

Creation of a collegial network between researchers and undergraduate students at The University of Queensland.

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Abstract: It is widely believed that authentic research experiences in science are pivotal in providing context to undergraduate student learning and providing a true sense of what it means to be a 'scientist' (Boyer Report 1998, Healey and Jenkins 2009). Research intensive universities might be expected to have the greatest potential for involving students in authentic research (Turner, Wuetherick and Healey 2008), however, their students often feel alienated from the research culture (Zamorski 2002), and frustrated when their participation in the authentic research activities of the university are delayed (Robertson and Blacker 2006). Therefore universities, and research-intensive universities in particular, are being expected to develop strategies for welcoming students into their research culture during the early undergraduate years.

An innovative model for introducing first year undergraduate science students to the research culture of a large research-intensive university has been implemented at The University of Queensland (UQ). The Undergraduate Science Students' Experience in Research (USSER) Network invites large numbers of undergraduate science students from their first semester at university, to meet with UQ researchers over lunch, tour research facilities on campus, and gain access to the daily workings of research groups through flexible placements.

Following the establishment of the USSER Network in March 2008, approximately 170 students have had lunch with over 40 researchers, and approximately 40 students have toured three research facilities. Eighteen research groups have offered work experience placement opportunities, and ten students have undertaken placements in the first or second year of their degree. Participating students and researchers have reported that the USSER Network provides excellent networking opportunities, with a key feature of the program being the small group format of the lunches. Students have expressed overwhelming gratitude for the informal opportunities to talk with researchers, and discover more about the diversity of research being conducted at their institution and the research-based career paths available to them. To foster the growth of the authentic research experience aspect of the USSER Network program in 2009, Placement Workshops have been implemented, with fourteen students participating thus far. In addition, there has been a large amount of interest in the USSER Network across the University, and the planning phase is underway to disseminate the USSER Network model to several research disciplines across UQ.

This paper will introduce the key features of this innovative networking program, highlight the successes and plans for improvement of the model, and provide mechanisms for the generalisation of this model beyond science.

Introduction

Across diverse disciplines, research experiences are considered to be important in helping students to understand the process by which new knowledge is discovered or created (Healey and Jenkins 2009, Jenkins 2004, Robertson and Blackler 2006). For undergraduate science students in particular,

evidence is growing for the specific gains in professional, personal, cognitive and technical skills students derive from participating in research experience programs (Seymour, Hunter, Laursen and Deantoni 2004, Hunter, Laursen and Seymour 2007, Lopatto 2004, 2007). This paper details some of the benefits undergraduate science students report they have gained as a result of their participation in an innovative undergraduate research experience (URE) program developed to facilitate students' entry into the research community of an Australian research-intensive university.

Amidst the current debate about whether the level of research conducted by universities is beneficial or detrimental to students' educational experience, one comparative study has demonstrated that more students are aware that their lecturers undertake research at research-intensive institutions compared with primarily undergraduate institutions (Turner et al. 2008). Students have reported beliefs that their education is enhanced by their lecturers' and tutors' involvement in research, but they also feel alienated from the research culture, seeing the research as something that usually goes on behind locked doors (Turner et al. 2008, Zamorski 2002). Thus, it can be anticipated that students entering a research-intensive university will quickly become aware of the research culture of their institution, and expect to be involved in research early in their degree.

Contrary to calls for science students to experience the research process of inquiry and discovery throughout their education (Boyer Report 1998), there is a tradition in science of delaying students' research experiences to the final year of their undergraduate studies (Zamorski 2002). This is thought to be driven by undergraduate students' struggle with the highly technical nature of scientific research (Robertson and Blackler 2006). For example, Robertson and Blackler (2006) found that physics students who were invited to attend research seminars felt excluded by seminars that 'went over their head.' If science students do indeed require a minimum threshold of technical or conceptual knowledge before being capable of participating in research, how are we to design a URE program which draws students into authentic research from the beginning of their degree?

