The evolution of science communication research in Australia

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Abstract

The strength of science communication in Australia has until now been in practice rather than theory, driven by a demand for practical solutions to problems. Science communicators are resourceful in devising solutions, either adapting international experience to suit local circumstances, or to inventing their own.

The theoretical study of science communication in Australia has been slower to develop. Only recently has Australia recognized that many science-based issues require a more considered approach, where practical actions are governed by a deeper theoretical understanding.

Prior to 1990, the limited number of university departments researching science communication-related issues worked principally from a social sciences perspective. Based in units with names such as 'History and Philosophy of Science', they had little to do with practitioners in science communication.

The practitioners usually worked for research organizations and museums, and came from a wide variety of disciplinary backgrounds. They performed a range of tasks and their title of their positions varied widely. There were no established training programs and the role of 'science communicator' was only beginning to be defined. Dialogue between theoreticians and practitioners was virtually non-existent.

Since the 1990s the practice of science communication has become more professional through the development of Australian Science Communicators, the consolidation of three centers for training science communicators, and the increase of academic research into science communication.

Academic research into science communication currently takes a mostly multi-disciplinary approach and has moved away from a deficit model focus to one that is more participatory. This may at least partly explain the closer links emerging between researchers and practitioners.

Introduction

This chapter traces the growth of science communication research in Australia. It examines the emergence of three strands of science communication, practice, teaching and research; and the way these strands have interacted with each other. In particular, it looks at how science communication practice has influenced the nature of science communication research.

We outline the emergence of science communication practice in Australia in the 1980s and early 1990s, and how this linked with and influenced the growth of university courses in science communication, and a recent increase in science communication research. In Australia, research on science communication with direct implications for practice was rare until the 1990s; but now most research is driven by the perceived needs of practitioners.

When we talk about 'science communication' in this chapter, we are referring to all the terms associated with science communication including science popularization, public communication of science and technology, public understanding of science and technology, science literacy, and social appropriation of science and technology. When we refer to 'science communication research' we are talking about academic-based research into science communication theories or the rigorous evaluation of science communication practice.

In researching this chapter, we reviewed the available literature, interviewed conveners of university science communication courses, reviewed publications relevant to Australian science communication over the past 60 years, and conducted a survey of science communication researchers and practitioners.

In examining the evolution of science communication research, we reviewed 22 journals which potentially contained articles on Australian science communication research (see Appendix A). An on-line search was conducted using the key phrases 'science communication', 'public communication of science', 'media and science', and 'science museums'. The search extended over a 60-year period, from 1951 (*Journal of Communication*) to contemporary publications such the Marquette Communication Journals, which have only recently been published online.

To discover the extent and nature of current science communication research in Australia, we surveyed (2011) the activities of science communication researchers and practitioners. The survey was promoted through the discussion list of Australian Science Communicators, a list with 800 subscribers and a good reach into the sector. It aimed to find out:

- who was doing science communication research
- what research projects they had completed or were working on
- what tools and disciplines are being brought to research
- how the research is being applied
- how practitioners are using research to inform their practice

There were 65 responses to the survey: 30 from those said they were involved in both science communication research and practice; 30 involved only in science communication practice; and five involved only in research. Most researchers are associated with universities, with the latter five all from the university sector.

Early science communication driven by practical needs

Every expedition which explored first the coastline and then the interior of Australia in the seventeenth, eighteenth and nineteenth centuries contained a person with scientific interests. These scientists documented and charted the coastline, the land, the geology, and plant and animal life in the period leading up to the first settlement by Europeans in 1788 and then beyond that as the continent was explored and opened up by the new settlers.

These traditions of scientific inquiry were extended into urban life in the nineteenth century, by the formation of mechanics institutes[iii], botanic gardens, learned societies, museums, public libraries and universities. The formation of these institutions accelerated after the 1850s, with

new wealth from the discovery of gold, and generous government support.

