A virtual laboratory for Bioscience e-learning projects

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Background and rationale

This case study presents a six-step framework for a course to train and support final year students who opt for e-learning projects. Students plan, design and develop e-learning resources that support the undergraduate curriculum and contribute to the Faculty's overall e-learning strategy. The course aim is to provide students with a similar experience to their laboratory counterparts, and develop skills associated with the scientific method, such as analysis, evaluation and critical thinking.

In the Faculty of Life Sciences (FLS) at The University of Manchester, the majority of bioscience final year projects are conducted in a traditional laboratory setting where students work independently under the supervision of a member of staff. Increasingly, however, non-laboratory projects are a popular alternative. This provision is driven by demand from a significant minority of students who are attracted by the opportunity to work away from the laboratory, as well as by pressure on staff to supervise relatively large numbers of students with somewhat limited resources. The challenge is to ensure such projects are scientifically rigorous, and that laboratory and non-laboratory students have a similar experience of project work. We have around 30-40 students per year, from a wide range of disciplines from Anatomy to Molecular Biology, who undertake e-learning projects. They are supported in an 'active-learning' training course that develops project skills, and they design, construct and then evaluate e-learning resources, such as data-driven activities, or virtual experiments to support laboratory classes, for example. Students use a range of software and technologies to develop their projects, as well as a variety of learning designs to promote enquiry-driven learning. We hope this approach will enhance and demonstrate the project students' problem solving and critical thinking skills as well as those of their target audience.

How to do it

Six-Step Course Framework

The six-step course framework has an enquiry-driven focus based on the 'language of inquiry' model (Justice et al., 2002) to promote self-directed learning, critical thinking and collaborative learning. Further, the framework aims to improve the student experience of the online learning environment by focusing on four key areas identified by Boud and Prosser (2002) as being essential for enhancing student learning:

- Learner engagement;
- The learning context;
- Challenging learners; and
- Provision of practise.

1. Course Environment

The compulsory course takes place within a computer cluster and uses blended delivery by e-learning staff comprising 15 face-to-face sessions over a twelve-week period spanning Semesters 1 and 2. In Semester 1 the focus is on learning project-related skills whilst the students write a scientific Literature Review, and Semester 2 comprises actual project work accompanied by workshops and presentations on statistics and report writing, for example. Additional workshops are held according to demand. The course is also accessible online within our VLE. Each session has an associated task, on which students report in online discussion forums.

2. Student Support

The project supervisor delivers academic advice and guidance on scientific content, and the e-learning team (Course Coordinator plus one or two learning technologists) are course tutors, lecturers and facilitators within the discussion groups.

3. Course Content

Course sessions cover a range of topics including the use of software, copyright issues and statistical analysis. We follow Strickland's (date unknown) ADDIE instructional design principles (Analysis, Design, Development, Implementation and Evaluation) to guide students through the process of product development. Planning the resource in the Design phase is crucial, and students must produce a storyboard and discuss their individual requirements with the e-learning team in 1-to-1 meetings, who will advise on the most appropriate software for the job.

4. Focus on Enquiry and Active Learning

- Students select their topic and target audience with discipline-based advice from their supervisor.
- They formulate a hypothesis to test. In its simplest form, this might be based on whether the resource improves learning; students might compare test scores of their target group before and after using the resource. Alternatively, students might investigate the efficacy of formative assessment by using control and test groups, or correlate performance with variables such as gender or A-level point score.
- Students are encouraged to use a problem-oriented approach, using scenario- or data-based formats. They use a variety of software packages including web authoring tools such as Wimba Create and Dreamweaver, as well as Flash, Macromedia Breeze and various assessment tools, plus audio and video technologies and editing software.

5. Communication and Collaboration

Central to the framework is the 'virtual laboratory' where groups of students (7-10 students) communicate, collaborate, and participate in peer review (Semester 2) in discussion forums to troubleshoot design and usability issues. The intention is that these project groups mimic the social interactions students might experience in the laboratory and form social networks for mutual support (Topping, 2005), as well as develop critical thinking and evaluation skills by peer review (Race, 2001).

6. Assessment

We aim to engage students in the course by constructive alignment of aims, online activities/course content, and assessment (Biggs, 2003). Online activities are relevant to the project endpoint, and assessment is linked to both the performance of students during their project, as well as to the final product and report.

Assessment of e-learning projects follows the same guidelines and procedures as other final year projects with the supervisor as principle marker. Scientific focus is maintained by production of a 10-credit literature review based on the bioscience underpinning the resource, which is submitted in advance of the project work. The project proper counts for a further 30 credits and equates to around 300 hours work (including training sessions). The mark has 3 components:

- 20% for project performance;
- 20% for the e-resource; and
- 60% for the project report.