Students' experience of research can come in many forms, from the passive participation of hearing about research from lecturers and tutors, and in research seminars (Turner et al. 2008, Robertson and Blackler 2006), through to volunteering to be a participant in a study (Turner et al. 2008), and to actively conducting research as part of a course (Robertson and Blackler 2006) or as part of a summer research program (Seymour et al. 2004). A large range of models for involving undergraduate students from many year levels, across a broad range of disciplines have been reported recently (Jenkins 2004, Healey and Jenkins 2009). As demonstrated by Edwards and colleagues (Edwards, Jones, Wapstra and Richardson 2007), a suite of diverse URE models can be drawn together to provide students with a staged introduction to the research culture of their institution, in a way that complements the development of students' discipline-specific knowledge.

The current study describes a unique model for introducing large numbers of first year undergraduate science students to the research culture of a research-intensive university, provides an evaluation of the degree to which the model has achieved its aims, and makes recommendations for the generalization of the model beyond science.

Methods

Description of model

The Undergraduate Science Students' Experience in Science (USSER) Network was designed to welcome undergraduate science students into the research culture of their institution from the very beginning of their degree. The model is targeted at all undergraduate science students, from those who think they might be interested in a research-based career, to those who are just curious about the research being conducted within their institution. As the science curriculum is already very time-intensive for students, the USSER Network was designed to be informal and flexible with no course credit, and thus no assessment.

The USSER Network aims to:

1. help students understand what scientific research really entails
2. help students realise the excitement that accompanies new discoveries
3. inform undergraduate students about the specific research being conducted at UQ
4. improve the frequency and quality of interactions between students and researchers
5. facilitate the entry of undergraduate science students into the world of authentic scientific research
6. help students make informed choices about research-based courses and careers

The USSER Network program consists of the following three types of activities:

Meet the Research Team Lunches

Several researchers, from junior and senior levels, meet with groups of undergraduate students for two-three lunches each semester. These lunches take a round robin a 'speed dating' format, where 3-5 students and a researcher have a 10-15 minute conversation about research and career paths. Once time is up, the researcher moves to the next table to meet with a second and third group of students. The design has been chosen to foster conversations amongst small groups, and thus provide numerous, personalised interactions between the researchers and undergraduate students.

Laboratories Unwrapped Tours

Scientific research laboratories are usually mysterious places for undergraduate students, separated from the teaching laboratories, often not revealed to students until 3rd Year or Honours. The aim of the Laboratories Unwrapped Tours is to explain the daily functions of research laboratories by showing students through laboratories in action, and ultimately, to make students feel more comfortable and confident walking into a research lab to meet with the team for a Placement.

Research Team Placements

Research Team Placements provide students with the opportunity to gain insights into the daily workings of a research team, through a 'work experience' based model. The Placement must expose students to the research culture and be educationally stimulating, however, the exact nature of each Placement is negotiated on an individual basis. Placements range from students being invited to research team meetings and journal clubs, to students actively participating in current research projects in the laboratory and field. The USSER Network advertises a database of Placement opportunities. Students apply and are interviewed by the research team leader. At the end of the interview, the researcher and student sign a contract detailing the exact nature of the Placement (time commitment, student roles, training requirements for occupational health and safety) to ensure there are no misunderstandings of expectations within this very flexible scheme.

Evaluation methods

After each event, participants were emailed a link to an online survey and requested to provide feedback on their experience of the event. Students were asked to quantitatively rate how useful the USSER Network event was at helping them to:

- understand what research is really all about
- realise the diversity of research being conducted at UQ
- make connections with UQ researchers
- find out about research experience programs available to undergraduates

Students were also asked four open ended questions:

What was the best aspect of the USSER Network event?

What aspect do you think needs improving?

What is one thing you learnt at the USSER Network event?

What is one question you have after leaving the USSER Network event?

