



nexus: journal of undergraduate science engineering and technology

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Abstract: Graduate destination survey data from the University of Tasmania (UTas 2005a) underscore the reality that a large proportion — at one extreme 79.4% from the Bachelor of Science in 2003 — of students undertaking undergraduate degrees in the sciences do not enter the workforce upon graduation. Science degrees lead to further study at Honours, Masters, and PhD level. Thus undergraduate degrees in science are a foundation for research careers and should contain a greater proportion of research-oriented knowledge and practice than most other undergraduate degrees. At the University of Tasmania, a project was initiated in 2004 to emphasise this reliance upon research skills in the undergraduate curricula and to highlight the nexus that exists between teaching and research that is so critical to scientific scholarship and student development. The project is the first such project undertaken within Australia.

This paper describes the project, which, because of its successful introduction is now an annual undertaking. The aims of the project are to provide a model and a means of consolidating, integrating, and promoting the teaching-research nexus within the undergraduate science curriculum at the University of Tasmania. The project seeks to develop a model that encourages academics to incorporate learning outcomes related to information literacy, research methodology, and the effective communication of scientific research into their undergraduate units, and, to establish a journal (entitled *nexus*) that showcases the research undertaken by our undergraduate students.

In the paper we present the methodology developed for the embedding of the journal's requirements within the undergraduate curricula, the novel use of mentors to aid the students in their writing, the infrastructure developed to sustain the project into the future, and insights into pitfalls and their avoidance. We highlight the success of the project, describe the learning outcomes engendered directly and indirectly by the project, and indicate critical factors for ongoing success. Finally, we present preliminary results of an evaluation of the project from the three perspectives of Editorial Committee, academic staff, and students.

Introduction

Undergraduate students study subjects that incorporate learning outcomes related to information literacy (including the location, interpretation, analysis, application, and communication of information), research methodology (including the design and conduct of experiments, the identification and verification of evaluation criteria) and communication (the transfer of ideas of their own and of others through a variety of media/mechanisms to their lecturers and to fellow students). In many cases such activities are assumed by staff to occur and not necessarily noticed by students: these are generic science, engineering, and technology skills. They are crucial abilities of professionals and day-to-day activities for researchers.

The nexus between teaching and research in the sciences is a large one. Not only does research inform the teaching by influencing and updating the curricula, but research training within undergraduate classes prepares students for Honours, Masters, and doctoral degrees (Webb 2000). At the University of Tasmania, graduate destination survey data (UTas 2005a) indicate that many students studying bachelor's degrees (particularly in science) will not go directly into the workforce, but rather, will continue their study through enrolment in higher degrees.

Thus, there is a need to emphasise the nexus:



- to highlight to students that skills gained throughout undergraduate study are important both for the students' future — and that they are at least as important as learning facts; and
- to highlight to staff the critical link between including research activity within the undergraduate programmes because of the benefit to further study and professional practice.

Context

In 2003–4 the Pro Vice-Chancellors (Teaching and Learning and Research) at the University of Tasmania embarked upon a whole-of-University initiative to emphasise the teaching–research nexus (UTas 2005b). This initiative involved offering funds for special projects designed to illustrate the nexus.

The University of Tasmania is a small–medium-sized university; as the sole university in the state of Tasmania it is comprehensive in its offerings. The sciences are spread across two faculties:

- the Faculty of Science, Engineering and Technology which comprises Mathematics, Chemistry, Physics, Antarctic and Southern Ocean Studies, Geology, Geography, Environmental Studies, Geomatics and Surveying, Botany, Zoology, Aquaculture, Agricultural and Food Science, and Psychology (in addition to Engineering, Computing, and Architecture); and
- the Faculty of Health Science which comprises Anatomy and Physiology, Biochemistry, Human Life Sciences, Pathology, and Psychiatry (in addition to Rural Health, Obstetrics and Gynaecology, Paediatrics and Child Health, Pharmacy, General Practice, Surgery, Nursing, and Midwifery).

A project was required which was equally applicable to all disciplines within the sciences, across engineering, and also to the subject areas of computing and architecture.

The project

Aims

The purpose of the project is many faceted and includes providing a mechanism to:

- incorporate research skills and activities into all undergraduate science, engineering, and technology disciplines;
- illustrate the nexus between teaching and research to undergraduate students;
- better prepare students for a society requiring life-long learning skills; and
- showcase the high standard of work completed at the University of Tasmania.

The aims of the project are to fulfil the purpose through the construction of a print- and web-published journal (entitled *nexus*) and to establish procedures that will make the project sustainable into the future.

