Turning undergraduates into science storytellers. What are the best practices? A panel report.

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Introduction

Sharing scientific discoveries with the public is no longer solely the job of professional communicators, rather a skill that all scholars should have. Instructors on both hemispheres have recognized the need to bring the science communication curricula from the graduate level to the undergraduate level and this international panel explored whether we should train the next generation of scientists to become storytellers and share scientific discoveries with the publics from the beginning of their academic careers. The panel discussed key issues in teaching science communication at the undergraduate level, and how to bring public communication of science into science education.

Roundtable participants discussed how scientific storytelling can be taught at an undergraduate level, and exchanged ideas about how digital natives use technologies for science communication. It was also discussed how undergraduate students can be encouraged to attend or participate in public science events outside of the university walls.

There is a rapidly growing scholarly literature on science communication training. A recently published study (Baram-Tsabari and Lewenstein 2017) shares guidelines for developing meaningful learning objectives, while discussions about core skills (Mercer-Mapstone and Kuchel 2017) ethics (Medvecky and Leach 2017) and assessments (Mercer-Mapstone and Kuchel 2015) in science communication provide essential information for developing a science communication program for undergraduates. Evidence-based research on undergraduate science communication

and public engagement education is still rare (Brownell, Price, and Steinman 2013) and bringing science communication education to the undergraduate level can help the development of new pedagogical methods (Cirino et al. 2017).

Participants from New Zealand, Australia and the United States were invited to this panel to share their experiences in science communication education at the undergraduate level and discuss what has worked and what has failed.

"Teaching Science Communication at the Australian National Centre for the Public Awareness of Science, Australian National University (ANU), Australia" by Merryn McKinnon and Will J. Grant

We teach about 14 different Science Communication courses to undergraduate students largely in the Bachelor of Science program. Many of these are co-taught with postgraduate students in our two Masters programs. Courses include those with a more practical focus (Science in the Media; Science Communication and the Web), and those with a more theoretical / conceptual focus (Making Modern Science; Science, Risk and Ethics). We will focus on the practically focused courses in this paper, both of which are for second and third year undergraduates, and postgraduate students.

In Science in the Media, the main assessable task is a group project where they act as 'consultants' for an external science related organization. Clients have included government departments, cooperative research centres, campus science marketing departments, and various representational and advocacy organizations. The tasks undertaken as part of this project range from writing articles, interviewing researchers and developing communication strategies, to producing fact sheets and brochures or conducting formative research to inform future communication activities. Essentially the projects are typically comprised of communication tasks organizations need to do in order to share their stories, but often do not have the resources to allocate to do it as comprehensively as they would wish - if at all.

In Science Communication and the Web, the main assessable task is a group or individual project where students are asked to build - over a series of weeks - a web presence communicating some aspect of science. This could be a podcast about marine biology, a YouTube series on geology, a series of photo essays on local scientists, or a web comic about gender in science. The project focuses on their ability to tell stories about science in different media, while giving students tools and approaches that set them up for a range of future science communication, science or related careers.

At the broad level, the greatest success we've seen has been getting our scientist colleagues to recognize that we're strengthening - not 'watering down' - the skills, employability and outcomes of ANU science students. Beyond that, in both the projects listed above, students are required to think about, plan and deliver assessments that are both a tangible set of products and outputs, as well as experiences which they can use in their CVs and job applications. Some students have been back in touch post-graduation to share that the experience these assessment tasks gave them helped them to get a role they applied for. Both projects also help drive recruitment to the courses; many note the work integrated learning aspect is the main motivating factor for enrolling.

For any project involving external stakeholders, ensuring that a suitable standard of quality and professional practices is adhered to requires more active oversight and guidance than a standard assessment task. This often also requires a certain level of expectation management - on all sides.

Outside of these assessment tasks / courses, every member of our staff needs a Time-Turner. We're small and we do so many fun / interesting / exciting / complicated things across campus that we are already quite stretched. These assessment tasks are great for our students, which makes the investment of time they require worthwhile, but every now and again it would be nice to have more 'spare' time to invest!

"Undergraduate Science Communication education at The University of Otago" by Fabien Medveczky

The University of Otago's Centre for Science Communication (CSC) has been teaching Science Communication since the early 2000's at a post graduate level. Launching of a one year programme (the Post-Grad Diploma in Science and Natural History, run in conjunction with major science and natural history film production company NHNZ), the Centre evolved to offer all forms of post graduate studies, most notable its unique Masters programme that requires students to produce a two-part thesis: one part practical (a film, a book, an exhibit, etc) and one part academic research (Fleming and Star 2017). Historically, most of the students have come from the sciences, though not all.

While staff from the Centre have long taught science communication components into other courses, such as teaching "writing for the media" component to the Population Health students, or more sociological issues on PUS/PES in an STS course. There were no designated undergraduate courses until recently.

Off the back of the success of the post-graduate programme, an undergraduate course (locally referred to as a paper) was finally introduced in 2016, "SCOM209 Science Communication: an introduction". This course has a very strong focus storytelling and follows the Centre's model of blending practical application with theoretical component. The course proved very popular and led to the launch of a new 5-course minor in Science Communication, which started in 2018.