A thematic analysis of students' responses to the open ended questions was undertaken to determine students' perceptions of the degree to which the program achieved each of its aims. Over 85% of the students' comments in response to the four questions could be mapped to the aims of the program (the most common responses excluded from this analysis referred to the food provided at lunches).

Results

In the 18 months the USSER Network has been running, over 170 students and over 40 researchers have participated. All of these participants (with the exception of two researchers), have attended a USSER Network lunch, and just over half of the participants have attended more than one lunch and/or another USSER Network activity (Tour and/or Placement). Approximately one third of the participating students responded to the feedback surveys. As all of the participants have attended a USSER Network lunch, the following analysis is restricted to feedback provided after lunches (n=59).

Over the three semesters the USSER Network lunches have been offered, nearly all respondents (97-100%) agreed that the events were useful for 1) helping them to understand what research is really all about, 2) to realise the diversity of research conducted at UQ, and 3) to make connections with UQ researchers. Over this time, the proportion of students who reported that the USSER Network lunches were "very useful" for providing them with information about the URE opportunities available to them at UQ, has doubled (Table 1).

Table 1: Students' ratings of the usefulness of the USSER Network lunches for providing information about URE opportunities.

	Semester 1 2008 (% of respondents)	Semester 2 2008 (% of respondents)	Semester 1 2009 (% of respondents)
Very useful	34	59	69
Slightly useful	52	41	31
Not useful at all	14	0	0

Comments suggesting that aims have been achieved

Improve the frequency and quality of interactions between students and researchers

The most frequent comments students made in response being asked what the best aspect of the lunches were related to being able to met "real researchers" (83% of respondents) for example: "*Just getting to talk to real researchers actually doing real research.*" "*Access to people I wouldn't normally get the opportunity to talk to about that kinda thing on a personal basis.*" "*The opportunity to mingle with those in the field was a great experience.*"

Help students make informed choices about research-based courses and careers

Across the responses to questions about the best aspect of the USSER Network event and one important thing students had learnt, 75% of respondents made comments that indicated that this aim had been achieved. For example: "*Being guided by the researchers themselves. They told us what we should be studying, who we should be meeting, etc.*" "*That if I really want to be sure that research is right for me then the best option would be to do a summer research scholarship that is related to my study interests and to get some firsthand experience.*"

Help students understand what scientific research really entails

Across the survey, 66% of respondents made comments that indicated that they had gained greater insights into what research is, for example: "*Meeting the researchers gave me a greater insight to what researchers do on a daily basis and how they feel about their career.*" "*Research isn't all being stuck in the lab.*" "*the lunches make researchers seem like less of a mythical creature*"

Comments suggesting that aims have been only partially achieved

Facilitate entry of undergraduate science students into authentic research experiences

A smaller proportion of students (31%) made comments that indicated they were on their way toward gaining a hands-on URE, one of the best examples was: *“I got a job! Woohoo!”* More often, students mentioned learning that there are opportunities for gaining research experiences as undergraduates, and that they had gained some strategies for taking the next step (24% of respondents), for example: *“That is it the people whom researchers know and have had contact with, even if just by email, that they are more likely to choose for vacation work, rather than those with the higher grades. Basically, that I need to get out there more and meet my lecturers.”* In contrast, the most frequent questions students raised were about how to contact researchers and how to get involved in research projects (30% of respondents), indicating that students need more information before being able to find a suitable hands-on research experience.

