Poster Presentations

The research-teaching nexus as a driver for science communication skills enhancement

Catriona Bonfiglioli, Faculty of Arts and Social Sciences, University of Technology, Sydney, Australia.
Les Kirkup and **Ian Woolf,** Faculty of Science, University of Technology, Sydney, Australia
Catriona.Bonfiglioli@uts.edu.au, Les.Kirkup@uts.edu.au, ian@ianwoolf.com

Abstract: *Scientists' ability to communicate effectively is vital to their employment prospects, their contribution to society and to society's reception of science. Our goals were to develop students' communication skills and to enhance the teaching-research nexus. An engaging communication activity was introduced to a large enrolment first year physics service subject for science students. Audio and video 'trigger' material, created as stimuli for the students and based on original research occurring at our university, was a key innovation of the activity. Students submitted a short but structured written response to these triggers in which they gave their own perspective on the research – thus enhancing the teaching-research nexus. The activity was piloted with senior students, revised for delivery to the target students and evaluated via a student experience survey. Students reported that they valued the communication assignment for allowing them to learn more about scientific research at their university, to express their opinion of the research, and to practise communication skills. Students indicated that the triggers gave them insight into future career paths. The qualitative findings were reinforced by quantitative survey data which revealed strong support for including the activity in a physics subject. This study shows that a communication assignment builds bridges between undergraduates and researchers, thus enhancing the research-teaching nexus, and indicates that students find the assignment engaging and rewarding. While we are encouraged that students find the communication assignment a positive learning experience, the extent to which it enhances students' science communication skills has yet to be established.*

Introduction and aims

Communication skills are recognised as an important graduate attribute irrespective of discipline (Gray, Emerson & MacKay, 2005; Longnecker, 2008). Attributes need to be framed in a way which allows them to be operationalised at the discipline level. Torpy and Piper (2009) gave this attribute discipline specificity by expressing it as follows:

> [a student is expected to gain] an understanding of the different forms of communication – writing, reading, speaking, listening – including visual and graphics within science and beyond, and the ability to apply these appropriately and effectively for different audiences. (Torpy & Piper, 2009: p.45)**.**

A scientist's ability to communicate effectively is vital to their employment prospects (Fallows & Steven, 2000), their contribution to society (Longnecker, 2008) and to society's reception of science (Department of Education Science and Training, 2002).

There is widespread recognition that there is an urgent need to improve scientists' understanding of, and communication with, the public (Sjøberg, 2002; Turney, 1996). Scientists need to be able to communicate to a non-specialist audience in the public arena in order to perform as public intellectuals. Although science graduates can study communication or journalism, few do; consequently, some science educators believe communication skills education should be incorporated into all stages of a science degree. A consideration of the skills and capabilities that are vital to those who study science as a degree, but do not go on to pursue a career in science, also indicates that communication skills are prized by graduates and employers alike (Leggett, Kinnear, Boyce & Bennett 2004; Rodrigues, Tytler, Darby, Hubber, Symington & Edwards, 2007).

This paper reports a curriculum innovation designed to implement and evaluate reception of a novel communication assignment into a first year, large enrolment (500 students per year) physics service subject, Physical Aspects of Nature (PAN). The students in this subject are largely drawn from the medical, biological and environmental sciences. We chose to use the research-teaching nexus as a driver for communications skills enhancement and to frame the communication assignment, its methods and its desired outcomes accordingly. Hattie and Marsh argue that universities should aim to improve the nexus between research and teaching by increasing "the circumstances in which teaching and research have occasion to meet" (Hattie & Marsh 1996: p.533). In marrying consideration of the teaching-research nexus to communication enhancement, our goal was to draw the (first year) student into the enigmatic world of research within the university in a meaningful and engaging way (Hattie & Marsh, 1996; Healey, 2005) so that they would:

a) be presented with cutting-edge research at their institution of which they might be unaware;
b) see and listen to the university's researchers as they explain their work and its significance;
c) respond to that research in ways intended to enhance their communications skills;
d) appreciate the relationship between the research presented (which could be closely allied to their major area of study) and physics-based techniques, methods and principles

Another goal of the activity is to connect researchers to students who might eventually become their PhD students. The starting point for this innovation was the work of Moni and colleagues on the 'Personal Response' (Moni, Moni & Poronnik, 2007). The Personal Response, which is designed to enhance students' communication skills, is based around interviews with scientists drawn with permission from the Australian Broadcasting Corporation (ABC) archives to serve as stimulating 'triggers' for students to respond to. We built on these foundations by placing unique research happening at our university at the core of the assignment, including open-ended questions in the feedback questionnaire and inviting a leading science communicator and a leading scientist to talk to PAN students about science communication before students embarked on the assignment.

