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UNDERGRADUATE RESEARCH AND INQUIRY ACROSS A ZOOLOGY CURRICULUM: AN EVALUATION THROUGH THE LENS OF EXTERNAL PEER REVIEW

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ABSTRACT

It has been established that student learning is greatly enhanced as a result of student engagement through research and inquiry based learning. However little emphasis has been given to how relationships between teaching and research are built within faculties or departments. External review of programs is a key strategy for building shared ownership of teaching programs. This project brought together a head of school and an external peer reviewer to carry out an evaluation of undergraduate research and inquiry across a curriculum, and to examine the student benefits. The first stage of the project, reported here, examined the extent to which undergraduate students are exposed to research and inquiry experiences within a department of Zoology. The approach utilised a mixed methodology including surveys and qualitative interviews with teaching staff. The reviewer identified a broad diversity of undergraduate research opportunities for students from first to third year, and a scaffolded approach to developing the students as researchers. In designing these learning activities, the teaching academics aimed to capture authentic research experiences for their students. This review 'closes a loop' between teaching and research within a department through critical evaluation of a program of undergraduate research opportunities. Stage Two of this project will focus on the student voices.

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INTRODUCTION

It has been established that student learning is greatly enhanced as a result of student engagement through research and inquiry based learning (Brew, 2006). There is, therefore, a continuing emphasis on increasing the ways in which we link research and teaching within higher education and in how students can be included within the community of scholars (Brew, 2006). Much of the extensive literature on research-led teaching focuses on the student benefits. Less emphasis has been given to how the relationship between teaching and research is built within faculties or departments. Zetter (2002, p. 12) considers that "the relationship between research and teaching has to be created, planned and structured in a systematic way by departments". He suggests that a detailed audit or review of a teaching programme can be designed specifically to identify research-led and research-based elements within the curriculum, and to "identify how the student experience of teaching and learning is linked to research" (Zetter, 2002, p. 13).

A department may carry out a self-review with such terms of reference; however an alternative approach is to commission a peer review. Peer review of teaching is often considered as a means of improving teaching at the individual level or of demonstrating teaching excellence. However peer review focused on a group of "teacher-scholars" is a mechanism through which a shared accountability for teaching and learning can be fostered (Quinlan, 1996). A key factor in the success of such initiatives is clear leadership from within the relevant department by an academic who is a respected scholar and teacher (Quinlan, 1996). Peer review is particularly powerful if the evaluation is carried out by an external reviewer (Malik, 1996) as this facilitates the benchmarking of local practice against that of other institutions. In particular, curriculum benchmarking allows a department: "to identify best practices in relation to curriculum design and assessment with a view to learning from others and improving one's own approaches to curriculum in the discipline" (*Enhancing Assessment in the Biological Sciences*, 2005).

This project brought together a head of school (= department)(Jones) and an expert peer reviewer (Myatt) to carry out an evaluation of undergraduate research and inquiry across a curriculum, and to

examine the benefits that students gain from such an approach. During the first phase of this project we examined the question – *To what extent are undergraduate students exposed to research and inquiry experiences within the School of Zoology at the University of Tasmania, and what are the student benefits?* Stage 2 of this project, which is yet to be implemented, will investigate the impacts of the cohesive set of undergraduate research experiences (UREs) embedded across the curriculum by examining the benefits reported by students. This work builds on similar research at The University of Queensland (Myatt, 2009), whilst providing an insight into the unique features of zoology education at the University of Tasmania.

A DEFINITION OF UNDERGRADUATE RESEARCH

Within the literature, there is a wide diversity of views on what is or is not defined as undergraduate research. Much of the debate is centred on the nature of the student activity and about the “newness” of the knowledge discovered. Although there is no “correct definition” (Beckman & Hensel, 2009) for undergraduate research, it is essential to define the term in line with our own aims and with the goals of the institution (Spronken Smith, 2010). For the purposes of this study, we defined undergraduate research as:

“An inquiry or investigation conducted by an undergraduate student or group of students that makes an original contribution to the discipline or to the individuals involved.” (adapted from Beckman & Hensel 2009)

This definition excludes research interactions where students are inactive or “passive” (Healey, 2005) such as in research seminars or research journal discussions; however it does include active participation in research activities where the students are seeking the answers to a research questions – whether in the laboratory, the field or the library. Figure 1 (from Healey, 2005) illustrates the framework that we used to examine and explain the diversity of possible UREs. Importantly we also consider undergraduate research includes research activities where the students uncovered knowledge that was original (new) to them, although not necessarily new to the discipline. This is an important distinction, and one that we made purposefully. We felt strongly that the student’s gains are dependant on a combination of features - the scientific authenticity of the task, the student’s sense of ownership of the research project and the student’s independence in performing it. These features did not include the newness, or otherwise, of the knowledge discovered.