The newly launched Minor in Science Communication is committed to the Centre's model of having significant strength in both theory and practice. To achieve this, The University has endorsed an unusual approach of endorsing a truly interdisciplinary, cross-divisional programme. The new minor in Science Communication is co-taught by the Centre for Science Communication (CSC) and the Department of Media Studies, Film, and Communication (MFCO), both department teaching two core course each, the fifth course being an elective from a range of topics and fields, from English to philosophy to ecology. The two departments work to complement each other, each drawing on their existing skill set. MFCO, which sits in the Division of the Humanities, brings fundamental theoretical knowledge of communication and associated critical cultural studies to the minor. The CSC focuses more on the practical skills such as narrative building and storytelling, filmmaking and editing, and hosting public events, which have long been its staple.

Once the students find out about the courses or the programme and have enrolled, the feedback has been overwhelmingly positive (maybe the result of self-selection). Though one of the challenges with setting up a programme such as the minor (or even the preliminary course), is the 'University as a Business' model and the demand for ever increasing attendance in each course. Everyone accepts that, in principle, it would be beneficial for most students to do a Minor in Science Communication—whether they are from the sciences or the humanities. But each department is funded based on student numbers, and a student doing a Science Communication Minor (or course) is a student NOT doing biology, or history. So in-theory support doesn't lead to full on the ground support. The best approach has been to be inclusive in the preliminary discussion, and importantly, to have strong institutional support from the very top of the university.

"Teaching science communication to undergraduates through public engagement at Cornell University" by Kitty Gifford and Mark A. Sarvary

Undergraduates are the new graduate students in the United States. We can make this statement because an increasing number of undergraduates conduct authentic research as part of their four-year-degree, and publish peer-reviewed journal articles. Since science communication is part of the scientific process, teaching how to become a scientist and hence become a better science communicator is an essential part of the undergraduate education at Cornel University. Kitty Gifford, the curator of a local science café called Science Cabaret (www.sciencecabaret.org) and Mark Sarvary, the director of the Investigative Biology Teaching Laboratories at Cornell University (www.investigativebiology.cornell.edu) has been collaborating to connect town and gown (Sarvary and Gifford 2017) and provide opportunities to undergraduates for public engagement. They have developed a course titled "Applied Science Communication: digital platforms and public engagement" targeting undergraduate students in STEM fields. Two main objectives of this course were to *a)* teach students how to use tools to develop a communication strategy that they can apply to their own research; *b)* expose students to public engagement by attending a local science café and become involved with a science podcasts at a local community radio station.

Instead of teaching one-off skills, the course focused on providing a framework for a science communication strategy. Students learned how to write concisely and accurately, translated dense scientific language into simpler concepts for the public, completed writing assignments using a wide variety of platforms, including social media posts, letters to policy makers, press releases, blog posts, op-eds, and Wikipedia articles. Students applied the gained skills to their own research interests and created a transferable communication strategy frameworks.

Students, who were enrolled in the course attended every Science Cabaret during the semester, met the speakers and assessed the audience. These Science Cafes are informal talks in bars, cafes and other public venues that give like-minded people a chance to discuss current topics in science. The overarching goal of Science Cabaret, the Ithaca-based science café, is to enhance the public's understanding of scientific discoveries and to increase science literacy in the community. This science cafe was established in 2005, and has been bringing science down from the hills with the leadership of its program director, Kitty Gifford. This free, once-a-month event in downtown Ithaca is volunteer-run, open to the to the public, and has maintained a steady 100+ person audience at every event. The presenters have included many professors from local colleges, community leaders, museum affiliates, entertainers, and local entrepreneurs who approach their topics from the scientific perspective. These events attract a lay audience who otherwise would not be exposed to these interesting topics. From young children, through homeschooled pupils and retirees, many locals learn about scientific discoveries via Science Cabaret. Undergraduate students enrolled in the Applied Science Communication course learned science communication via public engagement by attending these events and helped assess the impact of this science café on community learning and literacy, while gaining knowledge about how to start and maintain such a successful and sustainable informal science communication platform.

In addition, we asked students to be involved with a science podcast on WRFI community radio (www.wrfi.org). Both Kitty Gifford and Mark Sarvary are producers for this podcast and brought this public engagement platform into the undergraduate science communication curriculum. Students conducted interviews and produced shows for Locally Sourced Science (www.locallysourcedscience.org) and learned about science podcast production.

This collaboration between Cornell University and Science Cabaret and Locally Sourced Science with the help of the Office of Engagement Initiatives provided opportunities to undergraduate students to dive into research topics they are truly interested in. We believe that science communication, to both the publics and to fellow scientists is an essential part of the scientific process, therefore undergraduates who learn about how to conduct scientific experiments should also learn how to engage their audiences effectively. The essence of science communication education is a bottom-up strategy. As these skills become a natural part of the scientific tool-box of every undergraduate, no-one in the future will question why science communication is important or why scientists need to gain these communication skills. Through undergraduate science education, these skills will become an unquestionable part of the science curriculum, and learning how to communicate science will make our undergraduate students, and hence all future scholars, become better scientists.

"Summary comments" by Bruce Lewenstein

Many people in the PCST community have seen the growth in interest in science communication among scientists and science graduate students. What these three presentations show us is how much the interest in science communication is growing among undergraduate students, as well. They give us models of how schools can try to serve that interest: By creating full degree programs, by offering specific sets of courses (or units – different countries have different terms!), and by offering individual courses and instruction. The presentations also show us the variety of skills that students want offered: writing, visual, web, social media, public speaking, storytelling, etc. The PCST community can take away from these presentations inspiration for creating new opportunities for learning science communication at all levels.

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