

# Efforts Towards Popularisation and Public Understanding of Science: A Literature Review of 30 publications

Wafia Masih

**Abstract**—This article reviews different approaches taken by scholars and researchers in popularizing science for the common people. The review considers a wide spectrum of popularization methods for bringing Scientists, Industry, Government Organizations, R&D laboratories together for creating a scientific temper by encouraging science communication and popularizing the same, on a larger portfolio.

**Keywords**- scholarly communication, researcher, science popularization, common people, scientific temper.

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## 1 SCIENCE COMMUNICATION AND PRESENTATION OF SCIENCE TO THE PUBLIC

Since prehistoric period various scholars have contributed in popularising science using various means and methods the purpose and role of science communication. Dr. A. P. J. Abdul Kalam, former President of India has written different books comprising of various topics which concern political science, democracy, science and technology, science communication etc. besides authoring chapters to a number of books. Dr. Kalam, has discussed the purpose of science and commented that the role of science communication is no longer limited by the bandwidth of communication but the imagination bandwidth of scientists. He has iterated three important tasks for the experts engaged in science communication. Dr. Kalam remarks by illustrating the induction of information of science in young minds that working in science itself is the greatest award a scientist can dream of. Through his article, he discusses the mission of science communication, need of mobile science labs in rural schools and more of such discussions are found in Abdulkalam A.P.J, (2011), 'Powerful Science Communication is an Asset to the Transformation of Societies: Science Leads to Borderless World'. Abhay Rajput, addresses the importance of science communication and science communicators. According to him, public is the ultimate consumer of scientific research, the research many a times, is funded by the public money. In this hi-tech world of S&T, a science illiterate and technologically unaware person as mentioned in his article, cannot survive or at least enjoy life to the fullest. Abhay S. D. Rajput, (2009), 'Presenting Science to the Public: Role of Scientists'. Anthony in his research identifies the

'communication gap' between scientists and the public. This gap has been an important topic to many actors, including politicians, academicians, social commentators, business leaders, scientific organizations, and scientists themselves. The articles analysis the role that technoscientific, political and the economists are performing for reducing the communication gap. One ways of reducing the gap is to face the challenge of bringing the scientists and non-scientists to interface more regularly, either in person or indirectly through media. The author refers to various research work analysis performed by leading researchers that can illuminate to improve, predict and explain what motivates scientists to communicate with the general public. Anthony D Dudo (2011), 'Pathways to the public communication of science and technology: Toward a model for scientists' popularization activity'.

A commentary from the authors who comment that the definition of science communication, review of ongoing current issues and recent research has been defined in various publications, but still the status of science communication is not certain in the right sense. The commentary considers the clarity of base and the level of developmental theories that guide formal studies. It argues that further development is needed to support science communication's complete existence as an independent discipline. Brian Trench, Massimiano Bucchi, (2010), Road Maps For The 21st-Century, "Science communication, an emerging discipline".

Karen Bultitude through her book explores the fundamental motivations behind science communication activities like why they are important and how they can be achieved. The chapter begins with an emphasis on the societal factors that lead to an increased need for the

scientists to communicate and review cultural influences at an international level. Karen has attempted to explore motivational factors for science communication at the individual, institutional and wider strategic levels. Karen Bultitude (2011), 'The Why and How of Science Communication'. In a review of literature, Michael presents an overview of science communication, an important area of mass communication. The key players like the news organizations, reporters, science information professionals, scientists and audiences were reviewed by Michael. Through his article, he also reviewed the problem of science communication which he feels is to some extent responsible for widespread science illiteracy. The article contains valuable methods suggested for improving the practice of science communication and an agenda for future research. Michael F. Weigold (2011), 'Communicating Science', A Review of Literature. In another article, Uma and Bhushan offer solutions to a healthy relation between the professions of science and journalism. Together they discuss the role of public relation professionals and their involved role in disseminating the news of science to the public. The authors have brought out the fact that without the help of scientists, public relation professionals will not be able to deliver. Uma Bhushan and Dr. K G Bhushan (2008), 'Telling Stories of Science Non-science and Nonsense: Communicating with the Lay Public'.

