Research for real - an intensive Honours research project

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Background and rationale

In the School of Life Sciences at Napier, we have run a final year honours research project in all our biological science programmes for many years, for ~ 100 students per year. The following distinguishing features characterise our final year project provision:

- **Size** the module is worth 60 credits, contributing one third of the honours degree marks, and runs for the whole of semester 2 in the final year. Because the students have finished all other assessments (including any 'final exams', which are taken at the end of semester 1) they can thus focus entirely on their research, and have sufficient time to conduct a significant piece of work.
- **Choice** students are offered a wide variety of potential topics from which to choose, covering the whole range of the biological sciences. They are also encouraged to suggest their own research ideas and to discuss these with appropriate potential supervisors. All projects must involve the collection of original data (either primary or derived); they cannot consist only of literature reviews. But beyond that constraint the methods chosen are very varied and can include qualitative as well as quantitative approaches. Hence projects may range from interviewing creationists to isolating salmonella and from flamingo behaviour to nanotoxicology.
- **Authenticity** because the project is such an important part of their degree, and students commit significant time and effort, the resulting research is often of a high standard. This is demonstrated by the frequency with which student projects are published in peer-reviewed journals.

As far as possible, the project represents 'research for real'; carefully planned but opportunistic, full of false starts, frustrations and triumphs, driven by curiosity but controlled by ethical and health and safety guidelines, and constrained by money. As such we see it as a key vehicle for the development of all those 'research skills' that are also core employability skills: time management, independence, self-motivation and organisation, synthesis and analysis of diverse information, ethical sensibility and written communication.

More formally, the learning outcomes are to:

- Derive a project proposal, based on identification and review of relevant literature, consideration of experimental design and statistical analysis, and safety considerations.
- Develop a programme of independent research, using appropriate investigative techniques and research tools.
- Organise and analyse data derived from the research in order to test appropriate hypotheses.
- Synthesise results and present them in the context of previously published information, as part of a detailed scientific report, to appropriate standards of presentation.

How to do it

Early preparation

Because our students need to get started fast on a big piece of research, it is important they know the basics of literature review and retrieval and study design beforehand. Elements of these skills are developed in various modules throughout the programmes, but all students take a core 'dissertation and statistics' module at level 9 ('3rd year' of a 4 year Scottish degree), in which they produce a literature review on a topic of their choice, which ensures they all have these skills.

Choice of project topic

Students are encouraged to begin thinking about project topics at level 9, and can informally approach potential supervisors at any time to discuss ideas. Staff provide a list of potential projects at the start of semester 1, level 10 (4th year), and students choose a selection of potential topics and discuss these with the relevant supervisors (along with their own ideas if they have

them). They are expected to confirm a project choice and supervisor by mid-semester.

Project plan

By the start of semester 2 level 10 (in February), students have completed all other assessments and focus entirely on their project work. They have two weeks to produce a fully referenced project plan. This includes details of the background of the proposed study, procedures to be used, experimental design, statistical methods to be employed, safety considerations, and a project time plan. The plan is marked by the supervisor (and is worth 10% of the total project marks). Detailed feedback is provided to the student within 2 weeks of submission, thus ensuring there has been scrutiny of the project design and methodology.

Where relevant (particularly when working with humans or human material) students also complete a form for rapid independent scrutiny by an ethics committee.

Project execution and supervision

Students have ~10 weeks in total for their projects. During this time they are expected to communicate regularly with their supervisors; weekly or fortnightly meetings are normal, although considerable flexibility applies depending on the nature of the project. For example, some students conduct fieldwork abroad, and may thus have additional supervision arrangements where they are working, whilst others are in daily contact with supervisors while working in their laboratories. All students are encouraged to submit drafts of their thesis chapters and receive detailed feedback on these. They also maintain a project record book, which includes self assessment of skills developed.

Although students are assessed individually on their projects, they may work with peers during data collection. This can help with health and safety issues and also ensures the generation of sufficient data for some projects. There is a nominal sum of £50 available from the School for each project student – this helps cover small costs such as photocopying and travel.

Project assessment

The total project mark is composed of:

10% — project proposal. Mark given by the supervisor.

10% — project performance. This mark is given by the supervisor on the basis of the student's performance during the execution of the project. It includes aspects such as sticking to agreed meeting times and deadlines, engaging positively with advice and criticism, showing sufficient commitment and initiative and maintaining the project book and skills record. It is included partly as a partial safeguard against those occasions when there is less data collected than expected because of problems beyond the control of the student (such as extreme weather events etc.).

80% — project report. The final report is 10-15,000 words (excluding references) and usually follows the format of a scientific paper. It is marked by the supervisor and a second marker, and reviewed by an external examiner. Some students (particularly borderline cases) have an oral examination based mostly around their reports.