Our aim was to introduce an assessed communication activity into a first-year science subject, with the aim of contributing to communication skills development in science graduates, and to evaluate student experiences of the activity. Our research questions included: Can the Moni model be adapted to conditions at the University of Technology, Sydney? Do students believe they need better communication skills? Do students find communication assignments interesting? Do students accept the inclusion of communication assignments in a physics subject? Does using in-house interviews with scientists help to make students aware of research at their institution? Does the activity contribute to students' awareness of the physics underpinning the research featured?

Methods

Adopting an action-research methodology, the project worked through the cycle of diagnosing, action planning, taking action, evaluating and specifying learning (Lewin, 1946; Smith, 2007; Susman, 1983). The problem was identified as inadequate communication skills in science graduates, courses of action were considered and, drawing on scientific literacy literature and Moni and colleagues' work (Moni et al., 2007), it was concluded that a pilot communication assignment should be built into an undergraduate science subject. The action taken was to adapt the assignment item designed by Moni to conditions at our university, record the interviews, trial the triggers and the assignment on senior students from our university, introduce the activity into a first year subject, and evaluate the implementation by surveying students participating in the assignment. This paper reports the results of the implementation and the evaluation stages and considers what new challenges are identified for sustaining this activity as part of first-year science teaching.

How the personal response was modified for use at our university

Moni and colleagues chose as triggers a group of bioscience related interviews, first broadcast on Robyn Williams' Science Show on ABC radio. By contrast, we sought to exploit and enhance the teaching-research nexus by creating new audio and video interviews with scientists at UTS, in which they described their own research. This approach allowed us to evaluate the contribution the communication assignment could make to enhancing the research-teaching nexus. The Moni model was adapted for the assignment requiring students to listen to our in-house science interviews (which were made available through the Blackboard e-education platform) and write a short piece based on the following requirements:

> 700–750 words of prose, written in first person, present tense and using descriptive language; an engaging title; and formatted in three sections in which explicit requirements were aligned with cognitive levels (Moni, et al. 2007: p.91).

The rubric developed by Moni was employed by the markers (who were full time academics) to assess the student assignments. To assist in training, the markers were provided with exemplars of the Personal Response along with analysis of how marks were allocated to those exemplars.

Who was involved in the project?

Supported by a UTS internal grant, a small core team was formed consisting of a physics academic, a journalism academic and a science broadcaster supported by a project reference group of journalism and science academics and senior science students who had completed PAN. At the implementation and evaluation stages we involved current first-year science students studying PAN. The assignment was introduced to students by the authors in a lecture session which featured talks from leading Australian science communicator Adjunct Professor Julian Cribb and Dr Catherine Foley, who is a Research Program Leader with CSIRO Materials Science and Engineering Division. The two speakers were chosen because they speak eloquently about the value of science communication.

Results

Academics researching at our university in a wide range of areas including, climate modelling, energy efficient lighting and 'life on Mars' were recruited for interview. Interviews were recorded in audio (11) or video (four) formats. The assignment was piloted with a team of senior science undergraduates who rated the interviews, undertook the assignment and provided feedback on their experience in a focus group interview. The communication activity was refined and piloted with ≈100 PAN students offered a choice of five interviews (two video, three audio), who were surveyed to provide feedback on their experiences.

Senior students' evaluation

In a focus group discussion about the experience of writing a personal response, the panel of senior students said they found the interviews interesting, they were impressed by the science occurring in their own university, and they thought it would inspire students. They found writing the response easy but felt restricted by the word limit. They said they felt some concepts were too advanced for first years, and one student said she could not see much physics in four of the interviews.

