

## A practical alternative to final year research-laboratory projects in Biomedical Sciences

**Award Nominee:** Debra Bevitt, Newcastle University

**Centre Contact:** Jackie Wilson

**Subject Area:** Experimental design and laboratory practice/research project

This case study has been developed from data gathered through observations of the teaching component; interviews with the tutor; and focus groups and questionnaires with students from the current and previous cohort.

### Background

The Experimental design and the process of research module was established in 2007/08 as an alternative to the traditional final year laboratory project for 3rd years on a range of honours degree programmes in the School of Biomedical Sciences, and is aimed primarily at those who are not likely to pursue an academic research career but may well seek employment in industrial laboratories. The module aims to develop students' laboratory skills and increase their understanding of experimental design, the importance of accuracy, reproducibility and rigorous documentation of laboratory work, and the regulatory processes controlling biomedical research. The current cohort is 15 students and each is assigned a supervisor (the tutor or one of two other academics).

The module centres on a practical project through which students produce a 'product information sheet' for an untested sample of trypsin. Students attend seminars which provide the background necessary for planning, executing, analysing and reporting on their laboratory work. Prior to lab work students submit a project plan, which is marked and returned with feedback. Each student spends ~52 hours working individually in the teaching laboratory using a range of standard assays and techniques to analyse the trypsin. They document their plans, protocols and results in a laboratory notebook. The tutor/supervisors and two demonstrators are on hand to answer questions and provide support. Students also attend weekly one-to-one tutorials with their supervisor. The final project report includes the product information sheet and is based on an evaluation of students' own data and collated class results. Students are also marked on their 'professionalism and competence'. In addition to their report, students undertake an extended essay and an oral presentation based on research they undertake into a current laboratory technique.

### Reasons for introducing this teaching method

As elsewhere, large student numbers make it difficult to offer all final year students a traditional laboratory project in a research lab. Students achieving less than 55% at Stage 2 would generally be offered a 'dry' project option, such as a library or education project, but the tutor was keen to develop an alternative which would allow these students to gain intensive laboratory experience and develop laboratory skills to enhance their employability. This option enables students to develop practical and experimental design skills in a supportive teaching-laboratory environment, and aims to enhance their motivation to learn by giving them a similar sense of enjoyment and "ownership" of their work as traditional projects.

### Lecturer perspective

The development of the module was informed by discussions with an industrial laboratory manager, who provided an employer perspective on the skills they seek but sometimes find lacking in UK graduates. This identified the importance of: basic techniques such as pipetting consistently and accurately; the ability to troubleshoot experiments; understanding the underlying principles of assays; and the importance of documentation and recording any changes to standard operating procedures. From this the tutor derived the central project format involving a hypothetical but authentic scenario: "*I'm a client, I'm buying this trypsin, what do I want to know?*" This focus aimed to encourage students to think more broadly about what they were doing and avoid them becoming technique or assay-focussed. Importantly, the laboratory work the students undertake differs from routine practicals by requiring them to plan their own experimental protocols, including calculations and risk assessments, and to prepare their own reagents from scratch in a relatively low-risk environment. The laboratory experience is "*intense but*

*relaxed*'. Students have the time to carry out repeat experiments and to explore alternative approaches, which increases confidence and encourages them to trouble-shoot and redesign their experiments as they progress; *"It really does make them think a lot more about what they're doing"*. For the tutor the module is enjoyable and rewarding.

### **Student perspective**

In the focus group with 5 of the current cohort, students described the project as *"well-rounded"*, *"a really good alternative"*, and *"a better way to learn because it required finding out for ourselves"*. Students had enjoyed the laboratory activities and gained confidence in *"talking about being in a lab"* and *"doing experiments"*. All students identified improvement in their practical skills and 3 of the 5 felt they had also gained time-management and research-skills. All students felt challenged by the module which they considered involved *"just as much work"* as other projects *"if not more"*, found it *"a lot more interesting"* than practicals, and enjoyed having responsibility for their lab work and ownership of experiments and results. All were very satisfied with the level of support and supervision in the lab. In the focus group current students identified the one to one tutorials as being very helpful, particularly in relation to their written work.

All 7 students who completed questionnaires (5/15 of the current cohort and 2 from the 07/08 cohort) strongly agreed or agreed the practical project had developed their practical skills and increased their depth of understanding of experimental design. Four of the 7 also strongly agreed or agreed their numerical skills had improved, while in the focus group the majority stated improved confidence in their data analysis skills.

### **Issues**

The essay was the least popular element from the students' perspective, with a couple identifying it as *"distracting"* or stating a preference for more laboratory work instead. The essay ensures sufficient academic rigour and the tutor is confident *"it needs to be there"*. The project plan, oral presentation and extended essay create a marking burden for staff but this has proven manageable. There is potential for plagiarism or collusion with the 'project plan' task. Although this hasn't been an issue the intention is to design-out this possibility by individualising this task. Some students have difficulty visualising practical tasks such as making up solutions, prior to conducting these tasks. The tutor plans to address this by creating simple video clips or an extra lab session.

### **Benefits**

The module provides training in a range of common laboratory techniques and encourages students to think deeply about experimental work: *"If I ever go and do lab work again I'd think about it a lot more"* *"Why am I doing this? What will it tell me?"* The practical project and supporting activities give a breadth of experience: *"I know people who did lab projects..just in the lab for 8 weeks..they have no idea how to do the other things we do"*. Students expressed improved confidence in talking about lab techniques and planning experiments, and recognised this as useful for their CVs and job interviews. The project format ensures all students receive optimal supervision. All students considered the module *"well-structured"*, and the *"deadlines along the way"*, helpful. They also appreciated learning in a small group.

### **Reflections**

This project format provides a valuable in-depth laboratory experience and a popular and workable alternative to the traditional research-lab project for small numbers of students, and is applicable to students of all academic ability and which other universities may wish to consider. The only issue for other departments may be the staff time required. It is *"not a substitute for going into a research lab but has many advantages"*. The teaching-lab environment makes this type of project relatively risk free for students and staff: *"students can make mistakes and mess things up, reagents are relatively cheap"*; this freedom allows students to engage and experiment as never before. One current student reflected: *"people I've spoken to are like wow is that what you're doing, that sounds good"*.