Why a journal?

Journals to illustrate the work completed by students are not new. Whether these are edited by students or staff there are many such publications around the world (Mercyhurst 2004). A journal was chosen in this instance as it was the obvious product for illustrating the teaching–research nexus — it models the professional practice of researchers and academics, includes submissions that involve research activity, critical thinking, analysis and review, and consists of material from the undergraduate curricula. Finally, the production of a journal yields a marketable, attractive, and credible outlet for our students' research activity. The front cover of the journal (with photographs from each discipline) is shown in Figure 1.

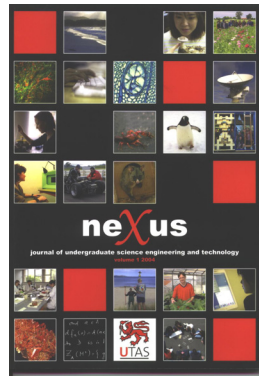


Figure 1. Cover of *nexus* volume one.

Model

General principles

In order to ensure repeatability and sustainability, we required a procedure that would minimise the work of the Editorial Committee, simplify the task of the students and those assisting the students, allow a consistent approach for all students and staff from each discipline, facilitate inclusion within the undergraduate curricula, and ensure that quality assurance criteria were met. If staff and students were overwhelmed in terms of workload to satisfy the requirements for publication the journal would not succeed.

Participants

We settled on three groups of involved parties: students, mentors (lecturers from each discipline), and an Editorial Committee.

Students comprise the authors. To maximise the number of potential authors, the journal must be embedded within the curriculum of each unit; this is discussed below. As each volume is of a finite size, there must be some criteria to limit the number of students whose work can appear in each volume. Also, the students must be given some guidance on format when developing their work for publication.

The role of the mentor is three-fold:

- to nominate students whose work is worthy of publication;
- to aid the students in (re-)developing their work for publication; and
- to provide advice to the Editorial Committee that the submitted work is of a standard suitable for publication.

The third group of participants is the Editorial Committee. With many of the functions of editors (nomination, collaboration with authors, intimate understanding of the material, approving the completion of an article, etc.) already performed by the mentors, the Editorial Committee is left with the task of selecting from the nominated students those who should be invited to meet with a mentor, to provide submission guidelines, to resolve layout issues, to receive final submissions and quality assurance documents, to encourage/cajole etc. as required, and to produce the final product. As such the task is essentially an administrative one; the Editorial Committee consists of the authors of this paper and the originators of the project.

Procedure

The phases comprising the production of the journal are as follows. Initially lecturers nominate students to the Editorial Committee. When all nominations have been received, the Editorial Committee considers the desired composition of the volume and issues invitations to the students.



Those students that accept are then paired with a mentor for the development of the submission. When the mentor is satisfied, the work is submitted to the Editorial Committee for review and final acceptance before it is laid out and published. The student signs a copyright form; the mentor signs an approval form.

This breakdown shares the load amongst the participants so that the majority of the burden is shouldered by the student authors - although as the work has already been completed as an assignment (see below) the load is not great. The mentors provide a crucial role of identification, encouragement, and quality assurance, but, again, since this is based on already-assessed work the workload should not be high. The Editorial Committee thus retains independence and (other than layout) is able to maintain an arms-length distance from the development of submissions.

Issues

At the outset, a number of risks were identified that could impact upon the project's success. These include the format for submission (whether to be precise or lax in specifying mark-up), whether different authoring practices exist across disciplines, the likely participation and enthusiasm of mentors, trepidation and confidence on the part of students, the severity of variations between assessed work and that required for publication, the need to create an infrastructure and process (for submission and publication), and the identification of sufficient funds for the journal's longevity.

To try to address the potential variation between disciplines, to reduce the load upon the students, and to simplify the creation of materials, it was decided that students should try to conform to three categories of article (research, short, and review) and should submit their work essentially devoid of formatting. This decision allowed for variation across disciplines (for example, some disciplines used endnotes, some did not), while allowing the Editorial Committee to form a consistent look-and-feel relatively easily. The lack of mark-up, however, did not suit all students. Some resisted relinquishing control submitting articles that required tedious re-formatting. To address this situation in 2005, students have been given a document in two formats: the first in the form the students should submit their work, the second in the form in which it will be laid out.

