पर कराये जाने वाले वर्णमाला से संबंधित विज्ञानपरक प्रयोगों और गतिविधियों की सूचना दी गई है। यहां ध्यातव्य है कि इस प्रकार विज्ञानोन्मुखीकरण में उपयोगी होने में भारतीय वर्णमालायें विश्व में अद्वितीय हैं : विश्व की अन्य वर्णमालाओं के ढांचों में मानव-ध्वनियों का वैज्ञानिक विश्लेषण निहित नहीं है।

तालिका 1 : देवनागरी लिपि : मानव-ध्वनियों की आवर्त-सारणी

उच्चारण स्थान	स्वर* (ह्रस्व)	व्यजंन						अंत:स्थ	ऊष्म
		पंक्ति का नाम	अल्पघोष		महाघोष		नासिक्य		
			अल्पप्राण	महाप्राण	अल्पप्राण	महाप्राण			
कंठ	अ	क वर्ग	क्	ख्	ग्	घ्	ङ्	-	ह्
तालु	इ	च वर्ग	च्	छ्	ज्	झ्	ञ्	य्	श्
मूर्धा	ऋ+	ट वर्ग	ट्	ठ्	ड्	ढ्	ण्	र्	ष्
दन्त	ऌ++	त वर्ग	त्	थ्	द्	ध्	न्	ल्	स्
ओष्ठ	उ	प वर्ग	प्	फ्	ब्	भ्	म्	व्	(फ्)

*अन्य भारतीय भाषाओं की लिपियों का ढांचा भी मोटे तौर पर इसी प्रकार का है। तमिल लिपि में व्यंजनों की मैट्रिक्स 5 x 5 न होकर 5 x 2 है। उर्दू की लिपि इस ढांचे में नहीं बनी है, क्योंकि यह विदेश से आई है।

+यहां केवल मूल ध्वनियां ही दिखाई गई हैं। इन्हीं को परस्पर मिलाने से दीर्घ स्वर, संयुक्ताक्षर आदि प्राप्त होते हैं।

++ऌ का उपयोग आधुनिक भारतीय भाषाओं में नहीं होता, परंतु सारणी को औपचारिक रूप से पूरा करने के लिए यह आवश्यक है।

तालिका 2 : भारतीय वर्णमालाओं के शिक्षण में गतिविधियां एवं प्रयोग

शिक्षा का स्तर	विषय	गतिविधियों / प्रयागों / खेलों के उदाहरण
पूर्व प्राथमिक और आगे	ध्वनि वाचन	1. दिये गये शब्द का प्रथमाक्षर खोजना। 2. दिये गये अक्षर से शुरू होने वाले अनेक शब्द बनाना।
	वर्णों की आकृतियां	1. छोटे फूलों, बीजों आदि से आकृतियां बनाना। 2. वर्णों से शुरू करके पशु-पक्षियों, फल-सब्जियों आदि की आकृतियां बनाना।
कक्षा 1, 2 और आगे	ध्वनि-वाचन	1. दिये गये शब्द का अंतिम अक्षर पहचानना 2. दिये गये शब्द को स्वरों एवं व्यंजनों में तोड़ना 3. शब्दों की अंत्याक्षरी।
	वर्णों की आकृतियां	1. विभिन्न वर्णों की आकृतियों में सीधी रेखा, टेढ़ी (वक्र) रेखा, वृत्त, त्रिभुज, चौकोर आदि खोजना।
कक्षा 3-5 और आगे	स्वर एवं व्यंजन	1. किसी वर्ण को लगातार उच्चारित करना। 2. किसी व्यंजन का विभिन्न स्वरों के साथ संयोग (बारहखड़ी)।
	ध्वनियों का उद्गम स्थान	1. विभिन्न व्यंजनों के उच्चारण में जीभ आदि की स्थिति पर ध्यान देना चित्र बनाना।
कक्षा 6-8 और आगे	उच्चारण में प्रयास	1. विभिन्न व्यंजनों के उच्चारण में होने वाले प्रयास (हवा निकलना, स्वर-यंत्र में कंपन आदि) को खोजना। 2. उच्चारण में निकलने वाली हवा को मापना।
	वर्णों की आवर्त-सारणी	1. उपर्युक्त प्रयोगों के आधार पर वर्णों की आवर्त-सारणी बनाना 2. मैट्रिक्स का खेल (प्रत्येक वर्ण का दो संख्याओं के समूह द्वारा प्रतिनिधित्व)।

व्याकरण की शिक्षा तो स्पष्टत: विज्ञानोन्मुखीकरण का माध्यम है, क्योंकि इस विषय का संबंध उन सामान्य नियमों से है जिनसे भाषा बंधी है। आवश्यकता इस बात की है कि इसके अंतर्गत औपचारिक परिभाषाएं रटवाने की बजाय गतिविधियों, प्रयोगों और खेलों की रचना की जाये, जिनसे बच्चे स्वयं ही परिभाषाओं और सामान्य नियमों तक पहुंच सकें। (उदाहरण के लिए देखें संदर्भ[7])

2. गणित

स्कूली बच्चों में गणित प्राय: एक कठिन विषय माना जाता है, क्योंकि इसमें बंध-बंधाये प्रश्नोत्तरों को रटने से उस हद तक काम नहीं चल सकता जितना कि अन्य विषयों में। परंतु यह अनुभूत सत्य है कि जिन विद्यालयों में विज्ञानपरक पद्धतियां अपनाई जाती हैं वहां विद्यार्थियों को प्राय: गणित अन्य विषयों की अपेक्षा सरल लगता है क्योंकि इसमें थोड़े से नियमों को जान कर बहुत तरह के प्रश्न हल किये जा सकते हैं। ऐसी पद्धति में आवश्यक है कि गणित की अमूर्त धारणाओं को मूर्त रूप देकर समझाया जाये। बहुत छोटे बच्चों के लिए तो संख्याएं (एक, दो, तीन ...) भी अमूर्त ही हैं। उनको एक पेंसिल, दो बकरियां, चार फूल, छ: बच्चे आदि उदाहरण देकर समझाना चाहिए। इसी प्रकार इकाई-दहाई और स्थानीय मान की अवधारणा को भली भांति समझाने के लिए दस-दस तिनकों के बंडल बांध कर उन्हें दहाई की तरह प्रयोग करना चाहिए। कागज़ के नोटों द्वारा भी इस अवधारणा को पुष्ट किया जा सकता है, बशर्ते कि वे 'नोट' केवल 1,10,100, आदि दशमलव मूल्यों के ही हों। इस प्रकार के सामानों के साथ शिक्षकों ने अनेक मज़ेदार खेलों की रचना की है। ज्यामिति में आने वाली विभिन्न आकृतियां (दो आयामी भी और तीन आयामी भी) बना कर बच्चों को दिखानी चाहिएं और उनको पहचानने के खेल कराने चाहिएं। माप-तोल आदि के पाठ पढ़ते समय यह आवश्यक है कि बच्चे अपने हाथों में उपयुक्त सामग्रियां लेकर माप-तोल का कार्य करें। ये सामग्रियां (मीटर की छड़, तराजू, लीटर मापक, घड़ी) वे स्वयं बनायें तो और भी अच्छा हो।

3. विज्ञान

यह विडंबना ही है कि अक्सर 'विज्ञान' का अध्ययन ऐसे ढंग से कराया जाता है कि विज्ञानोन्मुख व्यक्तित्व के विकास का साधन बनने की बजाय यह विपरीत दिशा में असर करता है। विद्यार्थी विज्ञान के सिद्धांतों, परिभाषाओं, प्रश्नोत्तरों आदि को रट-रट कर परेशान हो जाते हैं, विशेष ट्यूटरों से अतिरिक्त ट्यूशन भी पढ़ते हैं। इस अवैज्ञानिक साधना के फलस्वरूप वे परीक्षा में पास हों या फेल, इतना निश्चित है कि (एकाध प्रतिशत विद्यार्थियों को छोड़ कर) न तो वे प्रकृति के तथ्यों और सिद्धांतों का साक्षात्कार कर पाते हैं और न अध्ययन में उनकी रूचि ही जागती है। इसके लिए केवल शिक्षकों और उनकी पाठ्य विधियों को ही दोष नहीं दिया जा सकता। वास्तव में पाठ्यक्रम में भी कुछ मूलभूत दोष हैं जिनके कारण प्रयोग, प्रदर्शन, प्रेक्षण, भ्रमण द्वारा प्रकृति अध्ययन आदि की संभावानायें काफ़ी सीमित हो जाती हैं।

पाठ्यक्रम और पाठ्य पुस्तकों के निर्माण में प्राय: यह दृष्टिकोण दिखाई देता है कि जो कार्य वैज्ञानिकों ने अनेक शताब्दियों में किया, उसकी पूरी समझ बच्चों को दे दी जाये। परंतु ऐसी जानकारी पुस्तकों में ठूंस देने मात्र से बच्चे विज्ञानोन्मुख नहीं हो सकते। प्राथमिक कक्षाओं के बच्चों को तो अपने परिवेश में देख कर और करके सीखना होगा। उदाहरणार्थ, कक्षा 4 और 5 में मानव शरीर की रचना के अंतर्गत पाचन तंत्र, हड्डियों और शरीर के आंतरिक भागों की रचना आदि पढ़ाई जाती है। यह बच्चों की आयु व बौद्धिक स्तर के अनुरूप नहीं है। बच्चे न तो इन अंगों को देख सकते हैं और न इन पर कोई प्रयोग ही कर सकते हैं। अधिकतर आंतरिक अंगों की तो उन्हें अनुभूति भी नहीं होती। अत: इस पूरी जानकारी को रटने के अतिरिक्त क्या किया जा सकता है? इन्हीं कक्षाओं में बल, कार्य और ऊर्जा जैसे सैद्धांतिक विषय और उसकी परिभाषाओं को जबरन ठूंसा गया है। अच्छा तो यह रहता कि इससे पहले बच्चों को बिजली, विभिन्न ईंधनों आदि की व्यावहारिक जानकारी से भली भांति परिचित होने दिया जाता।

अनेक विद्वान एवं शिक्षाकर्मी मानते हैं कि घातांकी गति से बढ़ती (हर कुछ वर्षों में दुगुनी होती) विज्ञान की जानकारी को आगमी पीढ़ियों तक पहुंचाने का एकमात्र उपाय यही है कि विभिन्न पदार्थों और प्रक्रियाओं पर समय न लगा कर केवल सामान्य सिद्धांतों पर ज़ोर दिया जाये।[8] शायद इसी कारण जीव विज्ञान विषय में प्रवेश करते ही बच्चों का सामना जीव जगत की रोचक तथा व्यावहारिक जानकारी / अनुभूति की बजाय 'उद्दीपन के प्रति अनुक्रिया', 'अनुकूलन' आदि व्यापक सिद्धांतों से होता है। प्राथमिक शिक्षा के संबंध में ध्यातव्य है कि आज के भारतीय बच्चे की औसत बौद्धिक क्षमताओं के मद्देनजर यह प्रणाली बिल्कुल अनुपयुक्त है। इन सामान्य सिद्धातों को समझने के लिए ठोस उदाहरणों की आवश्यकता है। जब तक बच्चे इन उदाहरणों से भली भांति परिचित न हों, तब तक उनके लिए ये सिद्धांत हवा में ही रह जाते हैं। उधर, व्यावहारिक प्रकृति-अध्ययन की बच्चों में जो क्षमतायें हैं, उनको पुष्ट करने के लिए पाठ्यक्रम में पर्याप्त सामग्री नहीं रहती।

व्यावहारिक दृष्टि से उपयोगी विषयों पर अक्सर पाठ्यक्रम में वैसे ही बहुत कम ध्यान दिया जाता है। ऐसे विषयों को शामिल किया भी जाता है तो ऐसे आयु स्तर पर जहां उसका कोई उपयोग नहीं रहता। उदाहरणार्थ, स्वास्थ्य विज्ञान के अंतर्गत अनेक रोगों और उनसे बचने के उपाय, पर्यावरण के अंतर्गत सामुदायिक सफ़ाई के तरीके, विभिन्न दुर्घटनाओं के होने पर तुरंत करने योग्य कार्यवाही, इत्यादि यदि कक्षा 8, 9, 10 के पाठ्यक्रम में होते तो विद्यार्थी इन कार्यों को वास्तव में रूचिपूर्वक करते और लाभान्वित होते। परंतु ऐसे विषयों को अविचारित ढंग से कक्षा 3, 4, आदि, के पाठ्यक्रम में डाल दिया गया है जहां ये मात्र किताबी जानकारियां बन कर रह जाते हैं। (पाठ्यक्रम की विस्तृत चर्चा के लिए संदर्भ[9, 10] देखें।)