## **2 ANALYSING SKILLS REQUIRED FOR SCIENCE COMMUNICATION**

Tsabari and Lewenstein describe the first tool for measuring written skills by scientists in public communication of science. It includes seven areas for establishing learning goals such as clarity and language, content, knowledge organization, style, analogy, narrative, and dialogue, as well as the questions designed to assess these goals. These can serve as a base for surveying a formative assessment or evaluation. The article provides detailed criteria for analyzing the results of the instrument as well as findings from baseline data collected from science graduate and undergraduate students. Ayelet Baram-Tsabari and Bruce V. Lewenstein, (2012), 'An Instrument for Assessing Scientists' Written Skills in Public'.

Kumar, Garg and Dutt have provided an analysis from the study of about 18,224 papers published by about 3439 institutions in 445 Indian science journals. According to their investigation, major publications in 2006 came from academic institutions followed by state agriculture universities and medical colleges. The highest number of papers has been published in the discipline of agriculture, forestry, animal husbandry and fisheries followed by medical and veterinary sciences. Suresh Kumar, K C Garg

and Bharvi Dutt (2009), 'Indian Scientific Output as seen through Indian Science Abstracts'.

Tatalovic tries to connect communicating science education through science comics. For this, he analyses the existence of science comics in the past, addresses issues of lack of studies about science comics by suggesting certain possible reasons and questions that could be addressed in the future. Tatalovic examines the effect comics can have on science communication. The best way to communicate science with children is by making comic a medium of communication. Tatalovic M., (2009), 'Science comics as tools for science education and communication: a brief, exploratory study'.

## **3 NEED OF ENHANCEMENT AND CREATION OF ROLE MODELS**

Because of Nautiyal's direct involvement in some of the science communication efforts in India, he illustrates by way of analysing the current science communication or popularization scenario in India. He brings out the fact that rural people also carve for S&T information and need it as much as the rest of the people. Through his article, he discusses the need for science and technology communication, sustaining curiosity and creating role models. Chandra Mohan Nautiyal, (2008), 'A look at S&T Awareness - Enhancements in India'.

## **4 PUBLIC UNDERSTANDING OF SCIENCE**

Gauhar Raza along with Surjit Singh and Rajesh Shukla present Public Understanding of Science (PUS) as an area formed by scholars who have acquired expertise in various academic disciplines and shifted focus on a specific issue related to science-society interface. PUS in its initial stages has conducted surveys in various countries to measure the extent of scientific knowledge, probe public attitude towards science or scientists, and at times have explored the level and lack of confidence faced by common citizens in science. Surveys such as these, gradually turned into an important and regular activity in several countries that eventually led to the formation of PUS. Since 1989, NISTADS, India, has worked on methodology suitable for carrying out surveys. Gauhar Raza, Surjit Singh and Rajesh Shukla, (2009), 'Relative Cultural Distance and Public Understanding of Science'.

Wagner through his article argues that without answering questions such as why, under which conditions and in which form, the general public will understand scientific knowledge; without these questions, understanding of how public understands science, will remain incomplete. He

says, communication is ruled by social efficiency and is based on evidence from our daily life. Situations occurring in everyday life are enough for a lay person to have and occupy imaginary representation of scientific facts termed as vernacular science knowledge. These beliefs may be wrong in scientific terms but they may serve the purpose as long as they are acceptable and legal in communication with other lay people. Wolfgang Wagner (2007) "Vernacular science knowledge: its role in everyday life communication".

## 5 COMMUNICATION OF SCIENCE FROM EXPERTS

Hans in a chapter for a book states the function of science in society as the creation of special knowledge with specific scientific methodology. He says, knowledge produced in this manner is used in a number of forms namely for building scientific theories, for developing new technologies like medical therapies, weapons of war, nanomaterials etc. The problems that require scientific knowledge are discussed in public because of their relevance to policy issues, demand of collective issues, requirement to involve public for common problems etc. It is therefore important to distinguish scientists as public experts from other possible roles scientists may take in public. Hans Peter Peters, (2008), 'Scientists as public experts'.

An article by Davies describes the differences and similarities between scientific understanding of publics (SUP) and public understanding of science (PUS). It examines the ways in which publication communication is carried out by scientists and engineers, thus discusses that both public and science, are equally important. The paper includes survey details from a wide range of scientists and engineers from various research disciplines for example, biology, chemistry, physics, chemical engineering, environmental science and medical science. It also analyses the discussion between the groups on public communication and the manner in which scientist talk about the content and the purpose of science communication to the public. Sarah R Davies (2008) "Constructing Communication' Talking to Scientists About Talking to the Public'.

