TRAINING SCIENCE COMMUNICATORS THROUGH COLLABORATIONS BETWEEN UNIVERSITIES AND MUSEUMS

Susan M. STOCKLMAYER
Centre for Public Awareness of Science, The Australian National University

ABSTRACT

Science Communication is a relatively new academic discipline, just becoming accepted in many universities around the world. The collaboration between a university and a science museum is a powerful way of promoting the communication of science, in that the 'field' and 'laboratory' experiences attendant on a regular tertiary qualification in science can be provided through the science museum and its public. In this paper, aspects of such collaboration are discussed, with attendant strengths and weaknesses. This discussion takes place within the wider context of science communication as a rapidly developing discipline with its own theoretical frameworks and unique research problems.

Key words: Science communication, science communication partnerships, training science communicators

INTRODUCTION: WAYS OF COMMUNICATING SCIENCE

For those engaged in the business of communicating science, the basic principles have been understood for many years, dating back as far as the beginning of the 19th Century. I do not wish to dwell on those early beginnings, but to concentrate on a much more recent trend—the fruitful collaboration between universities and science museums which is now a global phenomenon.

Essentially, there exist at this time three kinds of science communication that may be useful to think about. The first is one-way communication which has most often been characterised as unproblematic promotion of science. One-way 'transmission' is usually described in terms of the 'Shannon and Weaver Model' (Shannon & Weaver, 1949). This model was developed originally to describe the problems of electronic transmission of sound, and was not intended to be the transferable general model of communication that it subsequently became. In the context of general communication, however, the model has been deeply criticised for its simplistic assumptions and, in science, has been attached to a 'deficit model' of the public (see, for example: Tench, 2006).

The one-way model has an underlying implication of the transmission of information from 'expert' to 'layperson'. The fundamental assumptions of the so-called 'deficit model' (Layton, Jenkins, McGill and Davey, 1993; Wynne, 1991; Ziman, 1991) are that members of the general public know and understand very little science and require further education. In recent times this model has been rejected in favour of a style of engagement that respects public knowledge as well as the knowledge of scientists, and regards the public and scientists as equal players in science communication endeavours (e.g. House of Lords Report, 2000; Lewenstein, 2003). Public engagement in Europe, in particular, has led to increasing attention being given to ways of involving the public in scientific issues.

What is generally considered to be the ideal mode of communication has therefore now shifted to some form of two-way, participatory practice, and current rhetoric is about 'dialogue', 'knowledge sharing' and 'knowledge building' (see, for
example, House of Lords Report, 2000; Research Councils UK, 2002; Welp, de la Vega-Leinert, Stoll-Kleeman and Jaeger, 2006). The informal learning of science has, however, been concerned almost exclusively with the first model, with strong characteristics of transmission of information in the Shannon and Weaver (1949) style. The tradition began with science textbooks and other written material. It has been continued by most science-based websites. In this model, science information is provided for those who are motivated to acquire it, with little feedback or interaction and no real discussion. The tradition has been maintained in part because external factors such as links with the formal education sector have supported a strong focus on acquisition of science ‘knowledge’. Until very recently, therefore, promotion of science has been the main goal for science communicators chasing the ideal of a ‘scientifically literate’ public. This emphasis has been reflected in their training.

PARTNERSHIPS: THE SHELL QUESTACON SCIENCE CIRCUS

Historically, the movement known as ‘Public Understanding of Science’—with its attendant push for ‘Science Literacy’—has been the motivation for all university partnerships with science museums. Indeed it has been the foundation for the science museum movement itself. The collaboration between the Australian National University (ANU) and Questacon—Australia’s National Science and Technology Centre was the first and is still the most far-reaching, not least because of the shared program known as the Shell Questacon Science Circus. This unique graduate program is now one of the longest running sponsorships in Australia, and has won many awards. It has reached the furthest corners of remote rural regions and has been seen by many thousands of people. Its goal is unproblematic—to promote science in an attractive and accessible way to people who have no access to a science museum. To quote one of its graduates:

I think anyone who has been lucky enough to spend a year in the circus would wave the flag and proclaim the value of the program for scholars, for the country, for Science (1994 veteran).