शिक्षकों के प्रशिक्षण में भी प्रयोग, प्रदर्शन, भ्रमण आदि विधियों को अधिक महत्व नहीं दिया जाता। शायद इसका एक कारण यह है कि सैद्धांतिक और आयु से बेमेल पाठ्यक्रम का बोझ गले पड़ जाने से शिक्षक और उनके प्रशिक्षक भी विज्ञानोन्मुखीकरण को भूल जाते हैं। परिणाम यह होता है कि चांद तारों को देखने जैसी सरल और रोचक गतिविधियां भी बच्चों को कराने में शिक्षक स्वयं को तैयार नहीं पाते।

हमारे अनुभव में आया कि सिद्धांतों व औपचारिक परिभाषाओं की बजाय *'प्रकृति से प्रत्यक्ष परिचय'* कराने में बच्चे आनंदित भी होते हैं और विज्ञानोन्मुख भी। इस दिशा में चलते हुए, उदाहरणतया, मानव शरीर के बारे में शुरू की कक्षाओं में उन्हीं अंगों की ओर ध्यान दिलाया गया जो प्रत्यक्ष दीखते/सूझते हैं। शरीर क्रिया को समझने के लिए शुरू में विभिन्न तंत्रों को नहीं बल्कि भूख, प्यास, नींद आदि प्रवृत्तियों को लिया गया और व्यावहारिक स्वास्थ्य विज्ञान को इनके साथ जोड़ा गया। पानी के स्रोतों और पानी की सफ़ाई से संबंधित अनेक गतिविधियां कराई गईं – सर्वेक्षण भी और सफ़ाई संबंधित उपकरणों में परिचय भी। हवा, पानी, मिट्टी, चुंबक आदि के साथ प्रयोग बहुत ही रोचक रहते हैं– इनमें से कई प्रयोग पाठ्य पुस्तकों में भी दिये गये हैं। आकाश में चांद-तारों को देखने संबंधी गतिविधियां[11] भी इन बच्चों तथा बड़ों को समान रूप से आकर्षित करती हैं। कुछ प्रयोगों का उद्देश्य किसी सिद्धांत विशेष का उदाहरण देना होता है (जैसे हवा दबाव डालती है) देखने में आया है कि बच्चे ऐसी घटना को आश्चर्य और ध्यान से देखते हैं (जैसे साइफ़न द्वारा पानी निकालना) और उसको कई प्रकार से करके उससे *परिचित होना* चाहते हैं और उन्हें इसका अवसर देना लाभकारी होगा। जहां तक घटना के *कारण* का संबंध है, वे सोचते तो अवश्य हैं और अपने ही ढंग से बताते भी हैं, परंतु आवश्यक नहीं कि वे वैज्ञानिक शब्दावली में उसे उतार सकें। इसका कारण यह है कि दबाव, बल, कार्य ऊर्जा, शक्ति आदि विभिन्न परिभाषाओं के पूरे ढांचे से वे रू-ब-रू नहीं हैं। अत: निम्न प्राथमिक स्तर पर ऐसे प्रयोगों को दिखाते समय मुख्यत: घटनाओं से परिचय कराते हुए बच्चों की रूचि बढ़ाने पर ध्यान देना चाहिए; निष्कर्षों को वैज्ञानिक शब्दाबली में उतारने का कार्य बाद के वर्षों के लिए छोड़ा जा सकता है।

4. सामाजिक अध्ययन

शिक्षा का सर्वसामान्य सिद्धांत, प्रत्यक्ष से अप्रत्यक्ष की ओर, स्थूल से सूक्ष्म की ओर, मूर्त से अमूर्त की ओर, यहां भी लागू होता है। प्रारंभिक शिक्षा में सामाजिक अध्ययन के अंतर्गत आवश्यक है कि बच्चे अपने आस पास के समाज का प्रत्यक्ष अध्ययन करें, प्रेक्षण करें, आंकड़े एकत्र करें, चित्र बनायें, समस्याओं को पहचानें और उनको दूर करने में अपनी स्वाभाविक भूमिका को निभायें। इस क्रम में हमने बच्चों द्वारा अपने समुदाय के लोगों का सामाजिक सर्वेक्षण, संस्थागत सुविधाओं का प्रत्यक्ष परिचय, पर्यावरणीय सफ़ाई और पेयजल का सर्वेक्षण, अपने गांव/शहर/विद्यालय/क्षेत्र का मानचित्र बनाना, वास्तविक एवं काल्पनिक यात्राएं और इनके अंतर्गत क्षेत्र के प्राकृतिक, औद्योगिक तथा सामाजिक पहलुओं से परिचय आदि गतिविधियां कराई हैं। इनसे बच्चे अधिक सजग और विज्ञानोन्मुख हुए हैं

परन्तु पाठ्यक्रम-निर्माता यहां भी बच्चों के नाज़ुक दिमागों में अधिक से अधिक निर्जीव ज्ञान ठूंसने के लिए उतावले हैं। प्रचलित पाठ्यक्रमों में कक्षा 3 में अपने राज्य की, कक्षा 4 में भारत जैसे विशाल देश की, और कक्षा 5 में विश्व की विस्तृत जानकारी बच्चों को याद करनी पड़ती है। पाठ्यक्रम निर्माताओं को शायद ऐसा लगता है कि वैश्विक गांव के हम नागरिकों के लिए स्थानीय जानकारियां और घटनायें अति क्षुद्र और महत्वहीन हैं, परंतु विज्ञानोन्मुखीकरण के लिए तो हमें वहीं से शुरू करना होगा *'जिस स्थिति में बच्चे आज हैं'*। और आज की स्थिति यह है कि कक्षा 3, 4, 5 के औसत विद्यार्थी का ध्यान आकर्षित वाली घटनायें अधिकतर स्थानीय ही होती हैं।

कक्षा 6 और उससे ऊपर की कक्षाओं में बाकायदा विश्वविद्यालय के ढर्रे पर पाठ्य पुस्तक तैयार कर दी गई हैं। बच्चों की पाठ्य पुस्तक *'कैसी नहीं होनी चाहिए'*, इसके बढ़िया उदाहरण के तौर पर एन.सी. ई.आर.टी. द्वारा प्रकाशित कक्षा 6 की इतिहास संबंधी पाठ्य पुस्तक[12] देखी जा सकती है। पहले ही अध्याय में विषय के मूलभूत सिद्धांत एवं उसके प्रतिपादन के पीछे निहित सोच को भी समझा दिया गया है, परिभाषायें भी दे दी गई हैं, लेखक तथा अन्य विद्वानों के बीच जो सैद्धांतिक मतभेद हैं, उनके मद्देनज़र लेखक की मान्यताओं को श्रेष्ठ सिद्ध शब्दों का प्रयोग किया गया है, जो न केवल शब्द के तौर पर बच्चों के लिए नये होंगे, बल्कि उनमें से अनेक की अवधारणा भी उसके मन में नहीं होगी। बच्चे की पूरी शक्ति या तो निरर्थक शब्दों को रटने में या उनके निहितार्थों को समझने में लग जाती है और वह इतिहास का साक्षात्कार करने में असफल हो जाता है। अत: वह विज्ञानोन्मुख भी नहीं हो पाता।

सामग्री कहां से लायें?

अक्सर यह सुना जाता है कि प्रयोगों, प्रदर्शनों तथा व्यावहारिक कार्यों के लिए आवश्यक सामग्रियां बहुत महंगी हैं, अत: भारत जैसे निर्धन देश में स्कूलों में इनका प्रयोग व्यावहारिक नहीं है। इस तर्क को माना नहीं जा सकता। यदि अफ़सरों और शिक्षकों के वेतनों पर भारत के औसत व्यक्ति की आय से दसों गुणा अधिक खर्च किया जा सकता है, भवनों पर भी इसी अनुपात में खर्च किया जा सकता है, परंतु छोटे-छोटे औज़ारों, उपकरणों, खेल सामग्रियों और शिक्षण सामग्रियों पर कुल बजट का पांच-दस प्रतिशत भी नहीं, तो इसको किसी भी प्रकार उचित नहीं ठहराया जा सकता। बच्चों के सीखने के लिए प्रभावी, आकर्षक एवं टिकाऊ सामग्रियां उपलब्ध होनी ही चाहिएं। परंतु यहां अनुभव के आधार पर यह बता दें कि जहां कोई बड़ी धनराशि उपलब्ध नहीं हैं, वहां भी उपर्युक्त सभी गतिविधियां बहुत कम खर्च में कराई जा सकती हैं। जहां कोई प्रयोगशाला या वर्कशाप नहीं है, वहां भी कराई जा सकती हैं।

निष्कर्ष एवं उपसंहार

बच्चों की विज्ञानोन्मुख बनाने में प्रारंभिक शिक्षा की निर्णायक भूमिका हो सकती है। इस संभावना को मूर्त रूप देने के लिए विभिन्न कक्षाओं में विभिन्न विषयों को पढ़ाने में कई ऐसी विधियां विकसित की गई हैं जिनसे बच्चे प्रेक्षण, प्रयोग, वर्गीकरण, सामान्यीकरण, कार्य-कारण संबंध पहचानने, नई-नई वस्तुओं के निर्माण आदि का अभ्यास करते हैं। इससे वे प्रकृति व समाज से परिचय करते है, विभिन्न विषयों के अंतर्गत आने वाले सामान्य सिद्धांतों, परिभाषाओं, अवधारणाओं आदि से साक्षात्कार ('दोस्ती') करते हैं और विज्ञानोन्मुख होते हैं।

इन विधियों और ऐसी अन्य विधियों को अपनाने से पहले दो आवश्यक शर्तों का उल्लेख किया गया है – मातृभाषा/स्थानीय भाषा को माध्यम बनाना और शिक्षण में प्रेक्षण, निर्माण आदि की केन्द्रीय भूमिका को मानना। दोनों शर्तें अलग-अलग नहीं हैं, बल्कि आपस में जुड़ी हैं। दोनों का कुल तात्पर्य है एक ऐसा वातावरण बनाना जिसमें रटने-रटाने की बजाय प्रकृति और समाज के विभिन्न आयामों, पदार्थों और घटनाओं के साथ प्रत्यक्ष परिचय हो, सिद्धांतों के साथ सहज ढंग से साक्षात्कार हो और इस कार्य में कहने-सुनने, लिखने-पढ़ने, देखने-करने बनाने आदि की गतिविधि सहज-स्वाभाविक ढंग से हो।

शिक्षण की विज्ञानपरक विधियों के विकास हेतु पहले भी कार्य हुआ है और आगे भी इसकी ज़रूरत है। विकास के साथ-साथ इन विधियों के सम्यक् मूल्यांकन की भी आवश्यकता है। विभिन्न प्रकार के शिक्षा निकायों (औपचारिक/अनौपचारिक) में उपर्युक्त विधियों का प्रयोग करके हमने बच्चों के विज्ञानोन्मुख होने का अनुभव तो किया है, परंतु इनकी उपयोगिता के वस्तुपरक मूल्यांकन की कोई विधि और पैमाना उपलब्ध नहीं है। ऐसी विधि और पैमाने की खोज (और इस प्रश्न का उत्तर भी, कि क्या ऐसा कोई पैमाना हो भी सकता है?) भविष्य के कार्य के लिए एक महत्त्वपूर्ण संभावना है।

पाठ्यक्रम की पुनर्रचना में भी काफ़ी कार्य करने की ज़रूरत है। इसकी एकमात्र कसौटी यह नहीं होनी चाहिए कि बढ़ते हुए ज्ञान को कैसे दस वर्षों में विद्यार्थी के गले उतार दें। इसे तो समाज में बच्चों की वर्तमान सामाजिक-शैक्षिक-पर्यावरणीय स्थिति और बच्चों के मनोविज्ञान के साथ जोड़ कर देखना होगा। हमारे समाज के विभिन्न आयु वर्गों के बच्चे सहज ही क्या सीख सकते हैं, क्या कर सकते हैं और क्या समझ सकते हैं? शिक्षक क्या सिखाने, कराने और समझाने में समक्ष हैं? इन क्षमताओं का आकलन भी पाठ्यक्रम के निर्धारण के लिए आवश्यक है। यह कार्य केवल एन.सी.ई.आर.टी. जैसी संस्थाओं से नहीं हो सकता; शिक्षकों तथा लोगों के कार्य करने वाली स्वयंसेवी संस्थाओं की भागीदारी महत्त्वपूर्ण होगी।

उपर्युक्त दिशाओं में कार्य किया तो जा सकता है, परंतु व्यवहार में वह कहां तक शिक्षा तंत्र में उतर पायेगा, इसमें संदेह होना स्वाभाविक है। अब शिक्षा के माध्यम को ही लें। देश में और दुनिया में शायद ही कोई शिक्षाविद हो जो प्राथमिक शिक्षा के लिए अंग्रेज़ी माध्यम की वकालत कर पाये। परंतु अंग्रेज़ी माध्यम फिर भी धड़ल्ले से चल रहा है और 'बढ़िया' माना जाता है। अत: हम यह प्रश्न उठाने के लिए विवश होते हैं कि हमारा समाज प्राथमिक शिक्षा के उद्देश्य को कैसे परिभाषित करता है। यदि हम अपने आस पास ध्यान से देखें और शिक्षा के नाम पर जो कुछ चल रहा है उसे समझने का प्रयास करें तो इस निष्कर्ष पर पहुंच बिना नहीं रह सकते कि समाज शिक्षा के उद्देश्यों में विज्ञानोन्मुखीकरण को कोई विशेष महत्व नहीं देता, न ही उसे बच्चों के बहुमुखी विकास की अधिक परवाह है। हम स्तर की शिक्षा का सबसे प्रमुख उद्देश्य सफ़ेदपोश, ऊंचे-से-ऊंचे पद प्राप्त करना है। शिक्षा सत्ता का गलाकाट होड़ में एक शस्त्र है। निस्संदेह, प्राथमिक शिक्षा को इस शस्त्र की पहली धार के रूप में देखा जा रहा है। 'शिक्षित' वर्ग अपने अब तक प्राप्त विशेषाधिकारों को उनके साथ बांटना नहीं चाहता जो कल शिक्षा प्राप्त करके उसके समकक्ष हो सकते हैं। अत: कृत्रिम रूप से अंग्रेजी को योग्यता की कसौटी बनाना आवश्यक है। प्राथमिक स्तर से ही इस अप्राकृतिक बात को बच्चों को घोट कर पिलाना आवश्यक है। पाठ्यक्रम, पाठ्य पुस्तकों और पूरे विद्यालय तंत्र की रचना को प्रकृति, समाज और श्रम से काटने के पीछे भी क्याा वही प्रवृत्ति कार्य नहीं कर रही है?