## 6 IMPORTANCE OF KNOWLEDGE IN SCIENCE COMMUNICATION

Park discusses arguments, a new topic on earth's creationism in America since 1960. He differentiates the 1960 period from the early 1920s anti-evolution crusade by

way of strategy, organizational base, and practice of public debates. The author discusses the beginning of the new method of spreading creationism, how they managed to manipulate the debate to serve their own cause and how the evolution defenders responded to this challenge. Hee-Joo Park, (2001), 'The creation–evolution debate: carving creationism in the public mind'. Calsamiglia and Dijk have examined properties of interface between the meaning and knowledge on the topic of sequencing of human genome in a Spanish press, El Pais (El Pais is the highest circulating daily newspaper in Spain). The article aims to study the linguistic and discursive structures of the ways in which science is written for the understanding amongst mass media. The article is in line with the study on communication of science popularization. Helena Calsamiglia and Teun A Van Dijk, (2004), 'Popularization discourse and knowledge about the genome'.

Schummer in one of his invited contributions confirms his belief in ethics as more than mere guiding practices. Science can be popularized by ethics. According to him, engineering ethic is a misguide for an emerging technology. Schummer describes three types of popularization traps that ethicists need to avoid. He also suggests ethicists to be self reflective in order to void the traps of popularization, help in making ethics a productive discipline and informs the ethicists to engage in cutting edge technology by working directly with scientists and engineers and not limit themselves only with ethicists and policy makers. Joachim Schummer (2008), 'The Popularisation of Emerging Technologies through Ethics From Nanotechnology to Synthetic Biology'. According to Bauer, the term 'public understanding of science' (PUS) has two meanings, firstly it brings science and people closer by covering a wide field of activities and secondly it refers to research that is social through which it investigates, using empirical methods, it tries to analyse the understanding of public towards science and how this can vary across time and context. Martin W. Bauer, (2008), 'Survey research on public understanding of science'.

The author Steven has reviewed a book written by Ralph O'Connor. Steven has summarized the important aspects of the book and remarked that it contains relevant questions such as, how scientists should present their findings to the public, effect of popularization of science in interpreting emerging disciplines by emphasizing on geology during the nineteenth century. The book covers the reaction by the British during the popular paleontology in the early Victorian era. Steven Newton (2010), 'Geology as Theater: The Earth on Show: Fossils and the Poetics of Popular Science, 1802–1856, by Ralph O'Connor.

## 7 SCIENCE WRITING, PRINT AND PUBLIC

Mukherjee describes a speech delivered by Joshua Lederberg, Nobel Laureate in the year 1991. The speech titled "Communication as the Root of Scientific Progress" (Lederberg 1993) indicates the significance of scholarly literature, scholarly publishing, and scholarly communication for the progress of science. The new information sought from the modern scientific research led to the development of a "knowledge society." The author emphasizes that for a knowledge driven country, it is not enough to focus on the generation of knowledge but it is equally essential to spread and share it. Bhaskar Mukherjee, (2009), "Scholarly Communication: A Journey from Print to Web". Hugh's article focuses on the textual revisions required for creating so called successful written product from scientific research articles (RA) by non-native speaker (NNS) novice researchers. The paper shows the difficulties and processes of interaction between inexperienced novice and expert RA writers of the scientific discourse community are manifested in linguistic and symbolic terms. Hugh Gosden, (1995), 'Success in Research Article Writing and Revision: A Social Constructionist Perspective'. Kouper article's focuses on one of the Digital information and communication technologies (ICTs) that have already been adopted in science communication, on science blogging. The findings from the analysis of eleven blogs are presented in an attempt to understand current practices of science blogging and to provide insight into the role of blogging in the promotion of more interactive forms of science communication. Inna Kouper, (2010), 'Science blogs and public engagement with science: practices, challenges, and opportunities'.

## 8 POPULARISATION ACROSS BORDERS

The paper identifies the role of public libraries for sustaining the initiatives of science communication. The author lists some of the problems that arise while disseminating science awareness in the country. The importance of the role from NGO's, science clubs, public libraries and initiatives by the government in spreading and enhancing the science communication activities. Jeevan V K J, (2008), 'Science Awareness through public libraries in India'. Jeevan V K J, (2008), 'Science Awareness through public libraries in India'.