Officially, its external goals are:
1. To promote among people in regional Australia, particularly young people, positive and personally relevant images of science and technology, of scientists, and of careers in science and technology.
2. To provide access for the people of regional Australia to a world class, touring, science and technology program.
3. To assist teachers in regional Australian schools to enhance the quality of the science and technology education which they offer their students.

The origins of the Circus lie in the recognition by Professor Michael Gore, Founding Director of Questacon, that there was a need to take highly successful science shows to regional Australia. He saw this as a way of taking science to those who could not travel to capital cities to take advantage of the growing science centre movement. He has explained (Gore, 2001: 233):

As the number of visitors to Questacon soared, short science demonstration shows were introduced to expand the scope of the attractions that were offered to the visitors. Many of the show givers were young ANU undergraduates and they took to the activity with great enthusiasm. Shows were a great success and the presenters became very popular with the visitors. However, an unexpected bonus for them was how much and how fast the students improved and developed their communication skills.

This recognition of the value of the experience to the students themselves led to the genesis of the Circus. The first and most important point about the program is that its graduate students are not people who have failed to make the grade in a more orthodox scientific career. Rather, they are highly intelligent and strongly motivated young men and women, with science degrees of very high quality. Many have a PhD. We believed from the start that these students should be good scientists, able to understand complex ideas in science before they applied themselves to science communication. The Australian National University, Questacon and Shell Australia give them a scholarship to cover their year of study, so they
must be of a standard to qualify for this scholarship. The science shows in question are short, thematic presentations incorporating simple demonstrations on a single theme such as Flight or Balancing. They are interactive, involving the audience as participants and as volunteers. Performing in a theatrical manner in front of paying audiences is a demanding task, especially for young scientists whose initial undergraduate experiences do not often include training in public speaking or the theatre. There are sixteen such scholars in the Circus, chosen each year from a large number of applicants from Australia and overseas. More women than men apply and are accepted. There are more biology graduates in the program than those from the physical and earth sciences and other related disciplines.

The competition to join the Circus is fierce. Around July, the course for the coming year is advertised all over Australia and recruits come from all States. We scan the applications for quality academic achievement. After that, we short-list applicants and ask them to prepare a video of themselves doing a science show. When these videos come in, we spend a happy day viewing and making our final selection of sixteen to join the Circus.

These sixteen arrive in January, ready for a much longer academic year than other students. After six weeks of preliminary training in giving science presentations, the Circus takes to the road. It travels to remote areas in a semi-trailer, filled with 50 interactive exhibits. At a venue, they will unload their exhibition into a hall and then disperse to local schools, some up to 150 km away, to give shows. Each school student who sees the show will be given a ticket to the venue, to come with their family in the evening or on a Saturday. In this way, we bring families into the exhibition. There is much research evidence that indicates that the family environment makes for good science learning (see, for example: Falk and Dierking, 1992), and no one can doubt this who has seen a Circus venue in a small town. At the site, our students will be interviewed by local media, sometimes appearing on local television. Each student takes a turn at managing the venue, staffing the shop, presenting shows—and all participate in loading and unloading exhibits and cleaning up afterwards. There are no ‘prima donnas’ in this program.

A very important part of this touring component is the inclusion of disadvantaged, remote Aboriginal communities. The Circus students undergo comprehensive cross-cultural training with Aboriginal facilitators before they travel to these communities, and many say that this is the highlight of the year for them. Science in this context looks quite different from that presented in rural towns.

Once back at the university, the students pursue their coursework. The content of the program is dictated by our perceptions of what skills are most useful for employers, but here we also take the opportunity to move towards science communication as dialogue and engagement. Coursework at the ANU for these students has three major components: Print and Electronic Media; Science and Society; and an Applied Project. The Print component includes writing assignments, which often result in publication in newspapers or magazines, while the Electronic Media component incorporates media and radio training. Science and Society is concerned with the interaction of scientific discovery with important social and ethical issues. It includes sessions on the constructivist model of communication, trends in understanding how to reach the public, ethics in science, the use and abuse of metaphor, and science and gender. Last, the Applied Project involves teams of students in evaluation of an interactive science exhibition, and in designing a portfolio for a new exhibition. Students also complete a work placement requirement. The Coursework component of the program requires that the underlying theory must move with the times. In a developing discipline, this presents challenges for lecturers who must change the content every year.