ऐसे में कोई एक व्यक्ति, शिक्षक, विद्यालय या संस्था यदि उपर्युक्त प्रकार की विधियों को अपना कर बच्चों को विज्ञानोन्मुख करने का प्रयास करे तो शीघ्र ही मालूम हो जाता है कि इस प्रकार कोर्स पूरा नहीं कर पायेंगे और 'अभिभावकों को ऐसे प्रयास के प्रति संतुष्ट करना कठिन है'। कुल मिला कर यह स्पष्ट है कि प्राथमिक शिक्षा में विज्ञानोन्मुखीकरण के लिए (और व्यापक रूप में, बच्चों के व्यक्तित्व व चरित्र के बहुमुखी विकास के लिए) केवल शैक्षिक, वैज्ञानिक और मनोवैज्ञानिक स्तरों पर ही नहीं, सामाजिक और राजनैतिक स्तरों पर भी संघर्ष करने की आवश्यकता है।

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Article

Telling Stories of Science Non-science and Nonsense: Communicating with the Lay Public

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Background

Since the credibility of science depends on meticulous process in which each hypothesis builds incrementally on all the work that has come before, science is not adept at feeding the media's craving for novelty. That science is part of a long and continuous narrative is lost in the parody of eureka science and the fantasy of instantaneous application. The human and cultural values of inquiry, of knowledge and of curiosity, as both cause and outcome of science, must be recognised and weaved, along with utility, into what gives the stories of science their value. The real stories of science re ect its values. The noble ideas of science play out in real human dramas of competition and failure, of frustration and ambition - but most of all - of amazing curiosity. Science must find ways to connect to the public - not in order to assure short term support but to be more fully integrated into our culture.

In this article, the authors offer solutions that could lead to more constructive relationships between the professions of science and journalism and discuss how well informed public relations professionals could play key roles in relaying science news to the public. Finally, Scientists need PR skills more than ever before because the onus of communication is upon the scientists themselves.

Introduction

Nearly 50 years ago, the British physicist and novelist CP Snow published his famous "two cultures" essay, which deplores the widening gulf between scientists and their intellectual counterparts in the arts. If Snow was alive today, he might have extended his argument to apply to the chasm that now exists between science and just about everyone else in society, including journalists.

Not seen as the public figures like Albert Einstein and or Homi Bhabha, scientists in India are generally reluctant to venture out of their ivory towers. Shunning messy public controversies, they tend to communicate only to each other and through the rarified language of peer-reviewed journals. Most consumers of news never hear about the work of contemporary science: the meticulous testing, honing and retesting of hypotheses- the process that ended the Dark Ages and continues to illuminate dark corners of our world.

How can we expect Indians to know anything beyond what they happen to remember from their science class? Journalists certainly don't tell them. When is the last time you heard a reporter explain in print or on the air that a scientific hypothesis is elevated to a 'theory' only after it is supported by overwhelming observational and experimental evidence and is widely accepted by the scientific community? Sure, evolution is a theory - and so is Mendelian heredity and Newtonian gravitation.

When is the last time you heard a journalist explain that the scientific process is not about 'proving' anything? Instead, it's about constructing a hypothesis, disproving it, and then developing a better one that offers a slightly fuller explanation of the natural world as we experience it. The cycle never stops. Science will never prove, in an absolute sense, that emissions of carbon dioxide from man-made sources are contributing to global warming, but science can show – and has shown - that no other idea comes anywhere nearly as close to explaining what's happening to our world.

And when is the last time you heard a journalist explain that science's supposed 'weaknesses' are actually its great strengths? Always self critical, the best scientists freely acknowledge the uncertainties that remain in even the most sophisticated theories. That's the way science corrects its mistakes, but it is a grave shortcoming in a sound bite world that prefers

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brash sloganeering. Nor is science adept at feeding the media's craving for novelty, since the credibility of science depends on a meticulous process in which each hypothesis builds incrementally on all the work that has come before.

But do scientists tell science as true story, as real narrative?

Unfortunately, the telling of science is too often lost in jargon, technicality and obscurity. Scientists fail to share the simple wonder, for example, that cancer, a disease we all at some point, unfortunately get to experience, is due to damage to the real instructions that guide the behavior of cells – or that the most basic cycle whereby one cell gives rise to two has a real physical mechanism – an amazing machine that we can know.

The story is not the names – chromosomal translocations, tumor suppressor genes, cycling dependent kinases, but the naming. It is that mystery gives way to manifest beauty and we can actually give name to things that exist in the physical world that we inhabit.

According to the 1998 Science and Engineering Indicators, Americans register the highest level of confidence in the promise of science and technology to make life better when compared to the citizens of 13 other industrialised countries. We have no data on what is the confidence level among Indians. This report emphasised the powerful connection that Americans make between science and its expected application. This connection is fueled by how science is presented through the media. But reporting about scientific discovery is different from telling great stories of scientific inquiry.

It is not surprising that interest in science stories is so often wrapped in a need to justify the effort. The scientific pursuit is justified by 'the discovery' and the discovery is justified by its utility. More often than not the media assign to the science its value and too often miss its riches. The utility of discoveries in science is actually remarkable. Despite the marvel of the utility, the real product of science is knowledge and insight and the bridge between discovery and application is often tenuous. Most often the discovery itself is, in fact, simply the creation of the scientific ability to articulate the newly possible. That is its true and immediate futility – to make the unimaginable imaginable. What links scientific breakthrough (a leap in knowledge and understanding) to a medical breakthrough (a true and valuable application) are many things - but most of all time. Herein lays one of the most difficult aspects of the public understanding of science.

Difficulties in public understanding of science

The sources of tensions between science and journalism can be explained by the occupational subcultures, or what the French sociologist Pierre Bourdieu calls 'habitus' (ways of holding and orienting oneself and the practical ability to cope with a wide range of situations unconsciously). Journalists see themselves as engaging in criticism, entertainment and information. Scientists continue to want scholarly communication and public education about science and expect this to come from journalists. In truth, journalists are as concerned about accuracy as scientists and scientists in turn are as concerned about making knowledge accessible to audiences.

Take the term 'research' as an example. Both groups use similar words but with different meanings, and they have no idea that this is the case. Scientists are heirs of Enlightenment thinking, and approaches to their work and the ways they write and talk about it are generally unconscious. Journalists are heirs of another significant social tradition. As members of the 'Fourth Estate', they regard themselves as the protectors and watchdogs of democratic ideals. While this view is often more in the forefront of their thinking, they don't perceive it as an obstacle to finding out the truth (or, more accurately, the 'truths') about science.

Given these orientations, once a sense of misunderstanding develops, each becomes wary of the other. In fact, in the name of professional integrity, members on each side can be led into some fairly unprofessional actions. Journalists sometimes forget their usual tools of the trade. They stop asking questions and rely uncritically on publicity releases. They avoid talking with scientists and resort to using stereotypical frameworks from past reporting experiences. Scientists also may refuse to speak with members of the media by not returning calls in time to meet publication deadlines. In terms of public accountability, some scientists regard their responsibility for reporting their findings to be to grant makers, as opposed to the public at large, and thus don't feel a need to respond to journalists' queries. Journalists, with some justification, think they have a role in scientists' accountability to a wider public interest.

Given the resilience of the tension and con ict between these two professions, it seems surprising that researchers continue to propose the same sorts of solutions - science education for journalists and communication skills training for scientists. Many journalists (as distinct from science writers) opted out of studying science in school, so when in the course of general reporting they find themselves assigned to science stories, they are unlikely to welcome more science study. And some scientists are reluctant starters when it comes to interacting with journalists and are unlikely to voluntarily undertake media training. Perhaps a different approach to the problem is needed.

Need for creative science story telling

The ethos of science was articulated by Leonardo da Vinci 500 years ago – "A bird is an instrument working according to mathematical law" replacing the medieval mystical view that it was the soul of the bird that embodied the nature of ight.

If we truly want science to be celebrated and enable the expression of the creativity of scientists, it will take more than well disposed appropriation, even more than vocal advocates; it will take a society that truly values the science and the scientists much as Renaissance Florence valued its art and its artists. It will take a society that sees its own historical narrative as, in part, the narrative of its science.

A culture, a civilisation is defined by the stories it tells and by the narrative it sees itself as creating and transmitting. For us, stories of science are among the most precious and most powerful. For science to truly thrive in a society, the stories of science must be central to how we attempt to understand our world and ourselves. They embody the very assumptions we make about how we come to know things and what we see as progress. Thus, science itself can help us define our sense of identity and our attachments to history - its effects not imposed on us by a mysterious community of distant scientists but part of us. Its progress can mark our culture's passage through time and the footprints we will leave as our history.

That science is part of a long and continuous narrative should not be lost in the parody of eureka science and the fantasy of instantaneous application. We must be careful to recognize the human and cultural values of inquiry, of knowledge and of curiosity as both cause and outcome of science and weave them, along with utility, into what gives the stories of science their value.

There is another facet of science that is central to a society being able to adopt it as part of its central narrative. It is what John Gardner spoke of when he called for 'moral fiction' in literature. He wrote not of moralising sermons but of stories that allow people to sift through competing values and thereby experience which values people want to live with. The real stories of science re ect its set of values – the freedom to reject past assumptions; the possibility that the future is different from the present and these differences are made that way by our own work and by our own knowledge, that power can come from evidence and not authority. These noble ideas play out in the sweat and grime of real human dramas of competition and failure, of frustration and ambition – but most of all – of amazing curiosity.

It is also increasingly clear that science is inextricably bound up in ethics and philosophy – from the splitting of the atom to deciphering the genetic code to cloning Dolly. Few things better support the argument that science is an essential part of the cultural narrative than the fact that some of the most compelling and pressing ethical and philosophical concerns are now born of our science.

In a world of sound bites and journalistic stories, the need for narrative remains.

Need to reach out

Today in India scientists are fortunate to be experiencing unstinted government support, at least for some of the science. Scientists need to worry how deep that support is. Is the support anchored in an understanding of science or in identification with the scientific narrative as one we all share? It is a real possibility that this support exists in a state of grace in a society not truly scientifically literate. While we are interested in science, as a society our hold on the nature of scientific inquiry, of the nature of evidence and of the difference between evidence and belief is tenuous.

At the practical level, gone are the days when technical professionals could throw their findings on the table and walk away letting 'the facts speak for themselves' and allowing others to make what they will of them. Viewers, readers and listeners are the taxpayers who fund much scientific research. They are also the consumers who buy the products resulting from the research. They are the public who rely on

you to protect their natural resources and they need to understand your work. In most cases, they want to. When the public expects to be engaged in the public policy process, the competitive edge scientists need, to explain their work, is communication skill. Communicating scientific findings is partly explain and partly persuade the lay public. Here the scientists are trapped between appropriately qualifying your findings as is common practice in the field, and appearing to not be committed to them in the eyes of the public.

All scientists are responsible for the products of their labors. Being able to clearly explain what their findings mean and what alternatives are left based on those findings, ensures that their work is not misused, or if it is, they are a willing participant in it. And rare will be a technical expert who doesn't want his work to be understood, acknowledged and supported by someone. For that to happen, however, shared meaning must occur and therein, too frequently, resides the problem.

Scientists and technical professionals consider their biggest 'audience' their peers. Certainly that's true when getting work reviewed for publication or presentation at a conference. The language of science is impersonal and technical while those interested in scientific work mostly find the results very personal and frequently emotional. And the bottom line is this, if the public can't understand scientists, they will reject what the scientists say.