First-year students' evaluation

To evaluate the effect of the assignment and students' experiences, we designed and administered a questionnaire to 99 students enrolled in PAN. The questionnaire included 10 items asking students to use a Likert scale to state to what extent they agreed or disagreed with statements about the assignment and open-ended questions about the strengths and weaknesses of the activity. The response rate was 56% for questions 1 to 8, and 54.5% for questions 9 and 10. Figure 1 shows mean student responses to the statements.

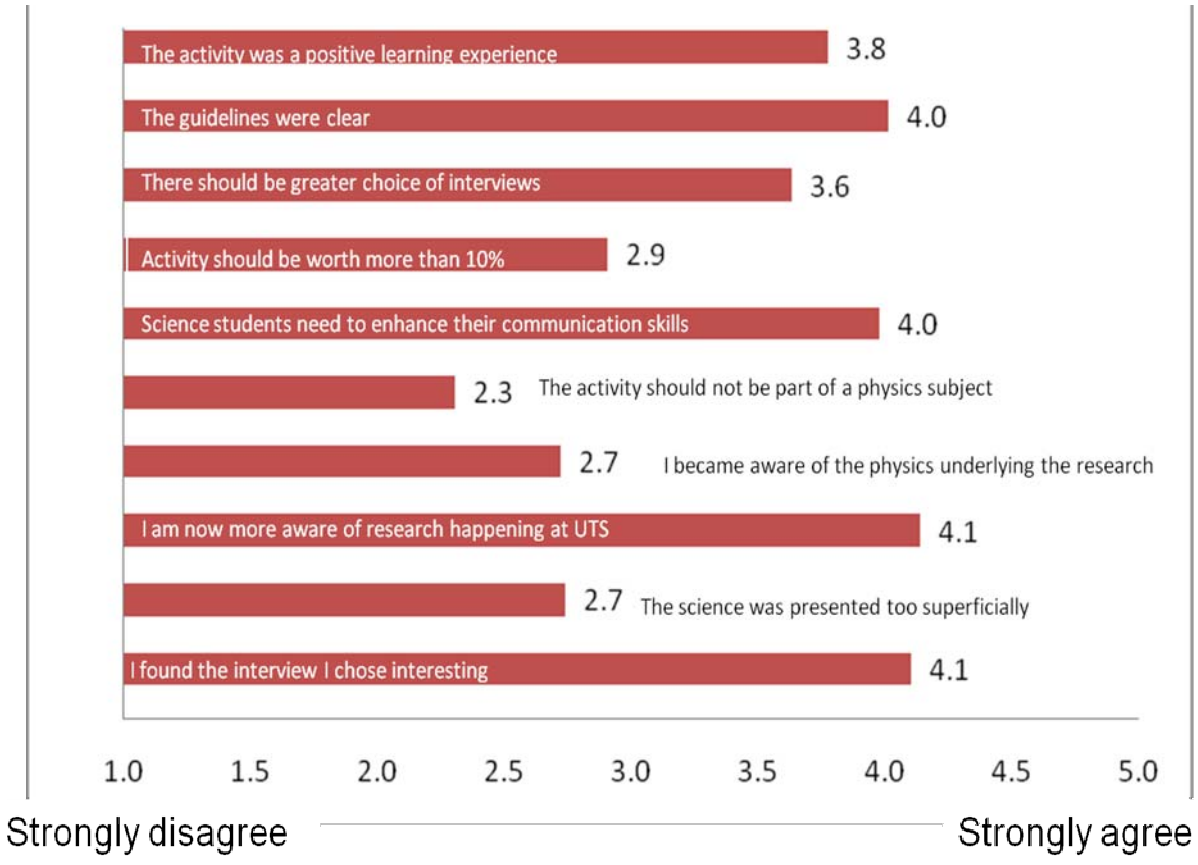

Figure 1: Students' level of agreement with ten statements about the activity

Most students found the interview interesting, most said it made them more aware of research occurring at our university, the vast majority agreed that science students need to enhance their communication skills and that the communication assignment belonged in the subject.

