Science & Society

EMBO reports

Thinking outside the 'knowledge deficit' box

Scientists could achieve more fulfilled professional lives by embracing the skills needed for effective interaction with the public

Chantal Pouliot[1] & Julie Godbout[2]

The professional activities of scientists are demanding and varied. In addition to their research activities, scientists are expected to be able to interact successfully with citizens to inform, consult, or, more rarely, work with them. In this article, we propose that the traditional model of communication itself—hereafter called the 'deficit model'—makes scientist uncomfortable with this societal role and, as a consequence, makes them reluctant to actively engage with the public. In order to break down such barriers, we suggest complementing the skills of scientists with knowledge and experience from the social sciences fields that examine the relationships between science and society, namely Public Understanding of Science (PUS) and Science and Technology Studies (STS).

There is a tendency in the scientific community to think that citizens suffer from a deficit of knowledge and are incapable of grasping the complexity of science. As such, scientists believe that the public are in need of education. Such attitudes, implemented in the so-called 'knowledge deficit' model of science communication (Fig 1), prevail, despite sociological studies that have demonstrated that citizens are able to understand both the complexity of research and the uncertainties accompanying many technological and scientific developments. We therefore argue that familiarizing scientists with the work of researchers in PUS and STS would enable them—including those who work outside academia—to become better attuned to the current needs of society and thereby benefit professionally.

Our suggestion is timely. On the one hand, the majority of today's graduate students will not go on to an academic position, but will instead work for industry, private research institutes, government agencies or international organizations and institution. In the USA, for example, fewer than 25% of PhDs obtain a faculty position within 5 years of graduation [1]. Thus, academic and government representatives in Canada, the USA and Europe have begun to explore ways to better align academic curricula with societal needs and employment opportunities. On the other hand, there is an ongoing crisis of public trust in both scientific advice and political representation; at the same time, scientists are increasingly called on to give their opinion in the public sphere, which many of them see as a burden.

> *"There is a tendency in the scientific community to think that citizens suffer from a deficit of knowledge and are incapable of grasping the complexity of science."*

Various models of interaction and communication between citizens and scientists have been developed [2] (Fig 1), and the feasibility of each alternative model has been documented in PUS and STS studies. The alternatives described below improve on the deficit model, as they enable proper public debate of science and give all parties the opportunity to express their opinions, exchange knowledge and clear up misunderstandings. Connecting scientist with those approaches could help to meet the social need of engaging them in the debates about issues that are of interest and concern to citizens.

> *"The alternatives [. . .] enable proper public debate of science and give all parties the opportunity to express their opinions, exchange knowledge and clear up misunderstandings."*

The 'public debate' model, then, considers that non-scientific knowledge from citizens is enriching for the definition of research challenges and the application of scientific knowledge. The 'co-production of knowledge' model takes this idea further and posits that citizens have both pertinent experience and competence to participate in defining social and technological issues and that they should be involved in forming 'research collectives' and producing legitimate knowledge. Of the three models mentioned, this last ascribes the greatest legitimacy to the knowledge of citizens, which is discredited outright in the deficit model. Cases in which patient groups have gotten involved in research on neuromuscular disorders, AIDS or the health effects of hazardous waste are examples of co-produced scientific knowledge [3].

1 Département d'études sur l'enseignement et l'apprentissage, Faculté des sciences de l'éducation, Pavillon des Sciences de l'éducation, Université Laval, Québec, Canada
2 Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre, Sainte-Foy, Québec, Canada. E-mail: chantal.pouliot@fse.ulaval.ca
DOI 10.15252/embr.201438590 | Published online 3 July 2014

