Matching the background of demonstrators with those of their students: does it make a difference?

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Abstract

Routine end-of-semester student satisfaction surveys revealed assistant laboratory demonstrators in first year classes rated more highly than their more experienced principal demonstrator counterparts. The rating appeared to correlate with assistant demonstrators' backgrounds. This finding prompted a project involving academics and students from the University of Technology Sydney (UTS) and the University of Cape Town (UCT) focusing on students' and demonstrators' experiences in first year physics laboratories. In particular, the project aims to examine the extent to which the congruence of the background, attitudes and interests of students and demonstrators impacts upon student engagement and achievement. Through the examination we are intent on gaining insights into approaches demonstrators can adopt to maximise student engagement and that will inform the induction and professional development of demonstrators. We report on the background to, and context of, the project, why it was undertaken, approaches adopted to explore student and demonstrator experiences and some preliminary findings.

Background

The laboratory is a potentially rich learning environment accounting for up to 50% of contact hours for students enrolled in first year physics subjects. This environment is characterised by relatively low student-to-demonstrator ratios and opportunities for close one-on-one student-demonstrator interaction. As a consequence, it might be anticipated that student engagement and satisfaction with the laboratory would be high. Regrettably, this is not the case. There remains widespread student dissatisfaction with first year students' laboratory experiences in physics, leading to national calls for action in this area (Kirkup & Mendez, 2009; O'Toole, 2012). Some dissatisfaction can be traced to the nature of the lab-based activities that routinely populate first year physics subjects, such as experiments that are recipe-based (Wilson & Russell, 2003), though this can only be part of the story. When student learning experiences are not positive, student attrition is exacerbated, especially in the first year (Hinton, 2007; Pitkethy & Prosser, 2001).

While there is little doubt that well designed student-centred activities are necessary for a positive laboratory experience (Boud, Dunne & Hegarty-Hazel, 1989), they are not sufficient. It is recognised that those who support student learning in the laboratory, often referred to as 'demonstrators' in Australian and South African universities, have a major role to play in the success of any laboratory program (Roehrig, Luft, Kurdziel & Turner, 2003). In a report on demonstrator development, O'Toole (2012) reported:

Demonstrators are constantly cited as having a critical impact on the teaching and learning experience in the teaching laboratory.

It is the demonstrators, their beliefs and views about student learning in the physics laboratory, and students' own beliefs and views, that form the centrepiece of the work described here.

Project Context

In the mid to late 2000's there was a rapid increase in student numbers in the following first year physics subjects at UTS: Physical Modelling (PM) delivered to first year engineering students, and; Physical Aspects of Nature (PAN), delivered to students majoring in the medical, biological and environmental sciences. We temporarily faced a shortage of people trained in physics, such as PhD students, who could act in the role of demonstrator. This, coupled with growing evidence that peer assisted learning was an effective way to support student learning (Hensen & Shelley, 2003), inspired us to consider recruiting senior students not specialising in physics, but who were (as examples) majoring in engineering (for PM) or medical science (for PAN).

Before students were considered eligible for recruitment, they had to satisfy several conditions including that they had to have achieved at least a distinction when they had studied PM or PAN. Students recruited in this manner assumed the role of assistant demonstrators in a laboratory class. The role of principal demonstrator in the same class was taken by physics higher degree students, casual staff with a PhD in physics or full time physics academics. Principal demonstrators are responsible for running the laboratory session. This includes introducing experiments, marking student work, leading semi-formal discussions in the laboratory and generally assisting students. In contrast, assistant demonstrators take part in discussions and assist students, but have no assessment responsibilities. To our knowledge, no other Australian university has opted to use non-physics majors routinely as demonstrators in physics laboratories, and we were anxious to evaluate the impact of such an innovation. We included questions relating to student satisfaction with the support they received from demonstrators on standard student feedback surveys administered electronically to all students at the end of each semester.

In the survey, students were asked to respond on a Likert scale from strongly agree (5) to strongly disagree (1) to five statements related directly to the laboratory demonstrators. These statements were: the principal demonstrator was well prepared to help me with my work; the principal demonstrator encouraged me to think deeply about the experiments; the principal demonstrator gave me good feedback on my work; the assistant demonstrator was well prepared to help me with my work, and; the assistant demonstrator encouraged me to think deeply about the experiments. The results for Autumn semester 2011 to Autumn semester 2012 are shown in figure 1. The return rate of the surveys in the three semesters shown was between 30% and 40%. The data represent the consolidation of responses from students enrolled in first year physics subjects at UTS, but are dominated numerically by responses from PM and PAN students.

Inspection of figure 1 indicates assistant demonstrators in 2011 and 2012 consistently (and statistically signficantly) scored higher on the statements: the [ ] demonstrator was well prepared to help me with my work, and; the [ ] demonstrator encouraged me to think deeply about the experiments.