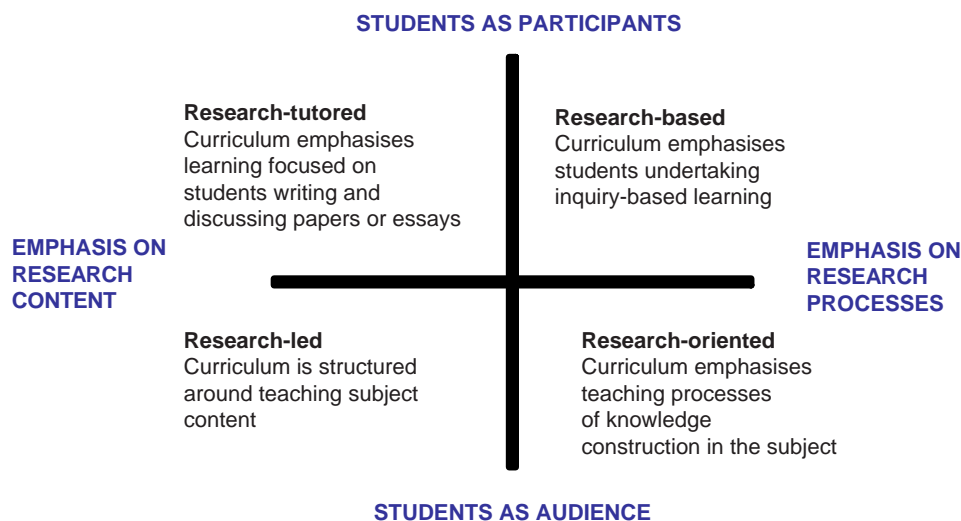


Figure 1: A Framework through which to examine the diversity of possible activities that can be defined as “undergraduate research” (from Healey, 2005)

METHODS

The project utilised a mixed methodology approach, using qualitative interviews and surveys to collect data. The external peer reviewer (Myatt) was hosted by the School of Zoology, University of Tasmania, for one week during April 2010. She was given access to printed teaching materials, including unit outlines and examples of assessment tasks for all relevant units taught by the School, and relevant evidence of the School’s approach to curriculum development (see Edwards, Jones,

Wapstra & Richardson, 2007; Jones, 2008; Jones & Barmuta, 2003). Teaching staff were invited to complete a short survey and to attend an interview with Dr Myatt. All interviews but one were face-to-face, with the exception being conducted by telephone; interviews were recorded and transcribed. A preliminary report summarising these findings was discussed with the Head of School (Jones), who provided further background information and rationale for teaching approaches before final analysis by the peer reviewer.

RESULTS AND DISCUSSION

The primary focus of this study was the identification and examination of active research opportunities engaging Zoology students - both inside and outside of the curriculum. The eleven activities identified and examined in this study (Table 1) represent a broad diversity of opportunities, some voluntary but most embedded as compulsory assessment tasks within Zoology units. These begin with tasks available in the first year of a standard zoology course of study, and move through opportunities available in second and third year and conclude with a voluntary opportunity that is available across all years of study.

An overarching characteristic of the UREs examined was the aim of the teaching academic to capture an authentic experience for their students. The authenticity was either inherent in the activity or was crafted as part of the learning design to ensure authenticity and thereby increase the effectiveness of the learning environment. It should be noted that while the individual authentic design features found in the learning activities were not seen as "unique", the reviewer found that an overall consistent approach to authenticity was a pervasive element in the undergraduate research activities identified.

The levels of authenticity encountered included:

scientific posters used as an assessment task, with presentation of the posters at a student conference-like event with an invited audience, food and informal discussions;
a scientific report submitted as a research paper manuscript, styled to a discipline-specific journal, and including scaffolded activities on writing and using the journal's *Guide to Authors*;
research projects based in research laboratories and with existing research groups; and
volunteer opportunities to participate in the research of others as an 'apprentice' scientist.