> *By the 1870s it was clear that the programme that had unfolded in these [learned] societies was one largely committed to the collection, description and classification of Australian natural history, phenomena and resources, combined with a discussion of practical matters involved in colonial development. This reflected the mood of the times, which had little patience with abstract theorizing.* (Home 1989)

From the very beginning, communication about science was rooted in the practicalities. The demands of establishing a settlement in an environment often hostile to European approaches to farming and management of the environment shaped the discourse of science. It was not an enterprise conducted in a rarified and scholarly atmosphere: in 1870, sixty per cent of the membership of the Royal Society of New South Wales had no scientific background or involvement (Home 1989).

The first formal studies on topics most closely related to science communication began at the University of Melbourne with the establishment of the Department of General Science and Scientific Method in 1948 (coincidentally the same year as the first PhD programs were offered in Australia).

The University of Sydney (1945) was another early entrant, and was in fact (with the University of Melbourne) among the first departments of its type in the world. In describing its role as to 'mediate change and help us understand the world and our place in it', the University of Sydney pre-empted many of the questions dealt with by researchers now working under the broad banner of 'science communication' internationally.

The 'profession' of science communication emerges

In 1994, Australian Science Communicators (ASC) was formed. This was an important milestone in the formalisation of the term 'science communication' and the emergence of a new profession. At this time, people involved in science communication had a wide variety of titles and came from different educational and disciplinary backgrounds. They tended to operate in a professional vacuum, because there was no place where they could seek advice or discuss problems with professional colleagues, and science communicators felt this lack of collegiality.

In the first two months after the intention to form ASC was announced, 375 people from across Australia demonstrated their interest in science communication (and their support for the new body) by joining as foundation members. This was a strong showing of support: the personal benefits were negligible but the funding did help the fledgling body to become established in September that year.

Science communicators came from a variety of training backgrounds and former occupations, and included people who described themselves as a media officer, scientific editor, public relations officer, librarian, scientist and science journalist. Their commonality was in their shared interest of communicating science to a diverse range of audiences.

One national research organisation, the Commonwealth Scientific and Industrial Research Organisation (CSIRO), played a powerful informal role in shaping the new 'science communication' role in the early 1990s. Many of the people working in science communication roles were staff members of this national research agency, with its 37 divisions and located at 100 sites across Australia. It provided the most comprehensive and cohesive approach to science communication, and offered a framework where like-minded professionals could discuss issues and share experiences. The CSIRO experience was in sharp contrast to the sense of isolation other 'science communicators' felt in their individual jobs in research organisations, museums, libraries, and as writers and editors.

University courses seek to make scientists better communicators

The same groundswell of interest that led to the formation of ASC also encouraged the emergence of new courses in science communication at Australian universities. The first was at the Australian National University in 1996, initially offering graduate diplomas (in conjunction with the National Science Museum) and bachelors' degrees. A survey in 1996 showed that 16 Australian universities were offering or planning to offer courses or subjects in science communication, mostly at postgraduate levels.

These courses were focused initially on improving the communication skills of scientists through specific subjects (e.g. the Queensland University of Technology offered its science students the subject: 'Scientific and technical writing'); joint degrees (e.g. the University of New South Wales offered Bachelor of Science degrees that included arts, media or communication subjects); or postgraduate diplomas open to science graduates.

This initial focus of university science communication courses was on training scientists rather than catering to the newly-emerging profession of 'science communicators', and many of the teachers of science communication had scientific rather than communication qualifications and experience.

Many of the initial courses and subjects in science communication failed to survive more than a few years, because scientists saw communication as a lower priority than other subjects; and without support they lost funding. But some courses targeting scientists rather than science communicators survive. For example, Monash University offers a joint Bachelor of Arts (Professional Communication) and Bachelor of Science. The announcement on the Monash University website is typical:

> *There is an increasing need for scientists to be able to communicate their work and its importance to colleagues in other rapidly diverging fields and to grant-awarding bodies, as well as to industry and the community in general* (Monash University 2011).

Science communication university courses shift direction

The closures of some of the early science communication subjects and courses led to the consolidation of science communication courses at three universities: the Australian National University, University of Western Australia, and University of Queensland. These universities

recognised the increasing professionalization of science communicators, and took advantage of this opportunity to provide courses with a vocational emphasis so graduates had the skills take up positions in this emerging area.

