

SCIENCE COMMUNICATION AND CITIZEN SCIENCE: HOW DEAD IS THE DEFICIT MODEL?

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Abstract

What are the assumptions that underlie the increasingly frequent references in discussion of science communication to two-way communication, dialogue and engagement? Terminology has shifted from 'public understanding' to 'public engagement', but do the dominant discourses and practices of science communication reflect a model of communication that is authentically contextual and participatory, and thus oriented to stronger scientific citizenship?

These are central questions in this paper, which notes that the critique of one-way, top-down approaches to communication was available for some decades before it was acknowledged in science communication. However, as science communication has matured, it has been increasingly able to recognise its connections with, and debts to, disciplines such as communication studies and sociology and it is argued that these developments have strengthened rather than weakened science communication, both as professional practice and as academic discipline.

Based on a review of the strategies of selected scientific institutions and government initiatives, it is argued that a deficit model remains the default position of scientists in their public activities and underpins much of what is proposed by public officials in their promotion of science. Approaches based on a deficit model also characterise many of the initiatives presented and discussed in science communication fora. It is argued that the policy framework of the 'knowledge society' has reinforced this previously existing tendency and that more critical approaches to science communication could contribute to fuller citizen engagement with science-based issues.

Keywords: communication models; deficit model; science critic

After many years of examining and devising methods and tools for communicating science with various publics, science communicators have only relatively recently concentrated attention on deeper-lying factors that shape public communication of science. Over the past five years, in particular, we have been witness to a remarkable ferment of ideas and propositions about science communication. This has been reflected in the proliferation of buzzwords around these activities and, in particular, the increasingly frequent references to concepts of two-way communication. It appears to be widely accepted that "public understanding of science" and "public awareness" are too restrictive; "public engagement" is now a standard reference, representing a commitment to dialogue. The larger framework of science and society now requires account to be taken of many complex dimensions of communication.

What has been driving this process? Is it based on the broadening experience of scientists in the public sphere, and on their critical reflections on that experience? This may well be a part of the explanation but it may also be a demonstration that the more "the public" knows about contemporary science, the less certain is its acceptance of science's applications. Equally, the more scientists engage with the public, the less certain are the outcomes of such engagement.

It is in these contexts of increasing complexity and uncertainty in public communication of science and of changing science-and-society relations that I want to focus on how scientists discuss and prepare for public communication and on the models of communication that underlie their participation in such communication. I take models of communication to refer to the implicit constitution of relations between participants in the communication process, and to the shaping of strategies and tactics adopted in particular communicative acts.

A superficial version of what has happened in recent years – in Britain, in particular – is that scientists and their organisations have tuned out of the publicly discredited deficit model of communication, and

into a dialogue model, that encompasses active listening as well as talking. A linear model has been replaced by a two-way, mutual, or reciprocal, model. Science communication is now contextual, participatory, and democratic.

But it is, at best, an implausible proposition that cultural change among a broad, differentiated set of social groups (“scientists”) might be so neat. What has undoubtedly changed is the language of policy bodies, research councils, and other funding agencies. The good practice guides, the science communication training, and, in some cases, the research funding contracts of such agencies speak of dialogue around the social implications of scientific research. The shift from “public understanding” to “public engagement”, and the attention to the nuanced difference of “science and society” and “science in society” do reflect heightened awareness of the challenges of public communication of science.

However, it was already the case in the late 1990s that the British research council for the life sciences, BBSRC, had “a programme of activities designed to enhance public access to science and scientists with a view to improving public confidence, and stimulating open debate about science and technology”. The council said its activities were increasingly about “mutuality” and “transparency in the way BBSRC interacts with the public”. Thus, a dialogue-based approach was being articulated for some years before it came to form the main thread of the House of Lords report, *Science and Society* in 2000, although this publication is often represented as a watershed or turning point.

The supposed shift was neither a radical new beginning nor comprehensive. The Guidelines on Health and Science Communication, produced in 2001 with active promotion from the Royal Institution and Royal Society propose essentially a linear, transmission model of communication from experts to the public, via the media. Nor is the supposed shift uniformly supported: scientists surveyed on public communication draw the line at public participation in assigning of research priorities [1].

Sociologist Brian Wynne, to whom we owe the original identification of the dominant science communication paradigm as the “deficit model”, is co-author of a recent pamphlet that argues that the deficit model has “reappeared” and that the discussion of public dialogue, engagement and participation in and around science should properly be one of “the codes, values and norms that govern scientific practice”. It is, in other words, about the culture of science, and the “challenge of building more reflective capacity into the practice of science. As well as bringing the public into new conversations with science, we need to bring out the public within the scientist – by enabling scientists to reflect on the social and ethical dimensions of their work” [2].