So how do you effectively separate what you are doing (which is presumably science) from the non-science and the nonsense that is so prevalent today?

Bridging the chasm between journalism and science

Efforts to bridge the chasm between mass market journalism and mainstream science are confronted with many problems. The market forces driving journalism away from serious science coverage are too strong to wish away with a five point action plan. But surely there are some steps to improve coverage.

To begin with, teaching journalists scientific reasoning is vital. We should give that training not only to reporters who are new to science related beats, but also to those who cover business, politics, culture or work in just about every other corner of the newsroom, and to editors, too. In one way or another, all of those journalists cover science, whether or not they realise it.

Just as importantly, graduate and undergraduate journalism programs must offer, and even require, more science related courses. Again, the emphasis should be on scientific reasoning, not merely the acquisition of dry facts.

The goal of such training should be to give reporters enough confidence to make reasoned judgments about the scientific legitimacy of competing arguments whenever they're doing a story about a controversial issue, whether it is global warming, stem cells, intelligent design, or something else. Reporters should be sensitised on how and why to resist the journalistic perversion of Newton's third law of motion — For every assertion in a news story, there must be an equal and opposite assertion. Phoney 'balance' is the bane of science journalism.

And finally, scientists have to internalise the importance of story telling, especially in science journalism geared to mass audiences, even as scientists teach the subtleties of cutting edge science, they should never stop talking about compelling narrative, clear explanation, and coherent organisation. Because if a reporter can't tell a story, it doesn't matter how much science she knows.

In short, scientists need to do all they can to show reporters how, even within the tight constraints of the sound bite society, it is possible to cover science stories in ways that do credit to both science and journalism. Once scientists start doing that, scientists will start climbing down from those ivory towers, and maybe our readers and viewers won't be quite so quick to assume that all opinions are created equal.

The role of Public Relations

Public Relations could help take the science-journalism relationship one step ahead. Today even the scientist needs public relations. Why? Because there are those who might appropriate a scientists work for their own purposes. A scientist's work is complicated and frequently communicated through a medium to a mass audience and that translation can distort your work. And accuracy is the currency of the scientific profession. To ensure the highest probability for accuracy in translation, scientists need the kind of professional who speaks that language.

Research colleagues in the social sciences make the occasional raids on scientific literature in order to appropriate the models for their own use. Complexity, chaos, systems theory and others now punctuate the social science literature... what might the appropriation of the social science models add to the scientific vision?

Models in social science include two way interaction, systems, integration, symbolic interaction, social and cultural contexts, group think theory, social networks, uncertainty and ambiguity analysis, structuration and so on. What these do is allow us to take the information that must be learned by the involved public, to make the necessary considerations as to the context and methodologies within which the learning must occur, the social networks, the prevailing attitudes and so on, so that your work has the best chance of a fair hearing. In the absence of information, people make stuff up.

In the presence of information they cannot or do not understand, people ignore it and rely on their emotions to fill the gap. Once emotions are engaged, the opportunity for dialog is frequently lost. Timothy Ferris of U.C. Berkeley recently wrote, "History's verdict on the scientific enterprise will depend not only on the knowledge gained through research, but also on the extent to which that knowledge is communicated to the wider world." That science speaks for itself is simply not true.

Scientists are as entitled to public communication assistance as other sectors of society are - but they are not entitled to just any PR. Science public relations people need to know more about science if they are to be effective. Scientists who take up this sort of role would also need to understand the needs and role of the media.

While the use of sophisticated, slick packages and provision of resources from private sector corporations and consultancies may not be always appropriate, it is critical that scientists and scientific organisations provide the same quality and quantity of assistance as the private sector does in the interests of enhanced science communication.

Another role of public relations is media training or coaching. This includes how to answer questions and present a news angle. Being able to answer questions concisely helps to avoid manipulation and reduces the risk of having bits of information (often in sound bites) taken out of context.

Scientists are also well advised to improve their use of metaphors and of some creative 'layering' techniques with text, pictures and graphics. A well cited communications scholar said, "While in general the truer and better cause has the advantage ..... no cause can be adequately defended without skills in the tricks of the trade".

Scientists need public support for this to occur and that support is built on a clear and honest understanding of what it that scientists are trying to do. The responsibility for communicating this information is with the scientists. It is a tough job, but there is really no one better qualified to do it than the scientists themselves. ■

Article

Re ections on Science Communication

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Science communication is riddled with several intricate problems: lack of enthusiasm on the part of scientists to interact with general public and mass media; con icting and indefinite views on scientific findings and facts among scientists themselves, non recruitment of journalists having special background of science knowledge by newspaper editors; lack of unanimity in science knowing community regarding sub categorisation of science topics, etc. These issues require special attention. Scientists, who generally get funds for their work from tax payers, owe a duty to the public to explain their research findings either directly or through mass media. Trained journalists should dare to question even the top scientists regarding their research matter, since close questioning often results in arriving at concrete and correct facts. Sub categorisation of science topics is inherently difficult, since science is expanding rapidly in all dimensions often inter disciplinary and intriguing. In India, mass illiteracy and gradually declining interest in science education in the upper strata of society are additional hurdles. Perhaps due to this, there is no significant increase in science coverage in Indian national dailies. However this may be regarded as a transitory phase. It is anticipated that the print media, aided by internet, will have a brighter, livelier and more attractive look and go a long way in strengthening science communication.

Joule showed the way

That was 1847. A public meeting, consisting of laymen, was being held. There, James Prescott Joule, a celebrated English physicist of the nineteenth century, divulged his most important scientific principle for the first time. His pronouncement dealt with a fundamental idea of physics, which states that, when force is destroyed by percussion, energy (mechanical) is transformed into equivalent of heat (energy).

This simple event, involving masses directly, rather than any research journal, has many implications. This has illustrated the self confidence of a scientist that he (a scientist) can make intelligible his complicated theories to the laymen. This further emphasises that a scientist, living in a democratic society and using the tax payers' money for his research works, owes a responsibility to the society and should offer an explanation to the public that their hard earned taxes have been properly utilised for their well being and benefit.

Scientists owe it to the society

D.W. Burkett has dealt with this matter with due weightage, when he writes, "new roles have been thrust upon the scientists. These derive partly from public trust accompanying the acceptance of public money, from the need for more leadership and coordination and from the size and cost of scientific understanding... Accompanying the changing role of the scientist in the society has been his acceptance of new responsibility to report to the society which sustains his activity. In some cases the reports fulfill the legal requirements under government contracts. But more and more the scientist seeks public understanding. One manifestation of this is increased cooperation with the press. However it should be said that this cooperation was desired more by the press than by scientists."

The scientist has a basic duty of creating public awareness about his works and other related scientific investigation. In fact many scientists have shouldered this responsibility to an admirable extent, such as, Issac Assimov. Despite his preoccupation with fundamental research works, he found time for writing popular paper back editions on genetic code a - complicated and recent topic of that time.

However, many critics are not satisfied with the extent of cooperation extended and initiatives

undertaken by the scientists in creating public awareness in science, in general - at least about their research works. In this context, Gerald Holton, Prof. of physics at Harvard, may be quoted : "Too many scientists have forgotten that, especially at a time of rapid expansion of knowledge, they have an extra obligation and opportunity with respect to wider public, that some of the foremost research men, including Newton and Einstein, took great pains to write expositions on the essence of their discoveries in a form intended to be accessible to the non scientist."

Media failure

In the absence of proper communication by scientists, technologists, scientific bodies, research and development institutes, the situation becomes very alarming . The agencies, like the print media, which from a vital link between the S & T experts and the laymen, fail to perform their duty satisfactorily. Of course, the entire blame should not be put on scientists alone for this lapse. The media men also have a fair share for the lack of proper communication.

M.W. Thistle, Public Information Officer for National Research Council of Canada, has rightly argued that, "The decision makers in newspapers seldom have any idea of the time, background and study needed to produce a good item of science; neither do they move among scientists to the degree they move among the political, economics or social leaders."

The newspaper editors should change their attitude radically towards science in the present S & T dominated age, in the way, suggested by Henery A. Goodman, Executive Secretary, Council for the Advancement of Science Writing, New Jersy, "Even a top reporter, if he or she lacks interest in and understanding of these fields (science, medicine and technology), will usually botch stories on science, medicines, technology, and soon. Just as bad, the editor who thinks his general reporter can handle these topics, will probably not recognise the mess the reporter has made nor understand the inevitable bitter complaints from scientists, physicians and engineers... Today a slowly increasing number of editors realise that covering science, no less than reporting on sports, requires special knowledge."

Problem of categorisation

Apart from this wide gap between men of science and newspaper editors, there is a crucial problem regarding categorisation of science news. It is maintained by many learned people that science news is not well defined. To illustrate this, we quote, "Both the scientists and science reporter (writers) are divided over the question : 'what is science news?' The disagreement over this question operates significantly in writing about science and public affairs" (D.W. Burkett, 1973).

In fact, the topics on science have been so complex and often interlinked with different disciplines, that it is found to be too intricate to have clear cut categorisation.

To illustrate this, we may look into some of the following statements :

"The close relation between science and medicine often makes it impractical to distinguish between the two in staffing a conference of scientists and physicians" (D.W. Burkett).

Even while defining chemistry, a very old and established branch of science with rich traditions, we come across a vague and indefinite statement, such as: "Chemistry is what chemists do and how they do it" (Joel Hildenbrand, 1957).

D.W. Burkette has extended this view on chemistry to science in general, "science is what scientists do. Writers can use this statement as a working motto. Any journalist who ignores the human element ignores vital information by omitting the role man plays in the process."

Of course, introducing a personal element into science has many advantages, especially for better science communication. But there must be a limit to this, so that it will not affect the objectivity or impersonal realm of the different branches of science.

Due to different perspectives, in which science is held, sub categorisation of science topics is found to be at times subjective and arbitrary. To illustrate this, we compare the categorisation, devised by VIPRIS (Vigyan Prasar Information System) with that of Prof. J.V. Vilanilam, in his book entitled 'Science Communication & Development' (Ref : Appendix).

The sub divisions made by Prof. Vilanilam (amounting to sixty, as against sixteen of VIPRIS clipset) are exhaustive and cater to the fine distinctions that exist between different S & T topics. However, Prof. Vilanilam, while conducting a study, was not very particular to consider the sixty categories, one by one; instead, he combined some of the sub categories in his list of sixty and shortened the list of fifteen. For example, public healthy, medicine and medical

technologic were brought under one head. Similarly, energy development and alternative source of energy were combined together.

Now the question arises: Is Prof. Vilanilam's detailed sub categorisation of S & T too ambitious? Perhaps the answer is in the negative, because science advances by leaps and bounds now-a-days and in this process, each category produces several sub categories and as time advances, a sub category, so generated, becomes an independent category, giving birth to new sub categories and like a chain reaction in an atomic reactor, the process simply goes on multiplying manifold. Hence it is becoming a tough job for the science communicator to handle this challenging problem, which is inherent in any meaningful science reporting.

Scientific attitude in scientists

Even the knowledge of science among scientists and science knowing community and the veracity of scientific facts need not be taken for granted. As a supporting evidence, we quote from the *Columbia Journalism Review* below.

"Scientists at a National Academy of Sciences press conference advised that women with a history of breast cancer should not nurse their babies. The scientists had found some mother's milk contained particles resembling those from viruses known to transmit breast cancer in some strains of mice. The (science) writers questioned the scientists until many uncertainties about the findings were established. The uncertainties included lack of proof of any connection between human mother's milk and breast cancer in daughters. Thus a scare story was defused by writers."

"John Lear, science editor of *Saturday Review,* finds most science writers too timid about tackling the large public questions with the same degree of critical evolution, analysis and scepticism towards science and technology that journalists apply to other fields."

The above excerpts from the *Columbia Journalism Review* illustrates that scientists and science experts may go wrong. It should be emphasised that science advances through trial and error, arguments counter arguments, refutations and debates. Interestingly, these are the characteristics of experiments with truth; the truth behind the behavior of nature and the natural laws that operate hidden behind theses intriguing displays. Hence journalists should gather enough strength to question even the greatest of scientists and try to go deep into the matter, so that they shall not only themselves get a clear picture about scientific facts; they shall also urge the scientists to review their works and reassure that their pronouncements are faultless at least at that particular time and the prevailing stage of knowledge.

In fact, science is alluring because "there is joy as well as wonder in science and the science writer should communicate as much of the joy as he can. Fear of presenting an unorthodox idea, that may later prove unfounded should not inhibit the writer too greatly. Discovery and failure are part of the adventure of science."