Supervisors are able to search for and access individual student contributions to the organised tasks and discussions within the VLE and use this information as a qualitative measure of the project performance. They are also provided with compiled transcripts of their student's contributions.

Student projects

Students employ a variety of project designs:

- **Linear resources:** allow the user to progress through a linear sequence of information, punctuated by interactive and assessment activities. This is useful for problem-solving activities where prerequisite knowledge is needed to move to the next stage of the problem. A resource on 'Molecular Cloning' designed to complement a Second Level laboratory class, for example, contained sequential information (figures, animations and text) and activities (such as searching databases and manipulating information) to enable the user to clone the Human insulin gene into a vector.
- **Non-linear resources:** Some students use innovative software, Scenario Based Learning Interactive (SBLinteractive, 2007) to design multi-path problems, which may have one or more final solutions. The user explores different possible routes through the content. The SBLi interface allows the user to visit different locations, such as a virtual laboratory, or clinic, and perform actions associated with that location, which then enable the user to progress to another stage of the investigation. Progression to the correct endpoint is dependent on the user successfully completing various pre-requisite tasks/actions.
- **Integrated resources (within the VLE):** these enable groups of users to interact via discussion forums, a key feature of enquiry-based learning. Thus, it is possible to move away from simple online assessment activities, to a forum where student users can present views based on critical analysis of information, such as ethical or data-based evidence. The process of investigation becomes group-based and more open-ended. Enquiry-based formats for group work can also be created with designs such as WebQuest (2007).

Advice on using this approach

- Market the course and projects to staff and students in order to recruit individuals interested in e-learning, rather than those who simply want to escape the lab!
- Report writing guidelines need to be clear so students understand how to present their project work, and we also provide criteria for assessment of the e-resources.
- Students tend to be over-ambitious and/or want to reproduce their literature review on the web. Encourage them to focus on one aspect and develop a problem-oriented approach to their topic.
- Remind students to maintain regular contact with their supervisor; the course coordinator cannot be responsible for 30-40 projects!
- Resources are unlikely to compete with commercially available packages but have the advantage of being tailored so they can be incorporated directly into course units.

Troubleshooting

- Non-participation of some students in online discussions is almost inevitable; advice is to review discussions weekly to see who is not participating and post 'reminder' messages to 'scaffold' and focus the discussion (Salmon, 2000), and email 'quiet' students.
- Time management is a problem for many students; provide deadlines to help them complete work on time (e.g. for posting plans online, constructing a Homepage, evaluating their resource).

Does it work?

- Annual evaluation of the programme over the past three years has demonstrated consistently high student attendance at face-to-face sessions and participation in the online course, as well as high level of satisfaction with the programme overall.
- Over 80% of students liked being a member of a project group, and found that working in project groups was helpful or very helpful.
- Students found that belonging to project groups facilitated socialisation and promoted participation in online tasks, as well as acting as a forum for support. They used the discussions to ask technical questions, make general enquiries, and share ideas and resources. Peer review was helpful to most students by providing feedback on project content, and in evaluating design features.
- Students used a range of strategies and designs to fulfil similar goals in creating e-learning resources. They demonstrated a range of skills traditionally associated with the scientific method, such as formulation of hypotheses, planning and experimental design, collecting, analysing and evaluating data, and communicating scientific ideas and results. The distribution of marks and degree classifications was similar to those of laboratory-based students, demonstrating that overall quality of project work was maintained.
- Our virtual laboratory offers many other advantages to students over more conventional laboratory projects; materials can be accessed remotely and at a convenient time; students can work through them at an appropriate pace, and communicate asynchronously and remotely. This is particularly important with increasing diversity in students, who may have different academic backgrounds, language issues, or family or employment commitments.
- The cost per student is minimal since software resources may be shared and recycled. Further, the training course run by one or two members of staff means that individual project supervisors do not have additional workload; indeed, supervision of more than one e-learning project student is more time effective because the students support each other.

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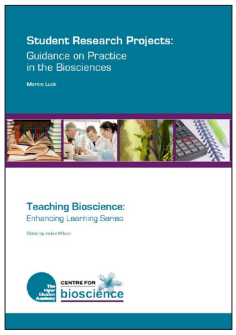
Additional materials



This case study was written to accompany 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:

- Full details of the Course sessions, associated learning outcomes and tasks.
- Examples of Student Projects.

Examples of student projects can be viewed at: www.ls.manchester.ac.uk/undergraduate/courses/modules/elearning/elearningprojects/ (under construction).

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