Mentors have proven crucial to the success of the journal. In 2004 there were mixed performances from mentors. Some were excellent, but some provided a less-than-ideal service. To combat this some check-lists will be utilised in 2005 to provide tighter guidelines for the mentors. Generally, obtaining mentors has not been difficult. Each discipline within the faculties involved has at least one unit where assessment tasks dove-tail nicely with the requirements of the journal. Thus to identify a potential author, a mentor need simply consult the top of their marks list. Similarly the student need only address such things as word limit — one of the journal's purposes is to showcase undergraduate work and hence it should be published in a form that is not too dissimilar from its assessed form. This fact facilitates sustainability — if the journal's requirements are sufficiently general that they are already accommodated by current assignment tasks, no extra effort on the part of academic staff is required; the journal is effectively already embedded into the curricula across the faculties for students to aspire to have their work published in.

A consequence of this is that students only need to be consulted once their assessed work is complete and returned to them. Publication in the journal becomes a task of revision rather than creation. Further, since the student is nominated by a mentor who is already aware of their capability, it would be rare for a nominated student to not be invited to submit or to have their work rejected. This not only simplifies the number of cycles for the Editorial Committee but also allows the student to be imbued with confidence from the point of nomination.

The initial grant received for the project was AUD\$15000. This has been sufficient to develop templates for both print- and web-publication, submission guidelines, forms for mentors and students, and publicity. Every decision that has been made has considered the future impact. It is



estimated that the project requires \$3500 annually to be continued (\$1000 if hard-copy publication ceases).

Related work

Many journals of undergraduate work exist. Most are American and include the University of California (2004), Dartmouth University (2004), Cornell University (2005), and Harvard University (2001). Some are produced by staff members but many are produced by students themselves. For independence and quality, it was decided that *nexus* should be produced by staff.

Many journals that state their purpose, for example (Dartmouth 2004) and (Potter 2004), cite reasons similar to those of *nexus*: to support the development of research skills within undergraduate teaching and to offer students an opportunity to publish. Many also address issues faced by us, for example (Potter 2004): who may submit articles for publication, whether the journal should be for formative or summative purposes, whether the activities are efficient for those involved, and issues of production (cost, media, and quality).

Evaluation

Within the University of Tasmania, the journal has been lauded as a great success and other faculties are considering the creation of their own journals. Distributed to significant national libraries and each Australian university, the journal was also presented at the University of Tasmania's internal conference on teaching and learning, amongst other forums. This does not mean development has ceased and procedures and templates continue to evolve.

Although a formal evaluation of the journal is not yet complete, qualitative data suggests the journal has been well received by all concerned. Anonymous student feedback includes: 'I felt very proud to be recognised for my efforts', 'I developed some valuable research skills', 'It will impress future employers — they will know I can write and present reports well', and 'May be of benefit in any postgraduate studies I complete in the future'. Only one of nineteen authors nominated in 2004 declined to participate. Nine of 2004's fifteen mentors have returned already in 2005 and another four new mentors have volunteered to join them.

Conclusions

We have created (on time and under budget) a self-sustaining journal that showcases the work undertaken by science, engineering, and technology undergraduate students at the University of Tasmania. This is the first such journal produced in Australia and the inaugural issue contains fifteen articles from eighteen contributing authors. These authors are drawn from fifteen disciplines and are studying towards eleven degrees taught by three faculties.

The aim was to construct a print- and web-published journal (and associated procedures and reusable infrastructure) to incorporate research skills and activities into all undergraduate science, engineering, and technology disciplines — from the broad representation of authors in the first volume and the existence of the repository of templates and forms, this has been achieved. The nexus between teaching and research has been emphasised through the inclusion of a research publication within the curricula of all disciplines across the Faculty of Science, Engineering and Technology. Assessment tasks identified as suitable for the journal involve activities of inquiry, analysis, and critique — necessary skills for life-long learning. Finally, the existence of the journal has provided an opportunity to showcase the high standard of work completed by undergraduate students of the University of Tasmania.



Further work

As indicated above, there are two areas currently being improved upon. The first is the inclusion of check-lists for mentors so that better guidance can be given and thus greater consistency achieved. The second is the provision of plain and marked-up submission instructions so that students can see how their work will look and thus feel more comfortable to submit an unformatted finished product.

In addition to completing the evaluation, the Project Team also wishes to examine the relationship between each assessment task's requirements and that of the journal. In this way the challenge of involving a greater number of students in the journal may be explored in more detail. It is felt that exposing all students to the possibility of publication will be beneficial, but there will be a consequential impact on acceptance which may be counter-productive. This needs further consideration.

Acknowledgments

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