Scientific attitude in society

Now let us look at the general public. NISTADS (CSIR) conducted a survey on behalf of NCSTC in 1990 among the residents of Mangolpuri - a resettlement colony in West Delhi, comprising residents of about 1.25 lakhs, with a 'relatively low standing' as compared with the metropolitan Delhi's socio economic environment. The final questionnaire, consisting of 26 questions, was prepared, covering four broad areas of knowledge, viz., astronomy and cosmology, geography and climate; agriculture; health and hygiene. Data were collected from 16,000 respondents. Random samples were drawn and after appropriate statistical tests and computerised techniques, following conclusions were arrived at:

(a) 64.3% of the people surveyed considered television to be an important source of information, followed by radio (44%).

(b) (i) 78.2% of the sampled population knew that the shape of the earth is round (may be due to the fact that the television is showing a globe before every news bulletin).

(ii) 79% knew about dehydration therapy.

(c) In spite of the fact that 37.6% were not exposed to any normal education and 58.9% of the illiterates of the sampled population were housewives, it is heartening to note from the survey that the population was not very much superstitious or orthodox, for example:

(i) only 20.2% of the respondents believed that the rainbow was Lord Ram's bow or India's Bridge; and

(ii) only 35.8% of the respondents believed that earthquakes occurred when divine powers punished human beings and / or when 'Shesh Nag' changed sides.

The surveyors concluded that the situation would improve much, if all people would be imparted with formal education; since they felt, 'there is no substitute for formal and proper education'. Further the study reveals that increased exposure to modern mass media (like TV) makes the mind free from extra scientific, blind beliefs and unscientific attitudes. The role of education and more importantly science education will undoubtedly instill a sense of belongingness to science, at least among the science degree holders.

Prof. Hiller Kreighbaum, chairman of the National Association of Science Writers Survey Committee, sees "a hopeful time ahead for science popularisation because the readership of science news increases directly with the number of science courses readers take in high school and college."

Few decades ago, the situation was such that D.W. Burkett, author of 'writing science News for the Mass Media' had remarked, "it is doubtful that readers will organize protests, if science and medical news is omitted, as they do when comic strips, or sports pages are left out" (pp 48-49).

With the advance of science and spread of science education, in the meantime, it is normally expected that science news will be as important and popular as, if not more, comics and sports pages. But unfortunately such expectations are belied. One of the reasons for mentioning this is based on an editorial of NCSTC communication (December 1999):

"For some years now, instead of bells tolling for basic sciences, it is the alarm bells that have been ringing — louder and louder with every passing year. Just the other day, a well known and sought after college (of Delhi University) announced that it still had vacant seats for freshers in chemistry (in October) – admissions were over in July-August 1999! All over the country, in almost every state, this declining trend has been drawing attention...."

Challenges facing science communication

Such a thing should happen defies all logic in this age of modern science technology. If parents, students and above all, society lose interest in science education, it may compel editors to provide less news coverage of science matters in print media. In spite of this declining trend, there is some hope for the future – there is enough to dream for the next decade, as has been proposed by Phillip Campbell, editor, *'Nature*', London. He has listed a series of challenges, facing science communication, as mentioned below:

1. How can society keep up with science ?
2. To what extent and how can the public be involved and consulted in dealing with the impact of science?
3. How can we deal with the unexpected Dolly (i.e., the cloning of mammal from adults, as in the case of Dolly - the sheep)?
4. How can we reverse the widening of information gaps between different parts of the world?
5. More generally, despite the voluminous coverage of science in the media, how can we do better?

Even though Phillip Campbell has observed that there is 'voluminous' coverage of science in the media, a pilot study (N.N. Panigrahi and D. Mahapatro, 1999) reveals that there is no significant rise in the Indian English dailies, so far as science news coverage is concerned. Regarding the future prospect of print media in this matter, we shall look at the picture depicted by Phillip Campbell:

"A day must surely come when print-on-paper will be replaced by a conveniently portable, possibly flexible, screen of equivalent quality and readability. That, allied to reliably rapid uploading through high speed optical or microwave transmission, will surely be the point where internet will begin to transform the daily lives of those who use it. The time scale? My slightly educated guess: less then a decade."

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Appendix

VIPRIS clipset, "which is involved in the compilation of science news clippings from 125 odd newspapers and magazine, both in English and Hindi language" since 1995, has 16 subject names, viz. alternative energy, agricultural and animal husbandry, anthropology and archaeology, astronomy, and space, atomic energy and nuclear power, biotechnology, chemical science, environment and forest, engineering and technology, earth sciences, information sciences and computer, life sciences, medicine and health, physical science popularisation and miscellaneous.

As against this subdivision, Prof. Vilanilam has worked out sixty sub categories of science and technology news, which are as follows:

Aeronautics and aviation, afforestation (social forestry), agricultural sciences (like agronomy, horticulture, gardening, kitchen gardens, seed environment, soil conservation), alcoholism, alternative sources of energy (wind, geothermal, gobar, solar), astrology (prediction as science), astronomy, atomic energy commission, awards and achievement in S & T, biographies of Indian and foreign scientists and technologists biomedical engineering, biotechnology, communication technology (telephone, telegraph, all communication except satellite communication), computer technology and application, CSIR, deforestation, drug abuse, earth science (geology, minerals), energy (general), engineering (general), environmental pollution & control, food technology fisheries, foreign scientific activities, genetic engineering, history of S & T, housing for the millions, inaugurations and dedications of S & T activities, industrial applications of science, inventions and discoveries, labour saving devices, mathematical science, medical technology, medicines (drug, pharmaceuticals, drug prices), military sciences, national laboratories, nuclear power projects, occult sciences (black magic, contacting the dead), occupational safety, health and safety hazards, oceanography, public health (contagious diseases, health camp and sanitation), radiation hazards, research (general), KSSP activities (Kerala Saastra Sahitya parishad) - (such type of voluntary organizations may also form a sub category in S & T news), satellite and space science (including satellite communication), S & T popularisation among masses, S &T policy and philosophy, S & T institutions, scientific attitude and temper, scientific interpretation of religions, myths, rites and practices, social and general science (including basics, other than mathematics), super conductivity, textile technology, thermal power projects, transport systems (railways, transport improvement), university science departments (achievements, research projects, contributions, etc.), veterinary science, wild life and ornithology.

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Article

Environment Journalism: Concept and Scope in India

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Environmental journalism in India is evolving as a profession but it has not so far evolved as a professional field of study. In India environmental journalism is taught as a subject in journalism which is not enough to make an evolved professional, as also journalism generally do not attract science based students, while academically scientific background is very important pre-qualification for environmental journalism.

Introduction

Environmental journalism is the collection, verification, production, distribution and exhibition of information regarding current events, trends, issues and people that are associated with the non human world With which humans necessarily interact. To be an environmental journalist, one must have an understanding of scientific language and practice, knowledge of historical environmental events, the ability to keep abreast of environmental policy decisions and the work of environmental organisations, a general understanding of current environmental concerns and the ability to communicate all of that information to the public in such a way that it can be easily understood, despite its complexity.

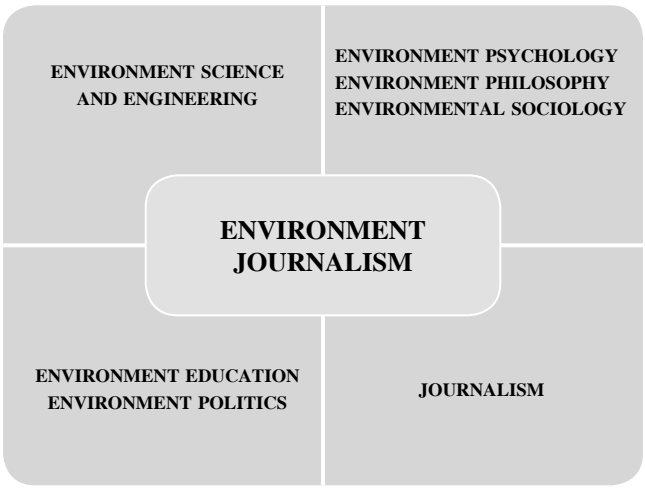

Figure 1: Showing interdisciplinary nature of Environmental Journalism

Environmental journalism falls within the scope of environmental communication, and its roots can be traced to nature writing. One key controversy in environmental journalism is a continuing disagreement over how to distinguish it from its allied genres and disciplines. However the authors believe that environmental journalism should be placed in science discipline, even though it needs knowledge of many more non science fields (Fig. 1)

History

While the practice of nature writing has a rich history that dates back at least as far as the exploration narratives of Christopher Columbus, and follows tradition up through prominent nature writers like Ralph Waldo Emerson and Henry David Thoreau in the late 19th century, John Burroughs and John Muir in the early 20th century, and Aldo Leopold in the 1940s, the field of environmental journalism did not begin to take shape until the 1960s and 1970s.

The growth of environmental journalism as a profession roughly parallels that of the environmental movement, which became a mainstream cultural movement with the publication of Rachel Carson's *Silent Spring* in 1962 and was further legitimised by the passage of the environment related legislation. Grassroots environmental organisations made a booming appearance on the political scene in the 1960s and 1970s, raising public awareness of what many considered to be the 'environmental crisis', and working to in uence environmental policy decisions. The mass media has followed and generated public interest on environmental issues ever since.

The field of environmental journalism was further legitimised by the creation of the Society of Environmental Journalists in 1990, whose mission is to advance public understanding of environmental issues by improving the quality, accuracy, and visibility of environmental reporting. Today, academic programs are offered at a number of institutions to train budding journalists in the rigors, complexity and sheer breadth of environmental journalism. There exists a minor rift in the community of environmental journalists. Some, including those in the Society of Environmental Journalists, believe in objectively reporting environmental news, while others, believe that journalists should only enter the environmental side of the field if saving the planet is a personal passion, and that environmental journalists should not shy away from environmental advocacy, though not at the expense of clearly relating facts and opinions on all sides of an issue. This debate is not likely to be settled soon, but with more recent development in the field of journalism as regards environment, it seems likely that the field of environmental journalism will lend itself more and more toward reporting points of view akin to environmental advocacy.

Environmental Journalism and Nature Writing

Environmental journalism traces back its history to nature writing. Nature writing is traditionally defined as nonfiction prose writing about the natural environment. Nature writing often draws heavily on scientific information and facts about the natural world; at the same time, it is frequently written in the first person and incorporates personal observations of and philosophical re ections upon nature.

Nature writing encompasses a spectrum of different types of works, ranging from those that place primary emphasis on natural history facts (such as field guides) to those in which philosophical interpretations predominate (Lyon 2001)). Some of the subcategories he identifies include natural history essays, rambles, essays of solitude or escape, and travel and adventure writing.

Modern nature writing traces its roots to the works of natural history that were popular in the second half of the 18th century and throughout the 19th, including works by Gilbert White, William Bartram, John James Audubon, Charles Darwin, and other explorers, collectors, and naturalists. Henry David Thoreau is often considered the father of modern American nature writing. Other canonical figures in the genre include Ralph Waldo Emerson, John Muir, Aldo Leopold, and Rachel Carson.

Environmental Communications and Journalism

Environmental communication is communication about environmental affairs. As with other forms of communication, environmental communication is both an activity / phenomenon and a field of study that, not surprisingly, studies the activity / phenomenon (Mark Meisner).

As an activity/phenomenon, environmental communication is all of the diverse forms of interpersonal, group, public, organisational, and mass communication that make up the social discussion / debate about environmental issues and problems, and our relationship to non human nature. Loosely speaking, we can refer to that discussion / debate about environmental issues and problems as 'environmental discourse'. Also, we can refer to the even broader social discussion about Nature as the discourse of Nature. Environmental communication manifests as the discourse of Nature and its subset, the environmental discourse.

As a field of study, environmental communication is a diverse synthesis of communication and environmental theory that examines the role, techniques, and in uence of communication in environmental affairs.

Environmental communication is the pragmatic and constitutive vehicle for our understanding of the environment as well as our relationships to the natural world; it is the symbolic medium that we use in constructing environmental problems and negotiating society's different responses to them (Robert Cox, 2006); pragmatic means the instrumental function of educating, alerting, persuading, mobilizing, solving, etc., where as constitutive means the creative function of helping to shape our perceptions of nature, environmental issues and ourselves.

The environmental communication has seven major areas of study (Robert Cox, 2006)

- Environmental rhetoric and discourse
- News media and environmental journalism
- Public participation in environmental decision making
- Environmental advocacy campaigns
- Environmental collaboration and conflict resolution
- Risk communication
- Representations of Nature in popular culture

Therefore professional approach of down filtrating environmental communication in electronic and print media is environmental journalism.

Need of Environmental Journalism

The planet's environmental future will be decided in the developing world. Home to four-fifths of the world's population, the world's fastest growing economies, and the richest remaining pockets of biodiversity, these countries will ultimately determine how drastically our climate changes, how many species go extinct, and to what extent our food chain becomes contaminated.

The local media play a critical role in in uencing how governments and societies balance growth with sustainability. Unfortunately, environmental news is given short shrift almost everywhere, particularly in the developing world, where reporters are often assigned to cover this field without any training in environmental or scientific issues. They also face tremendous pressures from powerful local interests, the advertisers who support their companies, and even their own editors.