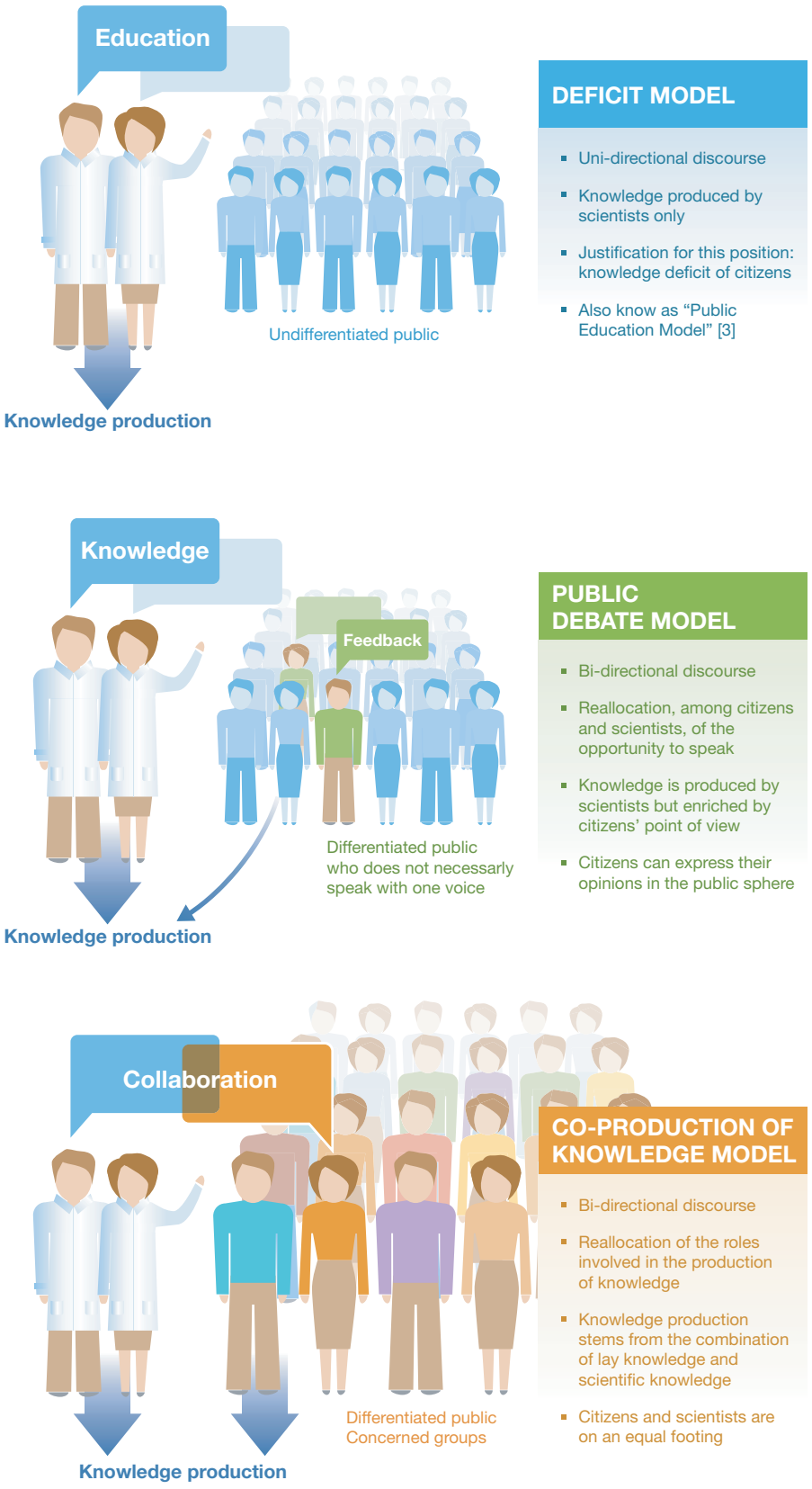

Fig 1. Models of interactions between citizens and scientists.

Scientists are increasingly called on to contribute expertise to policy discussions, to deal with emergency situations or to engage in public debates. A recent study identified that a perceived lack of competence may hamper scientists in getting involved in such activities [4]. Introducing future researchers to PUS and STS should help them develop a more accurate concept of their role as an expert advisor. Theoretical concepts of scientific expertise, such as those developed by Sheila Jasanoff [5] and Philippe Roqueplo [6], should enable scientists to better understand the locus of their intervention, which is generally at the interface between science and politics. These concepts also make it possible to more accurately assess the scope of the expert opinion required to make decisions and help define the problem.

Similarly, the work of Brian Wynne at Lancaster University, UK [7], shows that institutional scientific discourse tends to avoid questions related to unanticipated and unknown consequences (referred to as 'uncertainties' in STS) and considers only known possible effects with known probabilities (referred to as 'risks' in STS). In this sense, the fields of PUS and STS make it possible to deal with such a concept by integrating it into the discourse with citizens. They would thus allow scientists to better respond to citizen interactions and meet social expectations, as well as to better understand their own position regarding the management of risks and uncertainties.

