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Scientific Literacy in Public: Another Look at Science Education and Communication and its Relationship to Society

Isak Rajjak Shaikh^{†*}

[†] University of Glasgow, Glasgow G12 8QQ, Lanarkshire, United Kingdom

* Address for Correspondence: Razak Institution of Skills, Education and Research, (RISER),
722, Shrinagar, Nanded – 431 605, Maharashtra State, India. E-mail: <isak.rajjak@gmail.com>

Abstract:

The society is bit passive and dependent on scientists and local policy makers when it comes to discussing science and its advancements. Though some people appreciate the ‘knowledge of science and technology’ and recognize that scientific advancements could account for changes in life-style and overall well-being by overcoming great challenges including socio-economic and strategic ones, the public, in general, do not understand how science works; what its implications are, what to choose in science education, etc. Understanding the nature of science and the translation of the science research for the public and or the non-expert audience is a challenging task. Science educators can achieve *science literacy* in the public through regular dialogues and the science communicators can motivate the people and awaken public’s interest in science. Herein, the author proposes public engagement activities that make science accessible to the non-experts and provide them with open platforms for reforming foundations for their knowledge of scientific activities and relevant policy developments where they can critically voice their perspectives on contemporary science education, practice and policies. Good science education and its applications offer something new to the society: new information or just a new way of looking at well-known facts.

* Address of the corresponding author; [†] Please refer to the acknowledgement

Introduction

Science plays a substantial role in our lives. Its knowledge and technology steadily increased over the centuries. The technologies were continuously modified and refined and, as a result, science became more manifold and powerful. There was this industrial revolution taken place in the western countries, when people appreciated the terms ‘science’ and ‘technology,’ recognizing that scientific developments could account for changes in life-style and overall well-being. During the World Wars, the world experienced use of science and technology for destructive purposes. Nowadays, energy and climate crises around the world demand a need for sustainable science more than ever before. Scientific advancements could help us overcome great socio-economic and strategic challenges for our basic needs, environment, defense, fuel and energy, medicines, etc. We practise science for some centuries now; but the importance of *science education* was understood only in the 20th century.

Science, Education and Society

The society has become bit passive and dependent on scientists and policy makers when it comes to discussing science and its advancements. Because the public do not understand how science works; how to choose science; why it is necessary; what its implications are, etc. It is therefore inevitable to educate ourselves with science and look for useful methods of education and communication.¹ This involves a relationship of educators with people in order to achieve understanding through knowledge. The translation of the science research for the public and or the non-expert audience is a challenging task. Understanding the nature of science is useful for the science literacy.²⁻³ Communicating science and technology and educating people with foundations of science are relevant to the dissemination of knowledge. Educators explore various

forms of formal, informal and non-formal learning to better understand the science and promote its awareness for the scale of research and technological developments. In 2007, Falk, Storksdieck and Dierking pointed out that less attention has been paid on science with informal learning.⁴ Herein, we realize different forms that science education can take, and the contexts in which it takes place. Although science education is subjective, research suggests that ‘science communication’ and ‘implications of science education’ are meant to be object oriented processes. Many school students find science courses difficult to enjoy and so they fail in their examinations. It is not always due to the complex nature of science, but because of the way it is presented to them. Teachers generally present science as universal set of rules. Usually a science curriculum in educational institutions is designed by policy makers, and the local community. It is understood that students are always taught a part of science because of the constraints of time and the vast nature of the topic.⁵ Research was undertaken on what *ideas-about-science* should be taught in schools.⁶ It was widely accepted that there is a need for more inclusive education and communication methods especially to cover people from all sectors of society.⁷ The *Public Understanding of Science* implies to the assumption that non-scientist public lack in scientific knowledge. *Scientific literacy* (Hurd 1958) generally refers to describe a desired familiarity with science on the part of the public.⁸ The term *science communication* is only born few decades ago, and is an unexplored area of research. The two well-known journals are: *Public Understanding of Science* and *Science Communication*. A scientist communicating to other scientists, for example through scholarly journals, is a form of science communication. *Science communication* emphasizes ‘*public engagement*’ activities and more likely respects non-scientist’s own knowledge. This advocates bringing scientists in publics to talk with each other. Most of the times, *science communication* refers to use of media talking science with non-expert audience.