Professional approach to environmental Journalism

Environmental journalist often commits professional mistakes when highlighting any of the environmental issue. This mostly happen because of the following reasons

1. The journalist do not posses required scientific information to handle the issue this happens mostly in developing countries like India, as the journalism education attracts more students from non science backgrounds.
2. The person reporting for environment lack professional trainings related to journalism.
3. The issue is not highlighted and argued in the way that it touches most people. Mostly it has been seen that environmental issues are always highlighted with respect to environmental damages which are conceived by a few educationally elite groups only, while as same issue could be intensely popularised by linking in to economy, religion culture tradition and history so that it percolates to the whole cross section of the society.
4. The person reporting about environment is biased and is inclined to any political party or in uenced by any business enterprise.
5. The journalist does not update his / her information by studying famous success and fiasco case histories of environmental journalism.

Ethics of Environmental Journalism

Ethics are very important for professionalism apart from journalistic ethics even though it is clear that goal of environmental journalism is to *save Earth at any cost* still an environmental journalist is supposed to abide by some standard ethics. Before discussing ethics it is important to know how exactly an ideal environmental journalist should work. An ideal environmental journalist should

i) **Relate the issue to people :** The reporter has to add something more that would relate the issue to daily lives of people. The reporter should try best to relate the issue to the people by interweaving the issue into their social, political, cultural and religious fabric in such a manner that inter people con icts should be avoided and environment be benefited at any cost.

ii) **Listen to the people first :** The most important thing is that the journalist, who wishes to communicate environmental issues to the rest of world, should hear the people first, concerned or affected by the project causing environmental problems. Maintain contacts with their social, political and religious heads. Frequent their places, increase contact with them and involve common man in the story preparation. Win the confidence of local people involved and acknowledge them their importance in highlighting and solving the problem.

iii) **Be cautious and alert :** Environmental journalists need to be very cautious of being misused by some vested interests posing as environment lovers. Some commercial interests cleverly promote the cause of environment with hidden objectives. Sometimes this would be to divert attention from their own follies or to put down competitors. Some environmental organisations raise a bogey of protest over every issue just to keep themselves a oat. Even worse situation arises when naive environmental journalists are carried away by politicians to disrupt the development work initiated by their rival political party or falsely implicate their rivals in negligence related issues.

iv) **Depend on reliable source of information :** Environmental journalists should depend on first hand information gathered by reliable professional

sources rather that depending on second hand and third hand information from unreliable sources. Environmental journalists should not fall into the black hole of misinformation created by their own, there by pushing themselves into legal hassles and bringing embarrassment to profession. In sensitive cases, where journalists cannot visit, sincere activists with a sense of proportion can be source to learn about field level developments. The leaders of mainstream environmental organizations should not be depended upon for this, as their own information would be secondary. They are better when you need a few quotes.

v) **Be always professional :** Environmental journalists should bear in to their minds the only slogan *'represent Earth to save earth'*. Environmental journalists should remember that they are not environmental activists rather journalists. They should not fell victim to the bait of economic or political favors. They should represent the earth with sincerity and honesty. They should work hard to make earth greener and greener.

Code of Ethics for Environmental Journalists

The following Code of Ethics was ratified at the 6th World Congress of Environmental Journalists held in Colombo, Sri Lanka, on October 19 - 23, 1998.

1. The right to a clean environment and sustainable development is fundamental and is closely connected to the right to life and good health and well being. The environmental journalist should inform the public about the threats to the environment - whether it is at the global, regional, national or local level.

2. Often the media is the only source of information on the environment. The journalist's duty is to heighten the awareness of the public on environmental issues. The journalist should strive to report a plurality of views on the environment.

3. By informing the public, the journalist plays a vital role in enabling people to resort to action in protecting their environment. The journalist's duty is not only in alerting people about their endangered environment at the outset, but also in following up such threats and keeping them posted about developments. Journalists should also attempt to write on possible solutions to environmental problems.

4. The journalists should not be in uenced on these issues by vested interests - whether they are commercials, political, and government or non governmental. The journalist ought to keep a distance from such interests and not ally with them. As a rule journalists should report all sides in any environmental controversy.

5. The journalist should as far as possible cite sources of information and avoid alarmist or speculative reportage and tendentious comment. He or she should cross - check the authenticity of a source, whether commercial, official or non governmental

6. The environmental journalist should foster equity in access to such information and help organisations and individuals to gain it. Electronic retrieval of data can provide a useful and egalitarian tool in this regard.

7. The journalist should respect the right of privacy of individuals who have been affected by environmental catastrophes, natural disasters and the like.

8. The environmental journalist should not hesitate to correct information that he or she previously believed was incorrect, or to tilt the balance of public opinion by analysis in the light of subsequent developments.

Environmental Journalism in India

Environmental journalism in India began in the 1920s, but that valuable phase is forgotten. What is remembered and lauded is the environmental journalism of the '80s, when academics, NGOs and social scientists took on the cause. But this was the period during which the debate on the environment actually receded from the mainstream into technical and esoteric journals.

When we speak of environmental journalism in India, we have to see it against the backdrop of the environmental movement as a whole. The environmental movement in India has gone through two phases. The first phase starts around 1920 and continues till the 1940s. This is the forgotten, or undocumented, phase and foregrounds the ideas and opinions of a variety of thinkers, mostly nationalist. There were a number of environmental thinkers and writers all through that period. Some were Gandhians, like the great Tamil economist JC Kumarappa. Some like Radhakamal Mukherjee were social scientists. Mukherjee pioneered an interdisciplinary brand of

knowledge, which he termed social ecology and which sought to bring together the Natural Sciences and the Social Sciences. Some were dissident colonial scientists, for example, Albert Howard, who was in the Indian Agricultural Service, and is now revered in the West as a prophet of organic agriculture. He developed a method of composting known as the lndore method, which is used by organic farmers in the West. But in India he is forgotten.

What we really see in this period is a debate between the ecologically responsible and the modernisers. The former wanted co existence with nature while the latter felt that the concern for the environment was a deviation from the task of building an economically robust, industrially advanced India.

Beginning from 1947, the modernisers won the debate. Environmental considerations ee to the margins but they re-emerged much later in the 1970s — not in the form of intellectual critiques as in the first phase, but in the form of people's movements and struggles like the Chipko Andolan, the fisherfolks' struggle in Kerala, the forest movement in Jharkhand and Madhya Pradesh, the anti dam movement in the Narmada valley, the Koel Karo and the Tehri projects and so on.

Historical perspective

Environmental reporting in India has a long history. In 1920, the Tatas were building a dam on one of the rivers in the Western Ghats, near Lonavla. It was going to displace some 15 to 20 villages. There was a protest against it led by a brave socialist from Pune known as Senapati Bapat. This protest was reported right through its course in both The Times of India and the Bombay Chronicle. These were articles that took into account the wider argument meditating on issues like electricity for Bombay versus land for peasants, rights of displacement, large technology versus small technology, etc.

In 1937, when Congress governments came to power in the local legislature bodies of the provinces. S G Warty wrote in the Bombay Chronicle on a number of environment related issues. He strongly argued to undo the colonial forest policy. From 1952 to 1996 M. Krishnan, who wrote a fortnightly column for The Statesman, is considered as India's renowned naturalist as he had deep knowledge of India's biodiversity and his writing is precise, evocative and wonderful Krishnan is considered as pioneer of Indian environmental journalism by some. By the time of early '70s India witnessed many struggles by grassroots people to protect the natural resources around them. Soon many journalists stepped in to report and document these movements. The Chipko movement, for example, got wide coverage in the local newspapers and also got popularised in west as tree hugging movement. The period (roughly between 1975 and 1985) was a very vibrant one for environmental journalism in India. These journalists successfully challenged the conventional policies by the advocates of large scale development. Moreover most infamous Bhopal gas tragedy took place during this period which got wide coverage on national as well as international media.

In the next phase social scientists, academics, NGOs and even government bodies took up the cause of the environment and the professionalisation of environmental writing began with this. However, this came at a cost, as the discussion of matters of vital public interest (forests, energy, and urbanisation) moved away from the newspapers and other public spheres and into esoteric, technical publications.

Starting with 1991, the fourth phase got underway. This is when India witnessed a backlash from the proponents of the unbridled liberalisation of the Indian economy. Those who advocate environmental causes were branded as the people who want to keep India backward, significant initiatives in wild life protection, social forestry, soil management, resource management, alternative energy, etc., undertaken by voluntary organisations throughout the country during this time were poorly reported.

The current new era of environmental journalism (roughly from 2000 onwards) started with the exclusive publication of periodic environmental news magazines and journals which highlighted some hot issues of environmental consequences resulting due to human actions and calamities natural (earthquakes, tsunami, etc) as well as man induced (global warming, climate change, droughts, oods, etc). Some of the famous journals and newsletters are, *Down to earth, Survey of Indian environment, Terra Green, Agro Bios* etc. During this period local environmental programs were also aired on television like Bhoomi, Earth watch etc. Private news channels aired environmental and pollution watch of major cities. The release of Oscar winning documentary an inconvenient truth and active participation of Indians at global level to highlight climate change and role of Dr. R.K. Pachauri in winning Nobel prize for IPCC has initiated new era

in Indian environmental journalism. Since the dawn of environmental journalism in India, the focus has been consistently changing from the issues related to wild life, deforestation, mining and industrialization, to resource depletion, health, global warming and climate change or in other words we can say there is appreciable change of reporting from local issues to global issues.

Future of Environmental Journalism in India

India being world's fastest growing population and economy shoulders responsibility of environmental conservation both with respect to man power as well as environmental awareness with the popularisation of internet in India, access to satellite television, increase in literacy rate, re-popularisation of radio by FM stations, the prospects of environmental journalism is going to diversify in India beyond expectations and comprehension.

Environmental Journalism Education in India

Even though bachelor and masters degrees in Journalism is offered by many institutes in country but no specialised degree is offered in environmental journalism so far.

Many institutes in India offer environmental journalism as subject at U.G level, like IIJM Bangalore, Pioneer Media School, Makhanlal Chaturvedi National University of Journalism, Bhopal, and University of Mysore.

Conclusion

Environmental journalism is going to rock in the fast developing country like India but to maintain the quality of journalism many steps need to be taken right now, they include

1. Highly specialised environmental journalism degree courses should be introduced, unlike traditional journalism.
2. The curriculum of new introduced courses should be combination of science and communication and degree should be science based unlike traditional journalism which is arts based.
3. Every environmental research institute should appoint an environmental journalist who will report research work in artistic and easily grasping format to common man who does not understand jargons and will also narrow down gap between environmentalists and journalists.
4. It should be made compulsory for electronic and print media to carry environment related news in their issues.
5. Trainings and workshops should be conducted to popularise concept of environmental journalism.
6. A regulatory body of Indian environmental journalists should be founded, so as to maintain productive contribution of the field to the society in particular and whole mankind in general.

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To Our Readers

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

News

Science Communication course at Anna University

Anna University Chennai offers the new two-year programme M.Sc. (Science Communication) through its Department of Media Sciences. The National Council of Science and Technology Communication (NCSTC) of the Department of Science and Technology (DST) supports this M.Sc. programme which also supports several other such science communication initiatives.

An academic programme on Science Communication trains professionals to take up present and future tasks in various aspects of science and technology communication. It involves training students in communicating science through print media, radio, television, multimedia, and animation. Science can not only be promoted through the mass media but also through discussions, documentation, museums, exhibitions adopting folk arts games toys, and dances as communication tools.

Job opportunities for Science Communication experts include science journalism corporate communication, e-learning, and technical writing even as part of Business Process Outsourcing (BPO). All large research laboratories including those of CSIR across the country employ trained manpower in Science communication, Science and Technology related corporate companies have to promote science awareness and publicise a broad range of scientific and technological issues through the media. The professionals of science communication will be able to research and write / edit media release and feature articles for publication both externally and internally. Besides such subject-specific jobs, degree holders in Science Communication are also employed as public relations personnel in government, event managers, animators for films and a host of other jobs.

The total intake is 20 students. A stipend of Rs. 1,000 a month shall be paid to every student. All B.Sc., B.E. or B.Tech. degree holders are eligible. Sponsored candidates may also apply.

Application forms and other details can also be downloaded from the university website: *www.annauniv.edu/msc2008*

Books published

1. Handbook of Public Communication of Science and Technology

Comprehensive yet accessible, this key book provides up-to-date overviews of the fast growing and increasingly important area of 'public communication of science and technology'. The contributors convincingly demonstrate that science communication in not merely something that one 'does', but is in fact an intellectual field of its own whose practitioners can enrich and enhance their activities by exploring the conceptual challenges posed by the field.

The book has been published by Routledge has and edited by Massimiano Bucchi (University of Trento, member of the PCST Committee) and Brian Trench (Dublin City University, PCST Committee).