Thus the students’ learning includes an understanding of the public and of its relationship with science, skills in presenting and communicating science, a knowledge of evaluation, ability to design an exhibit portfolio, media presentation of the program, managing the Circus, team work, an understanding of indigenous issues and so on. The indications are that these skills are indeed very marketable to employers. We have tracked our graduates and found that there are many important areas in which they are now employed. Given that we now have over 20 years of producing these successful people, this is not
surprising. A recent external evaluation has found that the career paths followed by graduating scholars were "striking" in their diversity. Some have found employment in the media, some in event organisation, some in science museums and festivals, some in government or in scientific organisations, and many more. It is unlikely that these positions would have been offered to regular science graduates who did not have these skills. Proud achievements have included the prestigious national Prime Minister's Award for Primary Science Teaching in 2004 (to one of the few Circus graduates who has entered the teaching profession) and the national Prime Minister's Award for Community and Business Partnerships in 2006.

PARTNERSHIPS: A BROADER VISION

The Shell Questacon Science Circus is an outstanding example of collaboration between a science centre and a university, with an additional critical dimension of support from industry. It is not the only way, however, that two such institutions can work together in science communication. Science communication, as a new discipline, is still constructing a framework within which it can be defined, conduct research, and inform the public and policy makers. At the Centre for Public Awareness of Science, we are very conscious that if we are to understand the interface between the public and science, we must understand the public much better than we have done in the past. To this end, Questacon—the National Science and Technology Centre has been a friendly and cooperative laboratory for research into the adult public of Australia. We have, through interviews with visitors, framed a model for encounters with science experiences which extends beyond the interactive exhibit into all kinds of experience, including television, books, and even the formal classroom (Stocklmayer and Gilbert, 2002).

It is clear in 2007 that science communication is finding its own, interdisciplinary niche in the world of research. One of its distinguishing features is extreme complexity. When a prospective student comes into our Centre with the intention of completing a PhD or a Masters in science communication, it is likely that there will be no former work on which to enlarge, no theoretical framework on which to build a method, no other expert who can advise and guide the thesis. My first comment to such a student is that they have to be brave! They will dive into the pool of water at the deep end, with a life jacket of their own construction. The role of staff will be to oversee, to advise about the science communication part, to help in the big picture—but the fine detail is theirs alone to describe. In the end, they will become the expert for future researchers to consult and lean upon. To their credit, since 1996 there has been a steady stream of brave persons who have accepted this challenge. In 2007, we have 20 PhD students attached to the Centre.

Science Communication is also an interdisciplinary subject. In the beginning, at least, the inclusion of science communication in a regular Faculty of Science meant that we had to defend the position of the program. At all costs, the students had to be respectable scientists. The need to defend is much less now, but the requirement of this science background is one we still think is important for most participants—but not all. More recently we have extended our cross-disciplinary character at Masters and PhD level to include science journalists and practitioners of art. Our doctoral students therefore include candidates from psychology, chemistry, science education, mathematics, genetics, forestry, environmental science, physics, science journalism, new media arts and the world of science festivals and science museums. At the Masters level we have had students who have been interested in the combination of science and art, in problems with genetically modified foods, in the fishing industry, in science advertising, in alternative medicines, and so on. The challenge for the administrators and supervisors, such as myself, is to be effective in helping these graduates who are often operating very far outside their supervisors' comfort zone (my own background is in physics and chemistry). This requires courage from supervisors also!

What does science communication look like in 2007? It is now being informed by a much wider vision than was the case some six years ago, when we wrote our basic text in science communication (Stocklmayer, Gore and Bryant, 2001). At present there is still a tension between the original goals of the Public Understanding movement—simple promotion of
science—and a broader view of the discipline. So we come to those other aspects of science communication—knowledge sharing and knowledge building.

Other ideas about science, including local or indigenous knowledge, are now widely accepted as being critical to effective communication. New methods being endorsed worldwide include the notion of dialogue with the public, a model which is still evolving but is of crucial importance in understanding how to reach the public in matters such as genetic engineering, nuclear issues, and so on. Genuine dialogue, however, aims for more than simple public ‘engagement’. It is based essentially on the concept of sharing knowledge, which gives as much respect to public knowledge as to traditional scientific understandings and seeks to build new meaning from such shared knowledge. The idea of dialogue therefore extends beyond the challenges of new technologies. If we are to address issues of climate change, water shortages, over-fishing, contamination of the oceans, degradation of forests and all the other critical problems confronting every nation today, we must find ways respectfully to engage the public and involve them as partners in the enterprise. Partnerships between science museums and universities are uniquely positioned to achieve these goals.