In many of the tasks examined, student engagement was encouraged through empowering students to identify their own research questions within a broader research topic. The opportunity to engage students in this process not only assists in increasing their motivation, but also enhances their critical thinking skills as they determine possible research questions within the confines of the topic. In these situations students' choices were usually checked to confirm the validity and appropriateness of their selections. Students were frequently asked to define research questions, articulate strategies for answering those questions, conduct experiments, analyse data or appropriate discussion pieces. These steps replicate the scientific process, and enable students to gain an in-depth (and very real) appreciation of scientific research (Clark, Romero-Calderon, Olson, Jaworski, Loppato & Banjeree, 2009; see also Jones & Barmuta, 2003). Teaching academics reported that this level of authenticity meant that students encountered the unpredictable nature of science research. Gathering authentic primary data, in particular, can offer unexpected challenges and lead to unexpected learning outcomes. However, it is important to note that in learning activities in which students accessed existing data sets, the data were 'real' (that is, not fabricated but generated through research), thus enabling a level of authenticity to be achieved. The importance of making such explicit links between learning activities and staff research is emphasized by Brew (2007: p. 66).

A feature of the overall program is the change of focus from "Students as Audience" to "Students as Researchers" (*sensu* Healey, 2005) from first to third year. Freestone and Wood (2006) commented that failing to introduce students to research in their first year represents a 'lost opportunity' which may impede students' progression to postgraduate research.

Table 1: Examples of active research opportunities engaging students from years one to three of a degree major in Zoology

	Course/title of activity	Target students	Specific/unique attributes
a	KPZ163 Ethics workshop task (in <i>Ecology</i>)	1 st year students	Students hear 'research stories' from postgraduate researchers, then work in groups to design a hypothetical study that meets ethical guidelines.
b	KZA215 Information literacy and critical analysis task (in <i>Tasmanian Fauna</i>)	2 nd year students	Students are asked to view a conservation-message video clip and critically analyse the message focusing on the scientific 'facts'.
c	KZA212 Scientific manuscript task (in <i>Functional Biology of Animals</i>)	2 nd year students	Students hear an authentic research conference presentation, provided with an authentic data set and then design their own research questions, analyse data and produce a manuscript.
d	KZA225 <i>Biology & Society</i> (Prior to 2010: <i>Evolution, Ecology & Society</i>)	2 nd year students	A unit that focuses on critical analysis of the literature to enable discussion of contentious issues and synthesis of points of view.
e	KZA360 five-day field excursion (in <i>Conservation Biology & Wildlife Management</i>)	3 rd year students	Students experience a 5-day immersion in a research context to experience a very real research environment, with the positive and negative experiences that arise.
f	KZA355 Group research project (in <i>Freshwater Ecology</i>)	3 rd year students	Students self-select into research topic groups, devise research questions, propose methodologies and carry out the research.
g	KZA301 Group research project (in <i>Behavioural Ecology</i>)	3 rd year students	Students carry out group research projects, from design, through execution and analysis, to reporting orally at a mock conference.
h	KZA350 Research poster task (in <i>Reproduction & Endocrinology for Conservation</i>)	3 rd year students	A capstone experience within a unit; students synthesise published research, and produce a scientific poster within an authentic science conference environment.
i	KZA304 <i>Zoology Research Project</i>	3 rd year students	Students work in a research laboratory environment with a researcher on a defined project for a whole semester.
j	Undergraduate Zoology Research Volunteers Program	1 st , 2 nd & 3 rd year students	Students choose from a range of authentic opportunities and work in a non-threatening environment with 'real' scientists.
k	Summer Research Scholarships	2 nd year students moving into 3 rd year	A Faculty-wide program; students complete a small research project within a research group over 6-8 weeks and write a report.

However, in this program, there is an emphasis on scaffolding essential science skills and experiences, and a culture of placing 'research', in its many forms, in the student's path. Teaching strategies similar to those reported here have been shown to create an appropriate context for learning, and to encourage a deep learning approach (Macfarlane, Markwell & Date-Huxtable, 2006); students gain high level, transferrable, learning skills through exposure to research-led teaching (Deakin, 2006).

In conclusion, this review has 'closed a loop' between teaching and research by critically evaluating a program of undergraduate research opportunities embedded into the teaching of a university department through the lens of expert external peer review. Individual teaching academics benefited from active reflection on their teaching during interview, and the opportunity to seek advice or validation of their teaching approach from a critical friend. Thus, we have addressed the challenge of enhancing the link between departmental research and teaching through a structured review of teaching strategies designed to enhance that nexus (Zetter, 2002). Brew (2002) termed this "the backward glance", meaning the act of teachers reflecting on knowledge gained in (research-led) teaching. The next stage of this project will focus on the student experience, and will seek congruences between the aims of staff in designing these learning activities, and the learning and developmental outcomes reported by their students.

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