Inform undergraduate students about the specific research being conducted at UQ

Again, only 31% of respondents made comments that indicated that this aim had been achieved, for example: *“getting to hear about the cool stuff that some of the researchers get to do! there is some really interesting work going on.”* *“about the 4 eyed fish that lives off the coast of brazil!”* This low score may be linked to students’ suggestions for improving the program by providing more information about the researchers at the lunches, and for a greater diversity of researchers which includes those researchers work in the students’ area of interest (31% of respondents). For example: *“Maybe make a list of researchers that're attending so we can decide beforehand who to talk to.”* *“I would like to see more physicists and mathematicians as that is my field.”*

Help students realize the excitement that accompanies new discoveries

Only 22% of the respondents mentioned this aspect at all, and most comments did not mention the excitement of a discovery directly, but rather the passion of a research interest, or satisfying curiosity, for example: *“Having them explain their research and what drives them in their careers.”* *“that researching is a hard slog (funding wise) but worth it to satisfy the curious individual!!”* Alternatively students referred to a balance between research being rewarding and frustrating, for example: *“research can be tedious, but rewarding.”* *“I learnt that research takes a lot of work but is infinitely rewarding if you go about it in the right way!”*

Discussion

Overall the feedback from students who participated in the USSER Network program has been overwhelmingly positive, and supported our claim that the model achieves its primary aim to welcome students into the research culture of their institution from the beginning of their degree. By interacting with researchers in small groups, students have said they have gained insights into what research actually involves, and information they need to make decisions about research-based courses and careers. Consistent with the findings of Edwards and colleagues from the University of Tasmania (Edwards et al. 2007), a staged model of activities which exposes students to the research culture of their institution from early in their degree seems to help undergraduate science students realise that a career in research is within their reach, and is something they might like to pursue.

As the primary aim of this model was to help students gain a greater understanding of what being a ‘scientist’ means, we are pleased that students’ quantitative rating and qualitative comments provide such a strong support. Recent studies have however noted how difficult it is for science students to describe what research is (Turner et al. 2008, Robertson and Blackler 2006). Therefore we plan to investigate the impact of participation in the USSER Network on students’ articulation of the nature of scientific research further.

Robertson and Blackler (2006) also demonstrated quite clearly that undergraduate students often become frustrated at being denied access to research experiences early in their degree. Therefore is

was of no surprise that students who attended USSER Network events were crying out in their feedback for more information and processes to help them gain hands-on research experiences in their areas of interest. The quantitative ratings indicate that students see the USSER Network as very useful for finding out about the research being conducted at UQ, and small changes to the USSER Network model over the first three semesters have better informed students of the UREs available to them. However, students' comments suggest that matching students and researchers by interest is likely to help students understand the excitement of discoveries, and facilitate their entry into UQ research groups. The questions students provided in 2008 have been used to develop a website of answers to Frequently Asked Questions in 2009, which directs students to researchers' websites for more information about their research, and to using the Placements component of the USSER Network to gain entry to hands-on research experiences. Recently we have implemented Placement Workshops to assist students to find researchers in their area of interest and approach those researchers to request a Placement.

We have been working with researchers from the School of Psychology who have attended the USSER Network lunches, to develop a program based on the USSER Network model for Bachelor of Psychology students. The key components of the program are clearly the well attended lunches, which achieve most of the aims of the model, as outlined in this paper, and the Placements for which students express a keen interest. Analysis of students' comments for characteristics of the model that are important for achieving the aims of the program (unpublished data) indicates that the small group, 'speed dating' format of the lunches is crucial to helping students interact with researchers. In addition, providing short biographies about each of the researchers and allowing students time to 'mingle' and approach researchers working in their area of interest, helps students to develop strategic networks and facilitates their entry into hands-on research experiences.

This paper has described the design of an innovative model which welcomes early undergraduate science students into the research culture of UQ, by using stages from the passive end of Healey's (2005) framework, where students hear about research, to the active end where students join research groups. Student evaluations indicates that the program achieves most of its six aims, primarily providing students with personalised interactions with researchers, which allow them to gain the information and networks they need to better understand the nature of research and the paths that lead to a research career. As requested by students, the USSER Network program will undergo further development to better facilitate students' entry into hands-on research experiences, as early in their degree as possible. On request from researchers and students across UQ, the model will also be disseminated and adapted to more research disciplines.

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