The deficit model even has new practitioners and advocates within and around the scientific communities. In Britain, over recent years, several groups have emerged that argue for a scientific approach to current controversies in a manner that representative organisations of scientists would likely find excessively elitist. These neo-rationalist groups, such as Institute of Ideas and Sense About Science, and the initiatives they influence such as Science Media Centre and Social Issues Research Centre, propose themselves as the champions of scientific and rational thought in the face of fuzzy thinking or anti-science tendencies. In many parts of the developing world too, where there are high hopes for the solutions that science may bring to deep-seated problems, the dominant science communication strategies are based on a deficit model. In these cases, however, the practices may be nuanced by reference to local and cultural contexts; where some propose an enlightenment approach in the face of superstition, others seek to work out forms of engagement that take account of indigenous culture and knowledge.

Scientists’ discussions of, and approaches to, public activities indicate that a deficit model, or models, remain the default position of many scientists, including of many of those active in the public sphere. The dominant response in many quarters to the public credibility crisis of science has been to advocate even more grimly than before the merits of science, and of careers and studies in science. When so many initiatives proclaim that science is fun, science is exciting, and science is rewarding, we know that scientists perceive their enterprise to be in some way threatened. The version of the deficit model that is then applied has been helpfully characterised as a “defence model”.

However, scientists’ discussions of these matters also indicate that many scientists appreciate that the choices of communication model are more complex than a simple contrast between one-way and two-way, or deficit and dialogue, suggests. Scientists and their professional organisations can call on a number of communication models to underpin various modes or registers of public communication. These range from imperatives about educating various publics about sciences and persuading them about its benefits, through statements about a moral responsibility to engage with the public, to propositions about possibly learning about science itself through the insights of others.

In a paper to PCST6, Kirk Junker and I proposed that this range of options corresponded with a spectrum of communication models that we named, in emphasis on public participation, Deficit, Dissemination, Duty, Dialogue, Deference. They are not necessarily of equal bandwidth: Dissemination and Duty are close to each other; they underpin public information activities undertaken as a matter of course, or of social responsibility. The suggested Deference model referred to a model of communication in which scientists acknowledge the value of, or “defer” to, the insights of various non-scientists on science and its social meaning. They “defer” to intellectual disciplines and cultural activities other than their own, and to the inputs of “lay experts”. The inclusion in scientific journals (including *Nature*, over many years) of features on science in culture, or science and art, reflects awareness in at least part of the scientific communities that science finds its significance by reference to other cultural practices. Reflecting on his presidency of the Institute of Physics and on his own journey from “an extreme view of physics” to an acknowledgement of the influence of social scientists on his understanding of the place of physics in society, David Wallace wrote that “even the widest gulf may be narrowed with a little humility” (*Physics World*, May 2003).

Junker and I based our analysis on a review of magazines and journals published by and for various scientific communities in Britain and the United States. Examining contributions to these publications – including features, editorials and correspondence – allowed us, we argued, to see behind the scenes how scientists script and rehearse for public performance. In some sense, therefore, we can by this method better understand “the codes, values and norms that govern scientific practice” [1]. It may be that the five-band spectrum is too cumbersome an analytical or explanatory tool. It may be more appropriate to identify three principal models, each with its variants, and each with its reference to already available analysis and discussion [3]:

Deficit (including Deference)

Dialogue (including Duty, but also Context, as in strategies and analyses that consider the social and cultural settings of communication)

Participation (encompassing Deference)

At the risk of excessive simplification, we might say that these represent one-way, two-way and three-way models. The first two are essentially linear, and the last-named is multi-directional in that it considers and contains the communication between and among publics as well as the communication back and forth between experts and publics. All three will continue to have their specific applications in particular circumstances and, indeed, the deficit model has its conscious advocates as well as its default adopters [4]. However, in the context of discussions of scientific citizenship and citizen science the emphasis necessarily shifts to bi- and multi-directional communication.