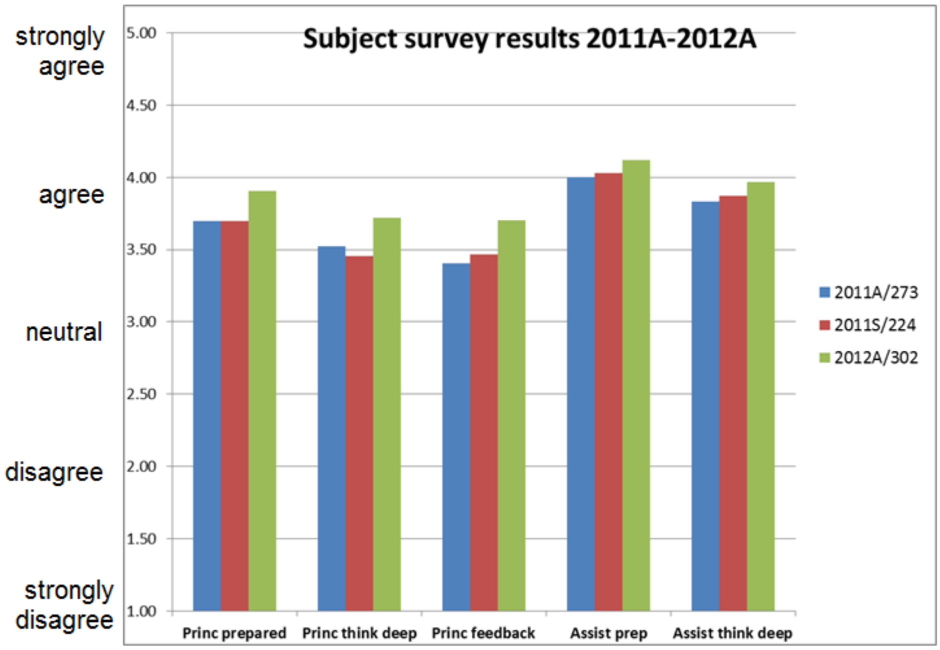

Figure 1: Student feedback survey results 2011 – 2012. The five statements are marked abbreviated on the horizontal axis. The legend indicates the year of the survey, the semester (<u>A</u>utumn or <u>S</u>pring) and the number of students surveyed.

We secured funding from the Office for Learning and Teaching (OLT) to examine the issue of better scores for assistant demonstrators more closely and in the process inform the way we support, recruit, induct and professionally develop demonstrators nationally. Demonstrators and their impact on student learning is an international issue. In order to enhance the transferability of the findings of the project to other institutions, two universities which have diverse student profiles, priorities, initiatives and organisational imperatives, have cooperated on the project, namely UTS and UCT. The latter face similar issues with respect to assisting demonstrators to maximise student engagement and provide an international dimension to the project. The context and focus of the laboratory program for first year students differs between UTS and UCT. Details of the UCT work will be reported elsewhere.

Aims and Methodologies

The project explores several questions that relate to the effect of alignment between the background, ambitions, and views on teaching and learning of students and their demonstrators on student engagement and satisfaction. The questions include the following:

- What are the demonstrators' views about learning and teaching in the physics laboratory, and how do these views impact on learning and teaching?
- How do the views about learning and teaching manifest themselves in student-demonstrator interactions?
- What aspects of student-demonstrator interactions are considered by students to be helpful in increasing their engagement in the laboratory work?

Three complementary approaches are being used to understand the qualitatively different ways students and demonstrators think about laboratory work and the nature of interactions in the laboratory: semi-structured, one-on-one interviews; surveys with open- and closed-ended questions, and; observations through video recording during classes. The interviews, analysed using a phenomenographic analysis (Akerlind, 2005), will be used to establish themes and categories in the views of students and demonstrators on aspects of teaching and learning in the physics laboratory program. To date, we have carried out 15 interviews with students enrolled in PAN. Additionally, we have conducted 6 interviews with principal and 5 with assistant PAN demonstrators. Altogether, 417 surveys have been administered to PAN students with a response rate of greater than 80%. The surveys given to 18 demonstrators included similar statements designed to allow comparisons to be made between student and demonstrator views. Video recordings of five laboratory classes in action were made to establish the nature of interactions between demonstrators and students that can be correlated with findings from interviews and surveys.

Preliminary Findings

So far, only the surveys of PAN students and demonstrators have been analysed. The student survey comprised 14 closed-ended statements and 3 open-ended questions. Closed-ended statements included:

I was encouraged to think deeply about the experiments by the Principal/Assistant demonstrator, and; I was comfortable asking the Principal/Assistant demonstrator questions about the experiments.

Responses to the open-ended questions in the demonstrator surveys reveal that more assistant demonstrators (than principal demonstrators) describe helping students at a deep/conceptual and higher order thinking level. Examples of such responses follow:

- ✓ *[I get the students to] Discuss the underlying physics and ... to think deeply about the experiment*
- ✓ *[I] encourage them to go beyond what was stated in the experimental protocol*
- ✓ *[I] explain the significance of the experiments and how it related to applications/fields. Talk about personal experiences in science*

In support of this finding, a higher percentage of students reported in the open-ended responses that they were encouraged to think deeply about the experiment more often by the assistant demonstrator as compared to the principal demonstrator.

With regard to the demonstrator's contribution to student learning, a large proportion of students praised the attributes and inter-personal skills of their assistant demonstrators. For example, the students described the assistant demonstrators as being *more approachable and helpful* and possessing an *awesome personality.*

A larger proportion of students reported in the survey that they were more comfortable asking questions of the assistant demonstrator than the principal demonstrator.

These qualitative findings support the analysis of the original student feedback surveys that found the assistant demonstrators to be more highly rated than the principal demonstrators in terms of readiness to help and encouragement of deep learning. Our next challenge is to uncover the reasons for this by exploring principal and assistant demonstrators' views on learning in the laboratory as expressed in semi-structured interviews, and the extent of the congruence of these with those of the students.

Questions for further exploration as part of the conference presentation

1. What are the risks/benefits of placing non-physics majors/peers in the role of physics demonstrators?
2. What other methodologies should we consider to explore interactions between students and demonstrators?
3. What are the most effective ways to measure student engagement (in laboratories)?

Acknowledgement: Support for this project has been provided by the Australian Government Office for Learning and Teaching. The views expressed in this paper do not necessarily reflect the views of the Australian Government Office for Learning and Teaching.

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