Advice on using this approach

- **Start early**

  You need to begin explaining the project early in the programme — even from first year. Students look forward to doing it, but need time to consider their own topics and arrange logistics. Students are much more likely to suggest sensible topics of their own if they are briefed well in advance.

- **Celebrate diversity**

  Allowing students maximum choice in their topics (within basic constraints) inevitably leads to challenges — such as how to compare work on a microbial genome with interview surveys on attitudes to conservation. But students deserve and relish choice. Many will not go on to do 'standard' biological jobs or research, so where possible their experience of the research project should be relevant to their aspirations. A recent survey of Napier students found that the topic was by far the most important influence on students' choice of project (Alison Craig, pers. comm.).

- **Permit mistakes**

  Your assessment process should allow for genuine mistakes and false starts, giving credit for overcoming these. Whilst giving support and encouragement (and preventing dangerous and unethical practices) supervisors need to allow students freedom, and remember that the purpose of the project is student learning, not the production of research.

- **Make supervisors accessible**

  Students must be able to access their supervisors — so they should guarantee a minimum availability (during 'office hours' for example) and be as approachable as possible.

Troubleshooting

The following issues are raised every year and need careful consideration:

- a) What is 'original data'?
  Our project requires students to collect original data. This is usually interpreted as quantitative (and sometimes qualitative) data generated by standard observational or experimental approaches. But many marginal cases arise. For example, some students use data collected by other people (such as wildlife records from environmental charities) and analyse it; we think this can make a very demanding and useful project, but involves different skills from designing a study from scratch and generates 'derived' rather than primary data. Other students choose to create a resource (such as a web page), in which case they must also collect data such as evaluations of the resource.
- b) Costs and equity
  Projects can be expensive, but the costs vary widely depending on the topic and discipline. Whilst the £50 nominally available for each student may be more than sufficient for an excellent piece of work on the behaviour of crows, it may not cover one reagent in a biomedical project. Students working in more expensive areas rely on pooling resources and benefiting from supervisor's resources, but sometimes this leaves them with less choice than is available for other groups, such as animal biologists.
- c) Parity between supervisors
  The success of a project depends on good collaboration between students and supervisors. Because different supervisors take different approaches (and different projects imply different arrangements) some students may receive more support than others. For example, all supervisors are required to give feedback on drafts, but how detailed this is depends on the circumstances. Whilst diversity of approaches is inevitable (and good), there need to be ways of ensuring fairness between students.
- d) The assessment of 'performance'
  Our system involves a 10% 'performance' mark, awarded on the basis of student conduct during the project. Because this is a partly subjective judgement it is open to bias. Hence it needs to be supported wherever possible with evidence (such as attendance records at meetings, records of advice properly taken etc.).

Does it work?

Student evaluations suggest the project is usually the most valued part of the undergraduate experience. Recent graduates emphasised the importance of the freedom and responsibility involved in building confidence:

- "Undoubtedly the biggest skill gained from my project, was confidence. I had researched a subject, had produced a hypothesis, planned and carried out the piece of work, liaised with staff and fellow students and then produced a thesis. My very own work!!"
- "The fact that the whole project is your responsibility is very challenging, but also makes it an invaluable experience that I will never forget."

They also talked about the importance of having plenty of time to do good research:

- "The whole semester spent carrying out a full-time research project allowed me to apply all of the skills and knowledge I had gained during the rest of the degree program. The project felt like a natural culmination of the all of the teaching and learning we had been through".
- "The benefits of doing this over a whole semester are countless … it was vital that I had plenty time to let my experimental work take effect."

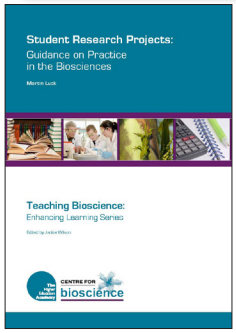
On average, student marks in the project are ~5% higher than in their other modules. We think this reflects the enthusiasm with which most students engage with their project.

Further developments

Project allocation

Currently students choose a topic then approach the relevant supervisor. But if the project is already allocated they lose out. We intend to develop a more sophisticated method of allocation, involving ranked choices adjudicated by a single member of staff, to ensure all students get a highly ranked project topic.

Accompanying materials



This case study was included in the Teaching Bioscience: Enhancing Learning guide entitled *Student Research Projects: Guidance on Practice in the Biosciences*, written by Martin Luck and published by the Centre for Bioscience. The associated website (www.bioscience.heacademy.ac.uk/resources/TeachingGuides/) contains a downloadable version of this case study and the following additional material:

- The assessment scheme used in marking.

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