Returning to the analysis of scientists’ own models and reviewing more recent editions of two professional publications, *Chemistry in Britain* (now *Chemistry World*) and *Physics World*, the picture painted in 2001 is largely confirmed but the simplified framework appears adequate to give an account of the differences within and between scientific communities: *Physics World* is much more actively interested in science and society (and culture) issues than *Chemistry World*; its coverage is markedly weighted towards Dialogue and Participation, whereas *Chemistry World*’s is oriented strongly towards the Deficit part of the spectrum. This difference is encapsulated in the contrast between the largely instrumental view of a *Chemistry World* feature (December 2003) on mechanisms and resources for public displays, and a *Physics World* feature (October 2003) on science and society issues that focuses on audiences. The chief executive of the RSC writes in defensive mode (*Chemistry World*, Comment, September 2002) that “we need to enhance our image to ensure that the skill base is not further eroded”. The editor of *Physics World* reviews more open-mindedly (November 2002) how contemporary novelists incorporate scientific ideas and images into their work, and regular contributor Robert P Crease advises readers (October 2003) dealing with the media that “behaviour that might appear as a sign of caution, concern or integrity to another scientist can be regarded as arrogant, threatening or dangerous to a non-scientist”.

The differences between publications, and the differences over time, could be the result of quirks of editorial personnel but they do also seem to point to differences between the dominant cultures of the respective disciplines. British chemists present themselves as strongly threatened, facing a hostile public and media, and having a desperate need to boost interest in the study of chemistry. A retired chemistry teacher writes (*Chemistry World*, Comment, February 2002) that “in recent years the ‘what’s the use of learning this?’ attitude became more common, reinforced by negative images and ideas picked up from the media and from relatives and friends”. From this perspective, the problem is always in “the public” or “society”, and the solution is to be found in more effective strategies by experts. The

remaining influence of that approach is confirmed when we review the current stated positions of British-based scientific societies. The general-science bodies have stronger commitments to public engagement in general, and to dialogue-based approaches in particular. Within the individual disciplinary areas, chemistry is the least strongly oriented in that direction.

The Royal Institution “prides itself on its reputation for engaging the public in scientific debate” and the Royal Society seeks to “involve the public in learning about and debating UK science ... to develop a widespread, innovative and effective system of dialogue with society ... [and] to take account of the values and attitudes of the public”.

The Institute of Physics is committed to raising the public's awareness of physics and its applications, the role of physicists and the relevance of physics in everyday life. The Institute of Biology “speaks as the voice of British biology, promoting biology and representing the views of bioscientists in the commercial world, in academia and in the political arena”, and the Biochemical Society engages in policy work by “providing information and advice to the government, media, and the public”. But the Royal Society of Chemistry (RSC) declares its aim to “enhance the perception of the RSC and the role of chemical science amongst our members, the wider science community and the public”.

What these statements, and the review of professional periodicals, make clear is that much of the performance of and proposals for public communication remain based on a barely reconstructed deficit model. Surveys confirm that a priority aim for those involved in science communication is to promote a positive attitude to science.

External influences, as much as internal processes, determine whether and how scientists and their organisations communicate in more open and responsive ways. A story from Ireland will serve to illustrate the influence of external factors in the positions taken by scientists on public communication: in 1999, the Health and Life Science panel of a technology foresight exercise advocated the establishment of a national biotechnology investment programme and, at the same time, the initiation of “the Irish national conversation on biotechnology”, namely, “ongoing, transparent and open dialogue” on social, environmental, ethical and safety aspects of technological developments.

A national biotechnology investment programme was, indeed, started soon afterwards with the establishment of Science Foundation Ireland (SFI) but, despite the very visible example of the Human Genome Project and its support for research on ethical, legal and social issues arising from genetic science, SFI made no commitment to such research or to facilitating a “national conversation”. A civil service report to government on biotechnology in 2000 proposed that various forms of face-to-face and mediated public information and consultation should be tried, mentioning specifically citizen juries and participative technology assessment. Only its proposal for a web-based information service on biotechnology was implemented, and, for a few years, biotechinfo.ie published stories in accessible style and fielded questions and comments from site visitors. In 2004, the site was quietly closed down. No other elements of the national conversation had begun. In a 2005 publication, *Science and Ireland – Value for Society*, geneticist David McConnell, recalling his key role in the development of policy on biotechnology, concentrated on the research investment and its wider economic effects, to the complete exclusion of social aspects, or public dialogue, although he was the originator of the “national conversation” proposal.

What this suggests is that without clearly expressed demand from the public or from citizen groups scientists and the public officials working most closely with them feel no need to converse in public and with the public. It does not come spontaneously and the relative weakness, in Ireland, of public demand for such participation is one of the external factors shaping scientists’ approach to public communication. But the major such factor must be the national policy commitment to a knowledge economy. In Britain and Ireland this commitment has been articulated in ways that restrict the discussion and validation of science very largely to its economic function, as a contributor to the generation of wealth and employment. As I argued at PCST8, the commitment to “the knowledge society” represents a hollow victory for the science communication movement in that it makes the voice of science heard and its value recognised but obscures science’s cultural and social value, and science communication’s possible contribution to facilitating broad social access, balanced dialogue, and cultural completeness. The dominant discourses of the knowledge society and knowledge economy may be promoting a new social separation of science but, as we have seen, scientists have adapted easily to this congenial environment.