Some researchers seek collaboration with citizens through what is known as citizen science. Such cooperation—for instance with patient groups, hobby astronomers or naturalists—has benefitted science and yielded interesting results. Collaboration between scientists and citizens can also be encouraged by funding agencies, as seen, for example, in the new sections of the US National Science Foundation (NSF) grant application forms reserved for describing the 'broader impacts' of research programmes. Studies in STS illustrate, in an in-depth and generally critical way, the various modes of hybrid knowledge production in biomedical, genomics and ecological research. In our view, mastering the concepts addressed in these studies would not only facilitate the research work of scientists involving collaboration with citizens, but also the development of research applications. Indeed, the direct involvement of end users in research

activities might also facilitate technology transfer and the development of innovations.

> *"...the perpetuation of these preconceived ideas about the limited roles and capacities of the public makes the task of interacting with citizens more arduous."*

However, such collaboration can sometimes be affected by what scientists perceive as hostility on the part of the public regarding the application of scientific research. PUS and STS studies strongly refute the idea that citizens' scepticism or hostility towards science is based on a lack of scientific knowledge [8]. We believe, therefore, that familiarizing scientists with these studies would help to eliminate such prejudices and enable them to better understand and appreciate the various forms of knowledge co-production.

The deficit model of knowledge production proves to be comfortable for some scientists, as it regards citizens—including journalists, decision-makers and political representatives—as non-experts who just need to be educated and informed. However, the perpetuation of these preconceived ideas about the limited roles and capacities of the public makes the task of interacting with citizens more arduous. Indeed, being the one who knows best—when in fact one does not know everything—and being required to make recommendations—while suspecting that others are not able to grasp the issues—involves challenges and responsibilities that can weigh heavily on scientists. Not to mention the fact that many citizens express indignation that their capacity to understand is underestimated or over-simplified. Thus, mastering alternative interaction models—models that view the scientists and non-scientists as different but equal and equally capable—would give scientists more credibility in the public sphere and shared responsibility for the discourse. Their participation in public life would be smoother as they would better meet sociopolitical demands and better understand the interactions between the various actors who are concerned by scientific developments and their applications.

> *"...the most effective way [...] is to introduce a curricular component that [...] engages budding researchers in learning about and debating [science communication]."*

Nevertheless, it is not easy to move beyond the deficit paradigm. The main hurdle is a structural one: scientists mostly interact with other scientists within a highly self-regulated and self-contained system. Although most research funding is derived from public money, its use is evaluated and managed almost exclusively by researchers and ex-researchers: research proposals are almost exclusively evaluated by peers; research results are reviewed by colleagues; articles in scientific journals mostly aim at informing other scientists; and scientific conferences and symposia are attended only by scientists and scientific editors. We therefore think that the most effective way to help scientists think outside the 'deficit model box' is to introduce a curricular component that presents the alternative models and engages budding researchers in learning about and debating the subject. This is an opportune time for the scientific community to take up this suggestion given that numerous academic institutions and governments are currently expanding graduate education programs.

Conflict of interest

The authors declare that they have no conflict of interest.

References

1. National Science Board: Science and Engineering Indicators 2012 (2012) *National Science Foundation, NSB 12*-01, Arlington VA
2. Callon M (1999) The role of lay people in the production and dissemination of scientific knowledge. *Science Technology & Society* 4: 81–94
3. Callon M, Lascoumes P, Barthe Y. (2009) *Acting in An Uncertain World: An Essay on Technical Democracy*. pp. 283. Cambridge: MIT Press
4. Singh GG, Tam J, Sisk TD, Klain SC, Mach ME, Martone RG, Chan KMA (2014) A more social science: barriers and incentives for scientists engaging in policy. *Front Ecol Environ* 12: 161–166
5. Jasanoff S (2012) *Science and Public Reason*. Routledge, New York: The Earthscan Science in Society
6. Roqueplo P (1997) *Entre Savoir et Décision, l'Expertise Scientifique*. pp. 112. Versailles, France: Quæ
7. Wynne B (2005) Reflexing complexity: post-genomic knowledge and reductionist returns in public science. *Theory, Culture & Society* 22: 67–94
8. Bucchi M, Neresini F (2008) Science and public participation. In *Handbook of Science and Technology Studies*, pp 449–473., Hackett E, Amsterdamska O, Lynch M (eds). Cambridge: MIT press