2. Communicating Environmental Geoscience

This book is a collection of papers addressing the issues surrounding communication of environmental geoscience. Geologists whose research deals with environmental problems such as landslides, oods, earthquakes and other natural hazards that affect people's health and safety, must communicate their results effectively to the public, policy makers and politicians. There are many examples of geological studies being ignored in policy and public action; this is in partly due to geoscientists being poor communicators. These papers document issues in communicating environmental geoscience, outline successes and failures through case studies, describes ways in which geoscientists can improve communication skills and show how new methods can make communication more effective. The collection has been edited by D.G.E. Liverman, C. Pereira and B. Marker. ■

European Guide to Science Journalism

The impact of scientific research is such important that communicating research initiatives and results is actively supported and encouraged by the European commission. Furthermore, dissemination of results is an obligation of participation in research projects supported under the Framework Programmes. Effective science communication is vital in order to ensure a continuous flow of information on the objectives and results of scientific research, the contributions made to knowledge and scientific excellence as well as the benefits to citizens in general. Dissemination of the results is also key to ensuring access to the appropriate scientific basis for effective policy-making.

The media are key actors in this process and clearly play a crucial role in communicating science. It is for this reason that Directorate-General for Research of the European commission has launched the European Forum on Science Journalism which brought together leading science journalists from across Europe and gave clear recommendations on the ways to increase the prominence and accessibility of science news and how the EU can further assist in raising awareness of the role of science in society.

This second edition of *European Guide to Science Journalism Training* is a clear result of these recommendations and provides an overview of the training courses available across the 27 EU Member States for those wishing to specialise in science journalism.

Europe has a wealth of formal and informal training opportunities in the field of science journalism.

The avenues span from Master programmes specifically dedicated to science journalism, to individual modules within general journalism or science degrees, to *ad hoc* workshops and debates on science communication.

This Guide provides a comprehensive overview of the training courses, exchange programmes and initiatives to support science journalism in the EU. Information has been collated through extensive desk research and direct contact with national associations of science journalists, key science journalists, universities and ministries of science and/or education.

Although this Guide is a comprehensive overview of training opportunities in this field, it does not constitute an exhaustive inventory. However several trends can be identified:

Science Communication courses at university level are widespread. The scope of such courses is broader than for pure science journalism, and prepares students for careers in scientific and technological firms, public bodies, foundations, specialised research study centres, museums and science journalism. These programmes include courses such as science writing, scientific dissemination, science publishing, and science journalism and are available in the majority of the old EU Member States.

There is a clear recognition of the need to increase the accessibility of scientific information. An increasing number of informal projects and initiatives have also been developed to bridge the perceived gap between the 'scientific community' and the general public. The "Danish Science Cafés" which are based on face to face discussions between experts and the general public in a relaxed and informal environment, provide a good example of such initiatives. Programmes explicitly dedicated to providing formal qualifications for Science Journalism are quite rare in EU 27. Only France, Germany, Spain, the Netherlands and the United Kingdom offer undergraduate or post-graduate degree programmes in Science Journalism. In addition to formal education structures, a number of journalist associations run *ad hoc* workshops and seminars on science journalism.

In Eastern Europe, there are fewer formal support structures for those wishing to become a Science Journalist. Science journalism is typically referred to within general journalism studies and discussed during *ad hoc* seminars and workshops. In Slovenia for example, the Science Foundation offers courses

in science writing for researchers and scientists, while in Bulgaria and Romania, science journalism is frequently promoted in informal settings through student initiated projects such as the Romanian Club of Scientific Journalism.

From the information gathered, Germany and the United Kingdom seem to be among the few member states with comprehensive approaches to science journalism training. In addition to the wide range of training courses at universities and higher education institutes, both countries also have a series of fellowships and exchange programmes to facilitate further training for journalists wishing to develop their skill base. It is interesting to note that in Germany, research foundations support fellowship programmes for science journalists.

This Guide is structured by country in alphabetical order. Each country section includes a fact sheet per training course and general information on other relevant communication or journalism courses. For countries where no specific science journalism programmes were identified, information sources related to journalism and science communication are provided.

Further details can be had from: *www.ec.europa.eu*

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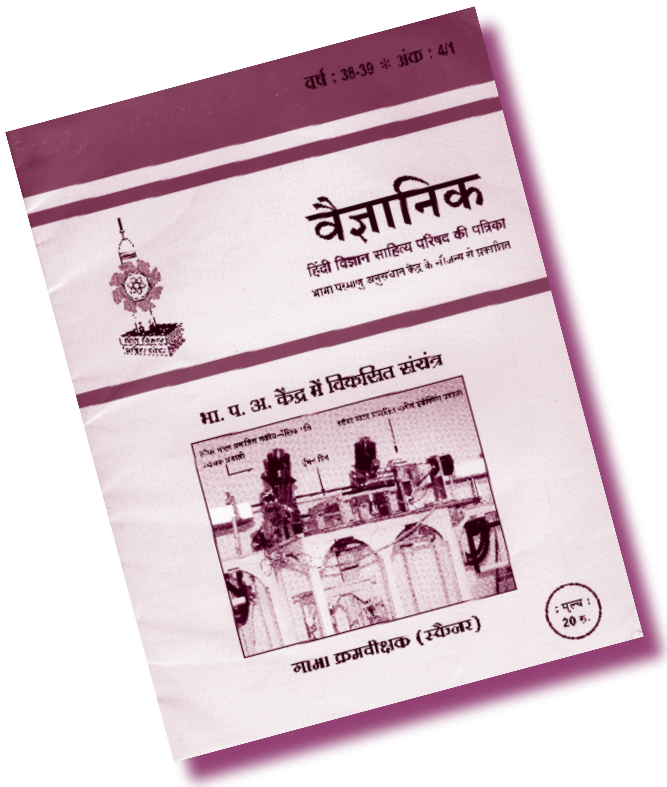

विज्ञान संबंधी पत्रिका की हिन्दी में कमी पिछले कई दशकों से अनुभव की जा रही है। परंतु कुछ वर्षों से कई शिक्षाविद् और वैज्ञानिक पत्रिका के माध्यम से प्रयासरत हैं। जैसे विज्ञान, विज्ञान प्रगति, आविष्कार आदि का कुशल प्रकाशन सामने आया है वैसे ही *"वैज्ञानिक"* वर्ष में चार अंक द्वारा हिन्दी में गांव शहरों में वैज्ञानिक चिंतन प्रारंभ करने के उद्देश्य से पत्रिका पाठकों के लिए उपलब्ध है।

एक उच्चस्तरीय लेखों का नियमित संकलन हिन्दी में विज्ञान में वैज्ञानिकों, शिक्षाविदों, संस्थानों के छात्रों व आप पाठक को मिले एवं एक वैज्ञानिक जागरूक मंच पैदा करना पत्रिका का प्रेरणा स्रोत रहा है।

"वैज्ञानिक" का परिचय अंक लगभग 37 वर्ष पूर्व 1969 में प्रकाशित हुआ था। वैज्ञानिक चिंतन हिन्दी में उपलब्ध कराने के अतिरिक्त इसमें नवीनतम शोध की जानकारी हिन्दी में पाठकों तक पहुंचाई जाती है। इसी उद्देश्य से 1970 से प्रतिवर्ष अखिल भारतीय लेख प्रतियोगिता का आयोजन हिन्दी में विज्ञान के संवर्द्धन के हेतु की जाती है। इसका मुख्य उद्देश्य आम पाठक में राजभाषा में वैज्ञानिक लेख लिखने की क्षमता पैदा करना, नये शोध की जानकारी एक दूसरे तक पहुंचाना वास्तव में राजभाषा के लिए बहुत शुभ है। पुरस्कृत लेखों को इनाम एवं प्रशस्ति पत्र भी प्रदान किया जाता है एवं इन लेखों का 'प्रतियोगिता विशेषांक' के रूप में 'वैज्ञानिक' द्वारा प्रकाशित कर पाठकों में हिन्दी में वैज्ञानिक जागरूकता पैदा की जाती है ताकि लेख के स्तर पर पाठक अपने ज्ञान व क्षमता में वृद्धि कर सकें। अच्छे लेख वैज्ञानिक रूप में लिखने की कोशिश इस प्रतियोगिता में लेखक करते हैं और सफल भी रहते हैं। इसमें सामान्य वैज्ञानिक विषय जैसे कृषि विज्ञान, खगोल विज्ञान, भौतिकी, रसायन, पदार्थ विज्ञान, पर्यावरण, लेसर, भूकंप, संगणक विज्ञान, नैनोटेक्नोलॉजी, भारतीय विज्ञान की भावी दिशाएं, आदि, विशेष रूप में शामिल है। इस पत्रिका के प्रधान संपादक डॉ. गोविंद प्रसाद कोठियाल हैं जो केन्द्र के सिरामिक्स अनुभाग के अध्यक्ष भी हैं।

प्रत्रिका की निरंतरता व विज्ञान लेखन जगत की परिवृद्धि के लिए ऐसे प्रयास सराहनीय हैं।

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Forthcoming Events

2nd European Communication Conference
November 25-28; Barcelona, Spain

The European Communication Research and Education Association (ECREA) commissioned the Autonomous University of Barcelona to organise its 2nd European Communication conference, with the support of the Communication Science Faculty at the UAB and the Communication Institute (InCom-UAB). The ECREA was created in 2005 by the joining of the two main European communications researchers, the European Communication Association (ECA) and the European Consortium for Communications Research (ECCR).

The central focus of the conference, 'Communication, Policies and Culture in Europe' will examine the development of communication policies for European culture in the face of the new globalisation challenges.

Objectives

The 2nd European Communication Conference aims to bring together specialists studying the role of communications and media in society, with a special emphasis on European challenges.

The conference will deal with a broad range of topics, from philosophy, history, the economics of communication and innovations in reception studies to research into the relationship between media and society, such as its impact on democracy, migrations, sustainable development, identities and cultural diversity.

The main focus of the conference, Communication Policies and Culture in Europe, is one of great importance. By focusing on this theme, the conference aims to contribute to questions surrounding the development of communication policies (regulation, impulse, etc.) for European culture in the face of the new globalisation challenges.

In addition, the local committee will seek to address a range of topics of general interest in Europe by inviting contributions of Spanish academics. This will include matters of education and communication, local media and communication, and academic collaboration between Europe and Latin America.

For further details, contact:
http://www.ecrea2008barcelona.org

The 8th Indian Science Communication Congress (ISCC-2008)

Media Convergence & Knowledge Revolution

December 10-14, 2008
Science City Auditorium, Tamil Nadu Science & Technology Centre, Chennai - 600 025

The enormous knowledge incidence from all around the world at one hand has largely widened the canvas and scope for development, while plurality of mass media has opened up new vistas for channelising and creating a knowledge society at the other. The ability of a nation to use and create knowledge capital determines its capacity to empower people at large towards taking advantage of this vast pool of emerging scientific knowledge for wealth creation and well being of a nation. The knowledge oriented paradigm of development would be crucial especially for emerging world in the decades to come as the time has arrived to converge all sets of mass media to better equip the society for a steady and evenly ow of quality information in all sectors. In the age of knowledge revolution and globalisation no country can even afford to miss this opportunity that is coming on our way as a result of democratisation of knowledge, which if not harnessed properly can lead to irreversible consequences. The abundance of old and new knowledge is more challenging as compared to that of deficit of knowledge because of unchecked constant bombarding of knowledge amongst us through plenty of information channels.

The common man is in great dilemma as he is unable to decide as what is useful! We are now in process of formation of knowledge cocoons surrounding ourselves. Inside these cocoons we are left with no option other than to converge all media and sharpen our edges to rupture the cocoon and come out of it to see the world and respond to it differently; that would mark the beginning of sustainable knowledge generation, delivery and utility system. Booming radio/TV channels, films and other media are ooded with lots of science information in their own way. Folk arts are still prevailing in rural areas causing remarkable changes in village life. Web media is becoming popular in general public; browsing centres are growing in nooks and corners of streets and even

in villages for communication, entertainment and getting medical and marketing details. Innumerable books, journals, newspapers and other printed products are adding to revolutionize the way a common man gets information. Convergence is not only related to technology, it is also a concept of combining various systems, processes and actions for multiple objectives with impact of technology and a quantum leap towards mature knowledge society. The conventional and new media crossroad when embraces grassroot audience and media corporate, the dyanamics between media producers and media consumers changes. It also induces changes within cultural, social, economical and industrial arena that necisitaes the audience to seek more knowledge and therefore more emphasis is needed on quality of contents, presentation and packaging. The proliferation of information resources is to be transformed into utility oriented marketable products that will promote knowledge economy.

The world has now entered into an era of convergence culture and we need to take steps to converge all the media to take advantage of it for developing a science oriented society. The NSCC-2008 is going to redefine scope of media convergence in the age of knowledge revolution for harnessing the immense potential offered for S&T communication. The issues amongst others emerging out of this area of unpredictable possibilities will be addressed, such as: the balance between knowledge abundance and knowledge deficit; knowledge creation vs knowledge handling; open access of science research and knowledge marketing; quality of contents and quality of packaging; problems of getting desired information with solutions; studies on converging bilateral, trilateral or multilateral media for effective S&T communication; the other side of media convergence; the problems and prospects of knowledge revolution; role of institutional convergence; converging networks, methods, processes, practices, professions for S&T communication; and alike.