The focus was still on training those with a science background rather than those from an arts or humanities background. But the training aimed to turn scientists into professional science communicators rather than teaching scientists communication skills to be used in the course of their scientific careers.

Science communication now most commonly undertaken in a natural sciences context rather than (as happens in other countries) through departments affiliated with English, media studies or social sciences (see the *Directory of Science Communication Courses and Programs* available in the USA from the University of Wisconsin-Madison 2010). The exception is the University of Queensland where science communication courses are offered through the School of English, Media Studies and Art History.

The normal prerequisite to enter a science communication course is a degree in science. The Australian National University's CPAS, for instance, advertises that entry to its graduate research programs require an honours degree in science; and its website promotes the course with the following promise:

> *We train a new generation of highly qualified scientists to become skilled communicators who can engage people with the science, technology, or medical information that is most relevant to them* (ANU, 2011).

The University of Queensland's science communication courses have similar requirements:

> *This field is intended for science graduates, or those with strong science backgrounds, who wish to communicate effectively with scientists and professionals in business, industry, government, and the media*. (University of Queensland 2011).

At the University of Western Australia, science communication is offered through the Faculty of Life and Physical Sciences. A bachelor's degree requires a strong maths background and a masters requires a Bachelor of Science. The UWA Master of Science Communication and Education is described thus:

> *Students learn principles of effective science communication, develop practical skills and design strategies that address the communication needs of groups such as government organisations, informal museums, science centres and research centres* (University of Western Australia 2011).

The stronger science communication courses now include disciplines other than natural sciences into their programs to cater better to the needs of science communicators. The CPAS courses at ANU include social science disciplines:

> *In this degree, not only will your science writing and presentation abilities be honed, you will also study how people think about risk and ethics, consider what types of communication techniques are most persuasive, and discuss the underlying social and cultural influences on science as it exists today.* (ANU 2011)

Research may be a compulsory unit in undergraduate courses in science communication. The University of Queensland, for instance, states on the course website:

> *Courses are designed to increase understanding of the application of communication theory and research to health promotion, business, public relations, policy and politics, intercultural relations and globalisation.* (University of Queensland 2011).

The Australian situation reflects the analysis of worldwide science communication courses and their intellectual foundation conducted by Mulder et al (2008), which concluded:

> *Science communication programs at universities appear to combine aspects from the four key cognate areas of science, education studies, social studies of science, and communication studies.*

Science communication research driven by practitioners

As science communication courses grew and matured and became concentrated in a handful of universities, interest also increased in conducting science communication research at a post-graduate level.

The number of students has increased steadily. In 2011, the University of Queensland had enrolled 15 masters and five PhD students in research projects. The number of research students has expanded steadily at ANU's CPAS, from three PhD students in 1997 to 20 in 2010. The first postgraduate research students at the University of Western Australia (UWA) began their research in 2005 and graduated in 2009. In 2010, UWA enrolled five PhD students and two Masters' students in science communication research. A review of recent research projects shows the breadth of topics the students tackled and also the strong influence of the natural sciences. (Longnecker 2010).

Twenty-two journals were referred to above as being relevant to science communication. A search of these journals discovered 73 articles describing research in science communication in Australia or written by Australian researchers. Two were published prior to 1990; 23 in the period 1990-1999 and 48 since 2000. These figures demonstrate the marked increase in science communication research over the last 20 years, particularly in the last decade. This increase has been driven by the increasing numbers and professionalization of science communicators, and the heightened activities of university departments in this area.

These views are supported by our survey results, which show that most science communication researchers (86% of respondents) in Australia are also practitioners. These researchers are largely

based in universities but they are involved in science communication practice through consultancies and training. Others work for Australia's national research organisation, CSIRO, which employs a number of people to carry out the dual role of research and practice in science communication.