The article written by Pandora signifies the attention on the realization of understanding of science in the American popular culture during the period 1815 – 1861 that is before war (antebellum era). The study compares opportunities by benefiting from the advanced state of scientific discovery by scholars in the U.S. history, American studies, literature and art history. Secondly the existence of popular science during the period before war and in the context of that environment it provides important information while

considering the variability and multiple interests in terms of politics of knowledge. The author emphasizes that a crystal clear view of the period before war will enable us to understand the development of popular science for relations between science and public graduating in the twentieth century. Katherine Pandora (2009), 'Popular Science in National and Transnational Perspective Suggestions from the American Context'. Mabe reviews communication approaches between scholars as well as researchers. The article considers viewpoints from a wide variety of scholarly communication routes and the roles they play. The author will provide a thematic method looking at the contrasting areas such as the information ecology, culture, and technology interaction, formal and informal, private and public. In addition it will consider the roles of journals and books as modes for formal communication. Michael A. Mabe, (2010), 'Scholarly Communication: A Long View'.

## 9 INTERNET, BLOG AS A POWERFUL MEDIA FOR COMMUNICATING SCIENCE

Panigrapy highlights the problems of scientists towards science communication for example, lack of enthusiasm to interact with the general masses and the public, differing views on scientific facts and findings, academic background of journalists an eligibility for writing science, ignorance of communicating the scientific knowledge by the scientists. The author argues that the scientists owe a duty to the public to explain their research directly or indirectly, since they get paid from tax payers for their research funds. The author feels that due to the development of science in interdisciplinary areas, it has become difficult to identify the core inter-disciplinary areas. Some of the hurdles in India are due to mass illiteracy and declining interest in science in the upper strata of society as a result there is no significant increase in science coverage in the Indian national dailies. The author terms this as a transitory phase and feels that the presence of internet as a media will help in strengthening science. Nikhilanand Panigrapy (2008), 'Reflections on Science Communication'. Web and academic literature consists of scientific discourse. The discussion in the literature influences the discussion on the web and vice versa. The study of the discourse has largely been isolated based on medium either using bibliometrics for academic literature or webometrics for web based communication. The study focuses on a set of 295 chemistry blog posts about peer-reviewed research. Based on bibliometric maps, we provide evidence that scientific discourse on the Web is more immediate, contextually relevant and has a larger non-technical focus than the academic literature. Paul Groth, Thomas Gurney, (2010), 'Studying Scientific Discourse on the Web Using Bibliometrics: A Chemistry Blogging Case Study'.



## 10 SCIENCE COMMUNICATION IN THE PAST AND INFRASTRUCTURAL DEVELOPMENT

Radhakrishnan recalls one of Nehru's book that he had read in the past titled 'The discovery of India'. He describes the problems undergone by Pandit Nehru and Gandhiji. The author describes the hardships Nehru faced during the British government in the year 1942 to 1945. The paper describes the nostalgic journey of the past which unfolds the charismatic role of science and scientific leaders with Nehru. Radhakrishnan B P, (2009), 'Nehru's 'Discovery of India' The Role of Science in India's Development'. Kumar in his paper describes the role of the government's objective to exploit the natural resources and available traditional knowledge from various communities across the map, as scientific tool for the inclusive growth. He says, Indian conservationists, scientists and rural communities have joined hands to promote conservation through science and technology. The scientist and government institution hold discussion at various platforms about the impact of using ICTs such as cell phones, global information system (GIS), global positioning system (GPS), cameras, and two way radios to promote conservation and development. The flagship programme like Bharat Nirman and NREGA has been engineered for the sharing of scientific infrastructure and R&D outcome in the national laboratories. Rajesh Kumar (2009-10), 'Scientific Infrastructure for Inclusive Growth'.

## 11 CONCLUSION

Though work on science popularisation is being carried out world-wide, it is still found to be less than the total recorded research found in scholarly journals. Scientific discoveries outnumber popularising these discoveries in other words; more emphasis must be given to bring in trained science communicators in all scientific institutions and laboratories where work on scientific discoveries is taking place. The need to press on non scientific articles from scientific discoveries must be taken as a serious concern by the policy makers. The gap between scientific discovery and popularising that discovery should be reduced. Doing this, will encourage a revolutionary change not only in the mind sets of people but it will also benefit the economic policies, government politics, literacy ration, difference of opinion, political environment, inflation and much more besides creating a paradigm shift in corrosive factors like pollution, fuel, energy etc.

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About the Author-Ms.Wafia Masih, Research Scholar, JJT  
University, Rajasthan.