Researchers in this field come from diverse backgrounds, such as: science, technology, engineering, maths, sociology, psychology, media studies, the history of science, etc. Science communication is a controversial academic and or professional discipline, as this requires inter-professional skills and often norms and interests of a multitude of groups bustle for dominance; e.g. communicators often face philosophical questions on the nature of democracy, and scientific realism. Bruce V. Lewenstein (in 2003) reported the motivations, strengths, and challenges associated with different approaches of public communication of science.⁹ Different perspectives on public communication can lead to different activities and achievements. Herein, the author's purpose is to change people's attitude and or to provide proposals that will help them make better decisions about the education of science and its applications in their lives. Good science education offers something new to the society: new information or just a new way of looking at well-known facts.

Sources of science

Literature is one of the best means to receive science. Quality journals publishing original piece of scientific research apply a system called as 'peer review.' These major science journals are focused more narrowly on a scientific field. Scientific journal articles use a style of academic writing which is quite different from the science news writing. Some multidisciplinary journals and books are also good places to look for interesting science and feature ideas. Science journalists, especially those working on news television channels, and newspapers, cover a wide range of science; often covering different subjects on mostly the weekly or daily basis. While they have a good idea of what makes an interesting story, they are not experts in all fields of science. Many institutions routinely send out news releases, from University press, to non-profit

and non-governmental as well as industrial organisations. Scientific conferences and meetings offer cutting-edge research and developments. Nowadays the organisers prefer media coverage to the fullest.

Mission statement for science in public

By working with the society, we expect to increase awareness and enhance the level of informed debate in science issues and contribute to the development of enabling technologies, products, devices and ideas. This will consequently develop a cadre of high-quality researchers and achieve significant advances in the generation of new knowledge.

The models of communication in developed countries

As until 1985, experts used to refer science communication as a simple matter of instruction.¹³ This ‘deficit model’ (Royal Society UK 1985, Wynne 1991) of science communication was replaced by a ‘dialogue’ between experts to influence scientific policy and practice (Demos 2004).^{13 & 14} Later approach took participation model one step further, in which the need for dialogue was emphasised, not only to influence the practices of government, but also to influence actions chosen by the local communities. The Public Understanding of Science as described by Geoffery Thomas and John Durant gives the various intellectual, aesthetic, and moral benefits to science, national economy, democratic government, individuals, and thus the society as a whole.¹¹

In America, Miller’s work highlighted four different attributes of scientific literacy and placed more importance on public’s knowledge of basic scientific textbooks, methodologies, rejection

of numerology/astrology by cultivating positive attitudes towards science.¹² Gregory, Jane & Steve Miller (1998) focused society on understanding the intended learning outcomes:

- Definition of science? what scientists are trying to achieve
- the components, principles (philosophy) and methods of science (practical)
- ... so that one can distinguish between science, non-science and pseudoscience
- how and why real science practice differs from the ideal
- the shifts from positivism to critical realism
- what makes something not science / pseudo science
- how to critique science (methodological critique)
- the limits of scientific enquiry (e.g. morality, ethics, etc.)
- Epistemology: what is “truth” or knowledge?; the connection between philosophy and empiricism in science; Conceptual distinctions, theories, relationships, mechanisms to understand or explain nature/world

Educational reforms by the National Academy of Science, USA in 1995 suggested that “students at all levels should enjoy scientific inquiry and develop their ability to think and act in the ways associated with scientific inquiry.” Science education and science communication in relation to the society shaped parts of this essay.

Project methodology

Educators are the key to any project’s success. Science teachers can generate the curiosity and thus encourage the young to choose science as their subject of study. They will reach out and talk with students, teachers and parents. The communicators will serve as a ‘bridge’ to dialogue

among all sectors of the society. Educators will explore science education in formal, non-formal and in-formal ways. They will additionally provide educators with feedback that will guide them formulate curriculum to suit the various needs of the different sectors of society including the non-expert publics. In the due course, all will exchange knowledge and exercise their interpersonal skills for the standardisation of science education. It has always been a challenge for scientists to do science well and communicate their findings and their dedication for the subject to a wide audience. They should be able to guide the educators and non-expert public to a better understanding of the basic principles of scientific developments. I plan to use a non-profit organization for the cause of science education where different tools of communication can be employed to get in touch with the society.

