



The Teaching-Research Nexus

A guide for academics and policy-makers
in higher education

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Examples from Australian universities

Designing Student Practical Experiments from Modified Versions of Own Research

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Broad discipline area:

Natural and Physical Sciences

- Plant science

Year level:

- First and second year undergraduate

TRN strategy:

- Drawing on your own research in designing and teaching courses
- Infusing teaching with the values and practices of researchers

Teaching and learning context:

- Practical experiment

Brief description of the initiative:

This academic uses modified versions of his own research as practical experiments in first and second year courses taken by students in a range of Bachelor of Science majors.

First Year Biology

First year students in *Biology 2* with typical enrolment numbers of between 200 and 300 are given a simple research question that they can answer during a three-hour practical after between 60 and 90 minutes of observations. This experiment *Do Grevillea seeds have a 'hard' seed coat?* conducted in groups of four with 40 to 60 students at a time, tests whether the seed coat of *Grevillea* is water-impermeable (or 'hard'). This is done by measuring the water uptake of *Grevillea* seeds which are either unscarified (control), or scarified. The same two treatments are used with wattle (*Acacia*) seeds which are known to have a 'hard' seed coat. Comparison of the water uptake characteristics of the two species allows students to answer the question. Students are given a detailed guide to assist them in designing the experiment themselves. Students working in groups of four make notes in their prac guide as they conduct the experiment and later individually write up a four-page report. By getting

students to design their own lab experiment, execute it and analyse the results, this academic considers these first year students engage more fully with and take greater ownership of this task, and therefore learn more, than when they are given a step-by-step process to follow. The academic includes his published papers (for example, Morris, 2000, Morris *et al.* 2000, Briggs *et al.* 2005) as background reading.

Second Year Ecology

Second year students in *Ecology 2.1* with typical enrolment numbers of between 40 and 60 conduct a second more involved experiment based on this academic's research, that involves watching seed germination over several weeks. Seeds of an *Acacia* and a *Grevillea* species are provided. Both species are known to germinate in response to fire-related cues such as heat, or smoke, or both combined. Ovens give heat shock over the range 60 – 120 degrees C, and a chamber exposes seeds to aerosol smoke. Students frame their own question(s) about the germination behaviour of the species, design an experiment to test their hypotheses, execute the experiment during the laboratory session, and collect the germination data over several weeks. Students undertake statistical analysis, as well as graphing results and present their findings orally using PowerPoint presentations as if they were giving a conference presentation.

Benefits to students:

- Students are inducted into the research culture of the department. Through the inclusion of papers reporting the results of experiments he has conducted, students come to understand that their lecturer is not simply a teacher; research is also an important part of his job.
- Students are inducted into the process of scientific enquiry, experimental design and discipline-based research protocols regarding replication, control and experimental groups, randomness and independence of readings.

References:

- Briggs C.L., Morris E. C., Ashford A.E. (2005) Investigation into seed coat dormancy in *Grevillea linearifolia*, *G. buxifolia* and *G. sericea*: anatomy and histochemistry of the seed coat. *Annals of Botany* **96**, 965-980.
- Morris, E.C. (2000). Germination response of seven east Australian *Grevillea* species (Proteaceae) to smoke, heat exposure and scarification. *Australian Journal of Botany*. **48**, 179-189.
- Morris E.C., Tieu A.L., Dixon K. (2000) Seed coat dormancy in two species of *Grevillea* (Proteaceae). *Annals of Botany* **86**, 771-775.

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