Science communication research evolves to a more multidisciplinary approach

The beginnings of research in science communication was in departments with names such as 'History and Philosophy of Science', or 'Science and Technology Studies' at the University of Melbourne (began in 1946) and the University of Sydney (began in 1945). Work in these departments continues today, although the departments themselves may have diversified and re-organised; but it continues largely separately from the new departments of science communication described above.

The effect had been to create two separate strands in Australia, with those training and teaching in the new 'science communication' areas working from a natural sciences disciplinary background and often dealing with more mechanical and descriptive topics; and those dealing with 'science and society' issues working from a social sciences perspective and looking at a different set of issues. Until recently, there has not been much contact between the two sides.

These boundaries appear to be breaking down. For example, the PhD students at ANU's CPAS are now studying more varied topics than previously:

> *Topics include everything from mental illness and illicit drugs to climate change and data visualization as well as science and public policy, science communication capacity building and evaluation in multi-national NGOs… [there is] also [research into] what makes a science hero, science theatre and performance... The change really has been in the sheer volume of work happening, and also in the increased interest in new (particularly social) media.* (Lamberts 2010).

The convenor of science communication courses at UQ, Dr Joan Leach, says that science communication research has both increased in quantity and in sophistication:

> *Things have gotten a bit more sophisticated than 'how many images of scientists do you see on mainstream TV' or the content analysis that was dominating about eight years ago. They [researchers] are theoretically more savvy and much more interdisciplinary. It seems that fewer scientists are trying to move from scientific research to research in science communication.* (Leach 2011)

These observations are backed up by our review of the Australian science communication papers published in relevant journals. The topics have changed in the last 20 years, from looking at the impact of communication on natural sciences to a more multi-disciplinary focus. From 1990 to 1999 the most favoured topics of research could be categorised under the following headings: media and science (22% of papers); public attitudes to science (13%); and museums and exhibitions (13%). In the last decade, a greater diversity of research topics is apparent. While

research on public attitudes to science (19%) and media and science (17%) have retained their popularity, the newer areas include policy or politics related to science communication (16%); science and culture (13%); and risk communication (12%).

There has also been a shift in the disciplines represented by the authors of research papers, which suggests a move to more interdisciplinary science communication research. Prior to the mid-1990s, many authors were writing from the disciplines of education (26%), communication (26%), science and technology studies (22%) or on technical/scientific fields (22%). Since the early 2000s, other disciplines have emerged in these papers, especially the social sciences, political sciences and psychology.

Overall, those researching from a humanities, arts and social sciences (HASS) point of view have increased from 57% of papers written in 1990-1999 to 71% of papers written in 2000-2010. Authors with a natural sciences background are also making more use of HASS themes, with an increase from 22% of papers to 33%. This suggests an increasing interest in multi-disciplinary research, a fact borne out from an examination of the authors' affiliations. For example, the article, '*Something to talk about: affective responses to public health mass media campaigns and behaviour change'* (Dunlop et al 2009), was written by joint authors from the School of Public Health at the University of Sydney; the Cancer Council of Victoria; and the Department of Psychology at Melbourne University.

Our survey of science communication researchers supports the multi-disciplinary approach to current research with a mix of disciplines and university departments represented. Of the 30 respondents involved in both science communication research and practice, double degrees and multiple qualifications were common. Most (57%) had a PhD and 87% had at least one science degree. One third had an arts, communication or media degree and 27% had had some involvement in social science, psychology or sociology. Twenty-three per cent said they had a specific science communication qualification.

Four of the five science communication researchers who did not practice science communication had a PhD and the other was a PhD student. Four had at least one science degree, and four of the five had a degree in arts, communication, media, social science, psychology or sociology.

The multidisciplinary nature of science communication research is reflected in the mix of qualitative and quantitative tools researchers use to conduct their research. The most common research tools are surveys (66%), interviews (60%) and focus groups (34%). To a lesser extent, researchers are also using document / media analysis, literature reviews, action research and content analysis.