Quantitative results

A strong majority of students (67%) agreed or strongly agreed that science students need to enhance their communication skills, no student disagreed strongly (mean = 4). The majority of students (64.8 %) agreed or strongly agreed that the activity was a positive learning experience (mean = 3.8). This is supported by comments like "it was awesome", and "It actually was enjoyable to do". A majority of students (81.8%) agreed or strongly agreed that the interviews made them more aware of research happening at their university (mean = 4.1). However, when asked whether the interview made them aware of the physics underlying the research, more disagreed or strongly disagreed (40%) than agreed or strongly agreed (27%) (mean = 2.7). Most students (89%) agreed or strongly agreed that the interview they chose was interesting (mean = 4.1). Fifty six per cent of students disagreed or strongly disagreed with the statement that the communication activity should not be part of a physics subject (mean = 2.3). Sixty one per cent agreed or strongly agreed that there should be a greater choice of interviews (mean = 3.6). Eighty per cent of students agreed or strongly agreed that the communications activity guidelines were clear (mean = 4.0).

Qualitative results

Students who commented on the strengths (48 students) and weaknesses (45) of the activity said they valued the communication assignment for enhancing their communication skills, allowing them to express their own opinion and increasing their awareness of scientific research, including at our university. Suggestions for improvements included a desire for a wider range of interviews and clearer communication of the requirements of the activity. Forty-eight students made 78 comments

on the strengths of the assignment. The most commonly identified strength was that the assignment enhanced communication skills (23% of comments). The opportunity to express their own opinion or engage in reflection received 18% of comments followed by increasing student's awareness of research (13%) (six of these specifically commented on our university's research), the fact it was easy/undemanding (9%), interesting (6%) and enjoyable (1%).

There were 11 comments on the strengths of the activity (it raised awareness of physics = 2; there was good choice = 2; links science to the real world = 3; creative writing = 1; opened the door to thinking about the future = 1; shows if we have paid attention = 1; makes us learn new things =1). Forty-five students made a total of 50 suggestions for improvements. The most frequently mentioned suggestion for improvement was to provide students with a greater range of interviews to respond to (34% of suggestions focused on this and there were two calls for more video options). The assignment was often considered satisfactory as it was or not in need of improvement (18% of comments). Four suggestions called for clearer instructions. Four called for better quality interviews. Three called for a longer word limit, three for a transcript of the interview, one for more time.

Discussion

Our main research questions were answered thus: students do believe they need better communication skills. Students do find communication assignments interesting. Students do accept the inclusion of communication assignments in a physics subject. Using in-house interviews with scientists helps to make students aware of research at their own institution. Using journalistic-style interviews may not be the most efficient way to enhance students' awareness of the physics underpinning the research, although we found senior students were more able to identify physics elements in the triggers than first-year students. Moni and colleagues' work showed their students found their triggers interesting and that the personal response challenged them to think about current issues in human biology. We build on this by confirming that students found this type of assignment interesting and useful and by eliciting individual responses about what students believed were the strengths of the exercise and what could be improved. Students often mentioned that the assignment enhanced communication skills and that they appreciated the chance to express their own opinion and become more aware of research. Some students liked the fact the assignment was relatively easy, an issue stressed by Moni and colleagues as important to promoting communication skills and positive first-year experiences (Moni et al., 2007). We also learned that students value choice and quality in the trigger material and clarity in instructions.

Conclusions

This study has shown that our students value communication skills, find communication assignments interesting and enjoyable and appreciate the opportunity to express themselves and to develop their communication skills. This type of assignment can be successfully incorporated into a first-year physics subject to commence developing the desired communication skills and to build a bridge between undergraduate science students and cutting edge research thus enhancing the teaching-research nexus. The success of this innovation was underpinned by our interdisciplinary approach to problem analysis, solution development, implementation and evaluation. The next step in the action-research chain can be informed by the findings that students wanted more choice of stimulus triggers and more video interviews, that tutors found the marking challenging and that there are questions about sustainability (funding recording of new interviews to keep the research fresh and marking for very large classes). We have found evidence to suggest students find it hard to identify the physics underpinning medical, biological and environmental research which indicates that physics as a branch of science may have an unhelpfully low profile, something which could be addressed by curriculum reform and strategic communication. Teaching and learning innovation operating at the

research-teaching nexus can drive science communication skills enhancement. Communication skills enhancement can also invigorate the research-teaching nexus.

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