Among analysts and educators in science communication some of the same tendencies manifest themselves as in the scientific communities, reflecting both the origins of science communication in the scientific communities and the relative immaturity of the discipline. Very many of the early

practitioners, instructors, or analysts of science communication came from a background in the natural sciences. In many cases, they had acquired additional knowledge and skills, either through immersion in practice, or – less frequently – through formal study. In the case of science journalism, a specialism that grew in strength and presence alongside the broader field of science communication, a background in the natural sciences was for a long time – and is still, in some quarters – taken as an entry requirement.

In more recent times, as the interest in science communication has grown, the range of that interest has also broadened, and the influence of that rootedness in the natural sciences has weakened. This has been both cause and effect of the growing maturity of the discipline. The early stages of development were marked by defensiveness and protectiveness and science communication sought to define itself as distinct and different. This has tended to obscure how much is shared with those in longer-established disciplines such as history of science, philosophy of science, science education, sociology of science, mass communication, journalism and cultural studies.

Science communication had to re-run the history of communication theory, in shortened time, to recognise the limits of engineering-derived models of communication (sender-channel-receiver). Science communication needed the contribution of sociologists to identify the limits of prevailing models of science communication and the need for a contextual approach to the study of science communication practices. As science communication has matured, it has found it possible to recognise these commonalities and connections. Its area of operation has also grown, necessarily bringing it into contact with neighbours and relatives. Its appeal and relevance have attracted an increasing number of contributions from those of different backgrounds. All of these developments have strengthened rather than weakened science communication, as professional practice and as academic discipline.

There are some still who seek to defend the uniqueness of science communication. Burns and colleagues (2003) insist on the special character of science communication; their starting point is that science communication is not “an offshoot of the discipline of communications” [5]. Their end-point is a definition of science communication in terms of its purposes and effectiveness. Such a narrowly programmatic approach risks obscuring the rich insights to be gained from the careful observation and systematic analysis of the diverse ways in which society talks about science.

The ‘transmission’ approach has influenced many studies of science news, particularly in the earlier years of the science communication movement. When I reviewed science news studies published in the journal, *Public Understanding of Science*, in 1992-96, I found that “an implicit or explicit comparison with formal science writing has informed the hypotheses or research questions which are the points of departure of many science news analyses. Hypotheses may be presented in terms of reporters doing one thing ‘rather than’ another, or going in one direction ‘at the expense of’ or ‘instead of’ another; the option rejected, or not taken, is implied in all cases to be superior” [6].

The tendency to examine mass media communication by normative reference to standards of accuracy, correct usage, or appropriate context, represents an application of a deficit model in the analysis of science communication. It has undoubtedly weakened in favour of more fully contextual approaches that take account of the specific constraints of media production and consumption, but it remains strong, and can be found, for example, in contributions to recent PCST conferences.

In a critique of dominant science communication models Dutch analyst Lucien Hanssen makes a comparison with reception of art, observing that works of art cannot be processed intellectually by means of “linear thought transmission”. Communication, he urges, should focus on uncertainties and on the concerns and fears among the public. “The exact meaning of scientific research can only be clarified on the basis of dialogue with a broad range of social actors” [7].

Also exploring the comparison with the arts, Jean-Marc Lévy-Leblond observes that a distinction between science and other cultural pursuits is that science does not have public critics; he has both described and practised this role [8]. The media’s role as science critic was already advocated in Britain in the 1980s by Maurice Goldsmith [9]. British neuroscientist Steven Rose turned the usual scientist’s complaint – and, indeed, the deficit model – on its head in a speech to the Edinburgh Science Festival (July 2004) when he argued that the media should be “more critical, less sycophantic” [10]. The media are “far too deferential to claims of scientific expertise”, he stated, and he drew the analogy with theatre critics in observing that “far too few of those who report the news know enough to treat us [the scientists] as they would do artists or politicians”. Rose insisted “there are a multitude of sciences and a multitude of publics”.

Approaches to science communication based on concepts of social negotiation of meaning and of science critique offer the possibility of a real engagement with and by the publics. Scientific citizenship that is measured in terms of literacy or awareness is passive. To be worthy of the name, scientific citizenship is based on participation and is active. A greater willingness within science communities to acknowledge openly uncertainties and limits of science, in other words, reflexivity and the capacity for self-critique, would help create conditions for citizen science and scientific citizenship.

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