At our Centre, over the past ten years, we have given workshops to scientists on how to communicate with the public and these are proving interesting examples of how views on the importance of science communication are changing within the scientific community. Young scientists no longer challenge the need to communicate, but seek to improve their skills in this regard. What we discuss in the workshops has also changed. Some ten years ago, a rather narrow view of communicating science was based mainly on skills, clarity and elimination of jargon. Now, there is a wide and encompassing view of consultation, dialogue and consensus.

It is exciting. For science museums and universities in partnership, however, what does this mean? First, a high priority is the training of young and enthusiastic graduates who will enter the workforce confident, knowledgeable and highly skilled. The Science Circus is testimony to the value of such young people to the nation. It is relatively easy to achieve, given the models that now exist in Australia and in other countries including Japan. For example, the long-standing partnership between the University of Glamorgan and Techniquest Science Centre in Cardiff, Wales, is a Masters program originally modelled on our Circus, which has now metamorphosed into one that exactly suits the environment of Wales and the outreach that is possible there. It does not have a travelling component comparable to the Circus, but trains its graduates in show giving within the science centre itself. Universally, the aims of such outreach are relatively straightforward and, in a sense, they date to a time when science communication was less complicated. The assumption underlying all such programs is that going out and talking about science ideas and science careers is a good thing.

Of course it is. We now know, however, that it is not enough. There are many other aspects to science communication which present a very great challenge to science museums and to their university partners. It is important that any analysis of the role of such partners in informal or free choice learning, especially that experienced through science museums, first asks what the goals of science communication with the adult public might be.

**SETTING REALISTIC GOALS**

Let us assume for the moment that we accept the goal of promotion of ‘science for all’. What, then, is the process by which informal learning occurs? We believe that there are two main reasons why adults seek scientific knowledge and understanding: because they are interested or because they have a need to know. Science museums and similar institutions work on the premise that visitors are intrinsically interested. They provide experiences that are ‘fun’—because that is why people come to visit. The power of this experience should not be underestimated and the participants in these activities do, without doubt, learn.

‘Science for all’ is a neat catchphrase but it is sadly undefined. The point at which all ‘have sufficient’ science has never been explained, because the notion of ‘science literacy’ is itself undefined also. If the literacy goal is ever to be more than
TRAINING SCIENCE COMMUNICATORS

a useful idea to persuade Governments and other sponsors of the value of science outreach, it should be measurable and quantifiable. I would argue that such measurement can never be achieved for the term 'science literacy'. In contrast, Léonie Rennie and I defined other goals which we think can be measured. These goals are about attitudes, ownership and access and they do not require the public to learn more science (Rennie and Stockmayer, 2003). The goals are:

- People who feel that science and technology lie within their interest and their personal lives.
- People who feel that the nation's science is both their property and their responsibility.
- People who are able to access new knowledge in science and technology and understand how it will affect their lives.
- People who feel comfortable about processing relevant scientific information so that their personal areas of interest are well served.
- People who feel that their own knowledge and concerns are valued by the scientific community.

To begin to achieve these goals, science museums must do more than 'promote' science. Opportunities need to be created within a science museum to address a broader brief. The question therefore arises as to whether the appeal of current science museum offerings is appropriate to draw a wider spectrum of adult visitors through the door, so as to provide for suitable broader experiences. Science museum demographics would argue otherwise and many museums are seeking ways to change this. Perhaps, some have argued, a different kind of exhibition might bring the adults through the door—a more thoughtful, issue-based, controversial kind of exhibition. I will not seek to debate this here, only to say that there is little evidence that this will engage substantial numbers of those who presently do not visit. An exception to this general observation has been the Bodyworks Exhibition mounted in Germany and Canada. At the Toronto Science Museum, there was a steady stream of visitors to this exhibition with a different demographic profile from the usual ones. Many were in their late teens and early twenties, normally a difficult group to reach (Lesley Lewis, Director, pers. comm.). Appropriate research will need be conducted to understand better what drew them there and how to maintain their interest and involvement.