Objectives

i) To encourage discussion and interaction on issues and aspects concerning S&T communication.

ii) To bring science communicators, scientists, technologists, journalists, academicians together.

iii) To offer budding S&T communicators a wider exposure and enable them to express their views/ ideas.

iv) To address various issues vital to promotion of science and technology communication.

v) To explore and share newer tools, ways, means for better target specific S&T communication.

vi) To provide a forum for young and experienced researchers and practitioners of S&T communication.

Sub Themes: There will be 5 Scientific Sessions on the following sub themes :

i) Understanding Media Convergence: The session introduces, defines and explores various concepts, determines various facets, aspects, and sub-sets for convergence of different mass media.

ii) Understanding Knowledge Revolution: The session finds out as what benefits can we expect for S&T communication in the age of knowledge proliferation with pedagogical aspects, methods and models.

iii) Converging Media and Knowledge Ecosystems: The session discovers role of software materials, institutions, scientists, technologists, media houses, and science museums with case studies.

iv) Human Capital in Knowledge Society: The session examines role of science communicators, young science enthusiasts with training opportunities, science literacy, S&T temper, and scientific wisdom.

v) Knowledge Economy and Knowledge Marketing: The session deals with issues of content development, knowledge processing and retrieval systems, packaging and delivery mechanisms, including knowledge-media interaction, effective methodologies and best practices.

ISCC Format: The technical sessions will have presentation of contributory research papers, review papers, survey analyses, case studies, and invited talks. Discussions in split groups would offer close exchange of thoughts and ideas. Deliberations will be in English, Hindi, and Tamil. A sub-theme cannot be the title of a paper/ presentation; select a narrower topic under a sub theme and design your research study around it. Papers must be prepared in standard research paper format, i.e. title of paper, name(s) and address of author(s), abstract, key words, introduction, objectives, methodology, observations, discussion, analysis, inferences, conclusions, recommendations, references, along with illustrations, graphics, photos including captions. In addition to scientific sessions and split groups, there would be two workshops and an open ended roundtable. One workshop would be for young researchers/ students; whereas the

other would highlight global perspectives in S&T Communication.

Who can Participate: Researchers and practitioners of S&T communication, i.e. scientists, technologists, academicians, writers, journalists, editors, scholars and faculty members of journalism, public relation and information officers of scientific organizations, representatives of media organizations, newspapers, magazines, science cells of AIR/ TV channels, science activists from NGOs; and senior government officials/ policy makers.

Travel Fellowship: Limited number of travel fellowships are available for selected/ invited delegates from India. International delegates will make their own travel arrangements; the organizers could offer free stay and meals. Best paper/ presentation awards would be given in junior and senior categories based on independent evaluation.

Registration/Submission of Paper/ Abstract: Last Date - November 15, 2008. Selected applicants would be invited for presentation. *Indian Journal of Science Communication* <www.iscos.org> would publish selected papers.

Exhibition of Popular S&T Publications and Information Products: The exhibition is being organized at the venue; please bring/ send your publications, articles, books, magazines, Cds, kits and software materials for display.

Weather: Temperature in Chennai would be pleasant in December; woolens not required.

Addresses for Communication:

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The First Ever National Discussion
Science Fiction : Past, Present, Future
November 10-14, 2008; Varanasi (Uttar Pradesh)

A sheer balance between fact and fiction on the grounds of science and technology paves the way towards imaginative faculties of human mind which we often refer to as creative dream and that may come true sometime as well! A science fiction is a fine fabric of a number of elements together interwoven in a manner so that it at one end can entertain and can arouse one's creative imagination at the other. At the same time, it can inform you with an analytical and rational approach and also enable you to foresee the futuristic perspectives. We all are aware of a number of classical science fiction stories that had prepared the ground for several landmark inventions. Moreover, because of its enormous potential in educating, motivating and entertaining the common man especially the children, science fiction has been a popular means of science communication.

The discussion is aimed at focusing on various aspects of science fiction and its role in communicating science and technology related issues to the common people and children. The goal of the five-day exercise is to prepare a draft for "Benaras Document 2008". The programme would also examine as how science fiction input could be enhanced and successfully employed in various science communication modules currently in vogue in India.

There will be at least one plenary session everyday besides usual technical sessions, followed by in-depth analyses on given topics in working group discussions. There would be a special forum for young researchers and students. The discussion is also aimed at bringing science fiction and fantasy writers, scholars, critics, enthusiasts, noted social fiction writers, litterateurs and scientists together. Attendees would be encouraged to discuss their views on the given topics, share knowledge and perspectives in an informal environment in order to encourage free ow and cross pollination of ideas for further advancement of science fiction profession.

The discussions, amongst others, would include topics such as science fiction as a learning device, various familiar story-telling formats including rich Indian oral traditions, and science fiction writing in regional languages, etc. Con icting issues would be specially taken care of by a distinguished panel of experts, including a Chairperson, a Co-chairperson and a Facilitator for each discussion group. A peer review system for the assignments and outcomes would also be observed during the programme to have a stock of the progress and achievements of the sessions and set the trend for the next sessions accordingly.

The National Council for Science & Technology Communication is the apex body of Government of India mandated for public communication of science and technology and inculcation of scientific and technological temper among masses. The Indian Science Fiction Writers' Association (ISFWA) and Indian Association of Science Fiction Studies (IASFS) are non-profit professional bodies dedicated to enhancing science fiction and fantasy in literature and mainstream media.

Sub Themes

Following 5 sub themes are incorporated in 5 technical sessions. However, the discussion on a particular theme or topic may continue informally beyond the stipulated session until the final conclusions are drawn, reviewed and finalized.

i) **Science Fiction - Historical Perspective :** The programme shall begin with analysing the development and evolution of science fiction in India vis-a-vis in the world with comparative and analytical accounts on evolutionary trends.

ii) **Understanding Science Fiction - A Cognitive Approach :** A number of definitions and theories are prevalent across the world when it comes to understanding science fiction. The session will try to redefine various forms such as science fantasy, story, fiction, tale, etc., with pedagogical and cognitive enrichment.

iii) **Current Trends in Science Fiction :** This shall examine many contemporary issues on science fiction currently debated. It may present an overview on possible cultural in uences on the genre, emerging trends, changing styles and characteristics of science fiction.

iv) **Science Fiction for Science Communication :** This session shall emphasize on various formats and styles suitable for presenting different contents and concepts using mass media, such as drama, theatre, puppetry, tableaux, novel, cartoon strip, film, etc.

v) **Science Fiction: Future Perspective :** The discussion shall focus on whether science fiction could be made better by making it more like mainstream fiction. The future scope and possibilities of science fiction in development of science and technology would also be explored. The session will also try to understand whether insinuation of science fiction or fantasy into serious mainstream literature is detrimental to hard science fiction!

Special Training Session on Science Fiction Writing : Apart from above, a special training session for young science fiction amateurs has also been planned. It is an added attraction for young participants enabling them to inculcate and develop amongst themselves science fiction writing skills, including important tips, tricks of the trade, subtleties and nuances of the genre under the supervision of noted science fiction experts. The group discussions can be divided into split groups to encourage more focussed approach.

Format of the Programme : The research papers are invited from the science fiction writers, scholars, experts, researchers, scientists and students on various aspects of main theme and sub themes, which will be presented during technical sessions followed by debate and discussion. The papers should be in standard research paper format. Research papers, including empirical studies, historical accounts, review papers, discussion papers, debates, and innovative approaches in science fiction are welcome. Each presenter may get around 10 minutes with more emphasis on discussion. Power point presentations would be encouraged. Deliberations will be both in Hindi and English. High standard papers could be selected for publication.

Who should participate : Anyone genuinely interested in science fiction profession with able contributions.

Registration : Some 100 science fiction buffs including subject specialists, experts and young researchers/ students will be invited to participate. There is a provision of limited travel fellowships covering travel expenses, accommodation, meals, and registration fee only for selected/ invited delegates from India. International delegates will make their own travel arrangements; the organizers could offer free stay and meals. An Expert Committee will evaluate the applications for final selection.

Contact for further information :

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Letters to the Editor

Sir,

As stated in the Editorial (Volume 6, No 1), we accept that there are some challenges existing before science communicators. To meet out these challenges, science communicators can avail the facility of multimedia and animation technology too.

Even though the science communication techniques like puppet show, print media, street play are popular, most of the people like to watch TV programme. We can also popularise science in any form through TV programmes.

It is stated in review coloumn (First India Science Report) that 65% of science news in India is acquired form Television. If we plan in such a way that more scientific inventions and developments are broadcast in TV in the form of cartoons and science fictions, this will attract the people from all age groups, children to adults.

Nowadays multimedia technology plays a major role in regular education. Similarly, this technology can be utilised for science communication so well.

We have tried few animated science cartoons on the issues such as effect of smoking, natural calamities, thirukkural and science & development of IT.

L. Jayanthi Kesavan M.Tech., HOD IT Department, CSI Polytechnic College, Salem - 636007 (Tamil Nadu)

Commissioned Studies/Papers

Indian Journal of Science Communication encourages potential scholars to undertake short term studies/ research/surveys on specific area/topic/sector concerning S&T communication. It is expected that such studies will also lead to writing of a paper/article and can subsequently be published in *IJSC*, if found suitable. A committee of experts will evaluate and recommend carring out of such studies. A nominal amount towards honorarium may be granted for undertaking such studies.

Proposals, including information pertaining to title of the study, scope and objectives, methodology, expected outcome, budget estimates and time schedule, etc., may be sent to the Editor, *IJSC*.

Indian Journal of Science Communication

Instructions to Contributors

Indian Journal of Science Communication accepts original papers in the area of science communication for publication. Besides, articles on related issues; write-ups on science communication skills, innovative ideas to communicate science, cartoons (scientoons) are also published.

Books, monographs, copies of TV and radio programmes are accepted for review. News, views, opinions, letters to the editor and suggestions on various aspects of communicating science are welcome for inclusion.

All above communications can be either in Hindi or in English language. Manuscript preparation is described below :

General: Manuscripts should be submitted in hard copy as well as electronic form. Good quality printouts (two copies) with a font size of 12 pt. are required. The pages should be numbered. Print outs must be double spaced with margin on one side of the white paper. The corresponding author should be identified by an asterix (include Email address). Electronic form of the manuscript should be submitted in a floppy (3.5 inches, 1.44 MB). Text should be entered using word processing softwares such as MS Word (IBM compatible). For illustrations, Corel Draw, Harward Graphics or any compatible format software (BMP, GIF, JPG, PCX, TIF) may be used. Label the floppy disk with the author(s) name(s), the word processing package used, software for illustrations and the type of computer. In case of any discrepancy between the electronic form, and hard copy, the latter will be taken as the authentic version.

Order of Text : The matter should be arranged in the following order : Title, Name(s) of author(s), Affiliation, Abstract (in English and in Hindi), Keywords, Main text, Acknowledgements, Appendics, and then References. The abstract, tables, figures and captions for figures should be typed on a separate page. In electronic form, figures or tables may not be imported into your text.

Units: The use of SI units in papers is mandatory. Commonly used units may also be given in parentheses following SI units.

Abstracts : Should not usually exceed 200 words in each language.

Key words : Five or six in alphabetical order should be provided.

Acknowledgements : Include only special nature of assistance. No routine 'permissions' to be mentioned.

References : References for literature cited in the text should be given at the end of text, numbered consecutively. In the text, the reference should be indicated by a number placed above the line (superscript). If done so, the reference should be listed in that order. References should be given in the following form:

> Vilanilam J V, Science Communication and Development, Sage Publications, New Delhi, 1993.
>
> Kotler Philip and Zaltman Gerald, Social Marketing - An approach to planned social changes, *Journal of Marketing,* 35 (4), pp 3-12, 1971.

Even if a reference contains more than two authors, the names of all the authors should be given.

Unpublished papers and personal communications should not be listed in the references but should be indicated in the text, e.g. (Vijayan C K, Unpublished work), (Das Anamika, Personal Communication).

Tables: Each table should be typed on a separate sheet of paper not containing any text. Tables should be numbered consecutively and given suitable captions.

Illustrations: All illustrations should preferably be provided in camera ready form on white drawing paper suitable for reproduction without retouching and about twice the printed size to facilitate reduction.

All photographs charts and diagrams to be referred as figures(s), should be properly numbered and the captions should be provided on a separate sheet. The figure numbers should be marked on the back of the illustration along with the author's name.

In case of photographs, only originals should be provided, photocopies are not acceptable.

Manuscripts sent for publication should necessarily conform to the above guidelines.

Address: All contributions may be sent to:

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- Enjoy Indian spicy food recipes
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रावि्प्रौसंप NCSTC

PCST-2010 Secretariat

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