Tools of Communication:

- Informative visualisations / exhibitions
- Public engagement: Science educators and communicators working hand-in-hand
- A website with information on science and technology

Effective communications are through traditional presentation techniques as well as studying the latest developments on the web, in sound and video production. The website contains multimedia with information complimenting the news and views about science. In this way, we combine the ‘deficit’ and the ‘dialogue’ model of science communication.¹⁰ New knowledge will be delivered to the people. The people will also have the opportunity connect with scientists and experts working in the field of science and technology. Science teaching resources would be made available on the websites and carrying information about teaching strategy, teaching and learning tips, learning psychology, practicals, etc. Particularly for the young, science and modernity are

inseparable, and technology is a culture because we think of no development without intellectual enrichment. The practical aspect of effective communication is through skills that explain the techniques and get the people to improve by doing. In an essay on science's contemporary audiences, Susana Hornig Priest (2009) concluded that science communication might be to help non-scientists feel they are not excluded.⁹ The website will be regularly updated with news and views; concerns and questions will then be answered by teachers and or science experts. We should enable young people access cutting-edge science & technology and support teachers in delivering intellectually stimulating science education to help all stay in touch with developments. Excursions or short trips could be organized to dedicated laboratory and Media and Web teaching facilities on the School /University and industrial campuses. Science communicators use their writing skills to make people aware of science and technology through books, and journal articles. They use media and develop exciting science programmes. Some journalists interview experts for radio, TV or a newspaper. For effective science communication, we can run public lectures, conferences, courses and workshops for many groups, including scientists, historians, teachers, professionals and policymakers. Our efforts will also provide practical training in the latest scientific research techniques and communication tools for students, researchers, academicians, and public. We can show different facts about our cause in a broad, interdisciplinary perspective. For example such issues could be:

- Activist groups and scientists clash over science policy (such as issues of genetically-modified-food, cloning, etc.)
- Science of new technologies, fuels, nuclear energy, etc.
- Environmental science and climate changes

Proper implementation of science literacy requires a lot of different resources and skills. We consider ourselves as a bridge between the world of science and the public. We aim to target the general public, but it is obvious that the public are heterogeneous in nature. We choose to focus on three main social contexts and categorise target audience: students (children), adult folks (or parents), and teachers. We will use these groups as tools to communicate broader ideas and promote certain attitudes:

- Their connection within social structure
- The future and foundation of a society lies on youngsters
- Their opinions and or feedback on science education and communication

Most of the times, we find lower working class being busy with their needs of “bread and-butter” and not really participating in science awareness from so-called elite groups. And so in order to practise science in their lifestyle, a long preparation should be done. This can be started by reaching out the parents from various class backgrounds.¹⁴ Parents-Teacher gatherings will boost this endeavour. While dealing with children and primary and or secondary students, we should focus on mainly three areas: the Parent-Teacher Get-Together type events; the collaborations among schools, colleges, universities to research laboratories; organisations of public lectures, conferences, exhibitions, science fairs, with the help of City Council Libraries, Community Centres, Governmental and or non-governmental organisations.

The purpose is to demonstrate public an understanding of the interaction between different types of science communication and relate these to their own professional context. Though I am aware of the key cultural, financial, ideological, inter-cultural and political influences on science

education and communication, I am keen on strengthening current conceptual stage of this project, which of course, is not without constraints. It is in the best interest to focus on the main goal, and keep some factors external to it. We know that many of the issues and concerns exist due to the heterogeneous nature of the society. In the present phase of planning, I prefer to take an account of plausible pitfalls and consider areas of improvement. There have been various science fairs, awareness campaigns worldwide. For example: Currently the UN or other equivalent bodies name each year with some cause or motivation. Year 2009 was dedicated to Astronomy and the year 2011 is declared as the “Chemistry Year.” This includes some motivation and information on awareness of science.

Science fair, events, and television shows such as quiz, advertisements, and events use the *deficit model* to communicate with the public. The shows clearly aimed at parents-children interactions and teachers-students associations are encouraged, and also have high possibilities of success. It is the best to add some dialogue to this project, where the newcomers and amateur science students are able to learn from trustworthy sources and ask questions to someone in their vicinity. Though our activities will have budget constraints, we must not fail to motivate the people in investing their time on science education and willingly access the scientific information available on libraries and the web.

Conclusion

My understanding of the science literacy in public is that people should be encouraged to critically voice their perspectives on contemporary science education, practice and policies. I believe that through dialogue, the educators will achieve *science literacy* in the public. In

principle, the communicators will motivate the people and awaken public's interest in science. This perspective on the science education and importance of science communication covers almost all age-groups, and different socio-economic groups. The activities proposed herein are in-line with the contemporary definition of *science communication* given by Burns et al. (2003). This provides a platform to the public for reforming foundations for their knowledge of scientific activities and relevant policy developments.

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