In general, however, science museums, science lectures and talks, zoos, aquaria, art galleries and historical museums mostly attract the 'converted'. Science-minded people come to a science museum to have a good time—why would they otherwise spend so much time there? In the everyday world outside the science museum, there may also be occasions when individuals choose to engage with scientific experiences, usually because of an immediate need. This may, for example, be in response to a medical question or to a local environmental problem. It is uncommon for this kind of engagement to be sought inside a science museum, and this is an issue for consideration. How much are the wider aspects of science communication reflected in the offerings inside? Can the public explore, get sense of science in a broad domain, and readily access information? Science museums are all about promoting science, but to what end? In this respect, universities and science museums can usefully collaborate to define, widen and enrich the visitor experience, informed by a joint vision of important, relevant and very modern science. Questacon is currently engaged in just such a discussion with the ANU of how to broaden its appeal to adult visitors.

Dialogue is the current 'buzz-word', and is attracting considerable interest. The implications of this new approach to public awareness of science are far reaching, and may be problematic for science museums. Dialogue implies first that it is imperative for scientists to engage the public on equal terms, not from the position of 'keepers of knowledge' on one side with 'learners' on the other. Second, it is not only public opinion that has a place in this interaction, but public knowledge. Increasingly, indigenous and local knowledge is seen to be important to this process. Respect for such knowledge is critical. Yet decisions about the goals of informal learning, for the many people whom these new directions aim to reach, are no closer to resolution than before. A gulf will remain unless scientists are brought into the discussion as players, not captains in the debate. This is the role of the university, in partnership with the science museum.

Fundamental to progress is a much deeper research agenda to understand how to make the most of occasions where the world of science interacts with the public through the science museum and the university outreach experience and to understand the diverse and multicultural groups that constitute our adult populations. We need to know how to reach them,
how to listen to them and how to make science accessible to them, should they desire it. The research required in this area is challenging. We know very little about what is interesting or useful to the public (recognising, of course, that the public is both heterogeneous and diverse), and we do not know how to reach the people who are “unengaged”.

A key question has not been addressed in any research to date and relates directly to the goals of science communication. This is the issue of what the public wants to know. “Public understanding” implies that the science knowledge is there, waiting for the public to join in. I suggest, however, that the more profitable process in the longer term will be to find out what is needed, where, and by whom. This is a task of interest not only to science museums, who need to provide attractions for an engaged public, but for university outreach, to bring science in universities closer to the community. Such knowledge might even guide some science research itself.

In terms of the task, therefore, the goals may be re-stated for science museums in partnerships with universities as the following challenges for research and practice:

- **Goal 1:** People who feel that science and technology lie within their interest and their personal lives.
  
  *For partnerships:* How can we promote relevant interesting science with ample opportunities for creative and innovative play and exploration?

- **Goal 2:** People who feel that the nation's science is both their property and their responsibility.
  
  *For partnerships:* How can we represent the history and tradition of a country’s science including gender and cultural perspectives?

- **Goal 3:** People who are able to access new knowledge in science and technology and understand how it will affect their lives.
  
  *For partnerships:* How can we present recent developments, in a relevant and open manner, with respect for dialogue and opinion, remembering that ways to find out more information should be emphasised and facilitated and ethical, cultural and social implications should be honestly and openly acknowledged?

- **Goal 4:** People who feel comfortable about processing relevant scientific information so that their personal areas of interest are well served.
  
  *For partnerships:* What are the personal areas of interest that will be well served?

- **Goal 5:** People who feel that their own knowledge and concerns are valued by the scientific community.
  
  *For partnerships:* How can we give local and indigenous knowledge and understandings appropriately high status?

  How can science be seen to be responsive and respectful?

There is much to be done to examine the ways in which great academic institutions and science museums can work together to provide a new vision of what it means to communicate with the public. At the heart, however, this requires a common understanding between these institutions of the goals towards which science communication should be directed. Achieving this understanding also requires effective communication!

**REFERENCES**


TRAINING SCIENCE COMMUNICATORS


(Received July 6, 2007; Accepted September 27, 2007)