Science communication research moves from a focus on deficit to engagement models

Interest in research into models of science communication has risen, more than doubling over the past decade from 22% of all papers to 48%. There has been an increase in interest in looking at science communication from an engagement perspective (23% of papers), rather than a deficit one-way communication perspective, as illustrated by the titles of recent research papers:

- Research partnerships with local communities: two case studies from Papua New Guinea and Australia (Almany et al. 2010)
- The public production and sharing of medical information. An Australian perspective (Ko 2010)
- Identifying and testing engagement and public literacy indicators for river health (Metcalfe and Riedlinger 2009)

These contrast with the first science communication papers from the 1970s, all of which used the deficit model as a theoretical base rather than a participatory one.

This increasing focus on engagement is illustrated by responses to the survey. We asked researchers to list up to three significant research projects they had completed recently or were working on. In total they described 45 projects. The most common topics dealt with engagement in science (20%) and formal or informal science education (20%). The next most common topics were skills development (13%) and audience attitude analysis (13%). Examples of some of the engagement topics were:

- Developing guides and evaluating engagement using social network analysis
- Seeking to discover how public engagement on new technologies influences attitudes, policy directions, behaviours etc
- How to best engage with the public/s in online environments

We asked researchers about their use or evaluation of science communication models, and the types of models they mentioned included participatory, behavioural, decision-making and learning theory. This emphasises the point that researchers are focusing more on participatory models of science communication.

Evaluation an unresolved issue

Three quarters of the researchers we surveyed nominated areas where the research they had conducted was being applied by practitioners. The most common applications were in the design and management of events or public programs (41%); informal public communication (33%); developing policy (26%); professional development workshops or training (26%); media (26%); and developing communication strategies (19%).

However, a concern expressed by both researchers and practitioners is that research is needed to provide for the accurate targeting, management and monitoring of programs that aim to influence public attitudes to science and technology. Respondents said:

> *There is an extreme lack of data on the long term effectiveness of any specific science communication activity. Basically we do not know how to construct programs very much beyond just good ideas. I hope my work, and that of my students, will contribute to filling that gap.*
>
> *Unfortunately it is limited to investigating the interest level or measured in terms of how much exposure one gets. I would love to have an effective method of measuring the true effectiveness of my communication efforts (in their many forms).*

Evaluation has depended on the project. Some evaluation has been simple due to ready determinant of baseline as effectively 'zero', so easy to measure change in practice against this. In other instances, can be difficult to determine the baseline against which to measure effectiveness depending on when I get brought into the project.

Evaluation is an unresolved issue in science communication. While activities to measure the 'success' of an event are quite common (usually rudimentary tools such as counting numbers, exit surveys or media monitoring), measuring attitude changes over time is more challenging and much rarer. Most practitioners (92%) said they had evaluated their practice in some way, usually through a survey (47%), feedback forms (30%), interviews or discussions (19%), or analysis of the number of website hits, visitors, media coverage or requests for information (17%).

They reported that they used the results of such evaluation to tailor or refine their practices (32%), with one person noting it led to further resource allocation for their science communication activities.

Where do practitioners seek ideas to improve the way they do their job?

The 65 survey respondents involved in science communication practice were asked about their sources for ideas to inform and improve their practice. More than half actively seek out research results, attend workshops or do their own research. They nominated informal conversations, conferences or seminars and books and papers as the most common sources of ideas to inform their activities. Their responses are detailed in Table 1 below.

Table 1: Where science communication practitioners get ideas to inform their practice

Source	Those involved in practice and research (30 respondents)	Those involved in only practice (30 respondents)	Total (60)
Informal conversations	22	27	49 (82%)
Conferences / seminars	21	22	43 (72%)
Books / papers	21	20	41 (68%)
Finding out about research	20	16	36 (60%)
Workshops	17	15	32 (53%)

Practitioners had a mixed response to the value of reading articles about science communication in journals. They are more likely to read these journals if they also do their own research (60%); and also more likely to find them useful or very useful. Their reservations centred on the issues of quality, relevance, rigor and accessibility, and they commented:

[I am] frustrated by papers that do not have the same rigour as applied to science papers.

I find sometimes there is a disconnect between practicing science communication and the research that is published. I particularly struggle with academic presentations that contain a lot of jargon - the exact kind of thing we try to avoid!

There was a strong preference for practitioners to use their colleagues both inside and outside science communication as a source of advice, and to find such advice very useful. Seventy eight per cent reported personal advice as their preferred source of information, but they were aware of variations in quality:

> *Some people are wedded to a single theory direction that aligns with their research area or their area of interest, and attempt to make it fit any other area.*
>
> *Science communication research is still emerging and there are many techniques from other disciplines which are yet to be tested/applied to science communication research. It is also a very messy problem to investigate the understanding of science.*
>
> *I have good relationships with particular researchers and science communication academics and I find my discussions with them useful - they are also very approachable.*

Discussion

Science communication is now a recognised occupation in Australia. The term is commonly used as describing a set of activities, and the title is well-established in the employment market at research organisations, museums, universities. A number of small vibrant companies have emerged over the last 18 years, each providing a range of services to research organisations and government departments. These include writing, event management, conducting surveys, designing signage, developing strategies, media relations and training.

Universities in Australia did offer courses in science communication prior to 1990, but they were fragmented and often short-lived. 'Science communication' was defined and shaped in the late 1980s-early 1990s; and the emergence of the new profession gave energy and purpose to a number of universities. New units were formed, new courses written, and a training framework established.

The need for research followed. Post-graduate qualifications in science communication by coursework and research are well-established at three universities. Other universities contribute to the research and training effort, using at times a different approach or a different disciplinary basis.

The growth in training and research programs has also marked a shift in the ideological approach. During the 1990s, science communicators focused on one-way communication via formal education, the media, publications, lecturers and static museum displays. This focus probably reflected their professional backgrounds as editors, journalists, teachers and librarians. Much of the science communication research reflected this deficit style communication with educational, attitude and media studies dominating the literature.

The science communication research leading up to the 1990s was largely from a natural sciences perspective or associated with the history of philosophy of science. There was little connection between practitioners and science communication researchers during this period.

However, an increasing number of tertiary courses or subjects offered in science communication led subsequently to a corresponding increase in research specifically focussed on science communication. Much of this research today appears to be carried out by practitioners in universities or research organisations. Such science communication research is becoming more collaborative across organisations and disciplines, with an increased inclusion of humanities and social sciences in the research. This is reflected in the tools being predominantly used for research: surveys, focus groups and interviews. More research is evaluating or using science communication models as a framework for investigation.

Today, there appears to be a much stronger connection between practitioners and researchers involved in science communication. This may be partly due to the fact that many practitioners also do research, but it also reflects the professionalization of the science communicator. Those practicing science communication are actively seeking advice from others and a significant number are finding out new ideas through published papers and articles as well as conferences and seminars. There is a move away from the deficit mode of communication to one that seeks to more actively engage people in science and one which seeks to better understand the concerns and needs of those they are trying to communicate with. This bodes well for a more egalitarian model of science communication that can more effectively engage in the big environmental, economic and social issues currently facing the Australian society.

Appendix A

Journals searched for articles on science communication

Journal	**Date searched back to online**
Australasian Science	2005
Communicating Astronomy with the public	2007
Communication Theory	1991
Critical Studies in Media Communication	2000
European Journal of Communication	1986
Human Communication Research	1974
Journal of Communication	1951
Journal of Science Communication	2002
Marquette Communication Journals	2008
Nature	1986
Public Understanding of Science	1992
Science and Society	1989
Science and Technology Studies	1986-7
Science as Culture	1997
Science Communication	1979
Science in Context	1987
Science, Technology and Human Values	1978
Science, Technology and Society	1996
Social Studies of Science	1971
The Journal of Science Education and Technology	1992
Web Journal of Mass Communication Research	1997
Written Communication	1984

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[iii] The objective of the 'Mechanics Institutes' was 'the diffusion scientific, literary and other useful knowledge among its members and the community generally and particularly among the young as well as the operative classes.' R.W.E Wilmot, quoted in Home (op.cit.)