

# Linking Teaching and Research: Using Research Seminars to Enhance Enquiry-Based Learning Activities in Faculty of Life Sciences Tutorials

Tristan Pocock, Carol Wakeford and Ian Miller, Faculty of Life Sciences

## Abstract

This project aimed to link teaching with cutting-edge research in the biological sciences by using Faculty research seminars as a basis for the development of enquiry-based tutorial activities, incorporating video clips of the seminars. The target group was Level 1 students, with the potential to extend activities to Level 2 and Final Level. The intention was that students would develop an awareness of current research in the biological sciences and develop a broader understanding and knowledge of current issues in biology. This might encourage them to attend seminars in the future, and enhance their skills of enquiry, and thus help prepare them for Final Level projects and examinations. A pilot was conducted using the Faculty of Life Sciences (FLS) Annual Lecture 2007 by Professor Sir John Sulston entitled 'Genetic Equity and Global Medicine – What is Science for anyway?'

Three themes were identified, and CDs were produced combining selected video clips with a range of tutorial activities and resources. Tutor notes were also compiled. Evaluation by three tutor groups and tutors provoked a positive response from students and staff, although a more rigorous evaluation will be carried out with larger numbers of students in the forthcoming semester. Future developments include production of further video-based activities using a wider range of seminars from the FLS Frontiers of Science series. This process could involve Final Level project students.

# Background

'Research and teaching are essential and intertwined characteristics of a University' (Research Forum 2004). FLS is a 5\* rated research Faculty which attracts high-calibre students on the basis of its reputation for excellence in research. Evidence from other universities suggests that students 'value the idea of studying in a research-rich environment' as they feel that they are part of a 'research community'. However, in practice, they often feel excluded (Zamorski 2002). Increasing focus on linking research and teaching can 'aid students' learning, their pride in their discipline and department, staff morale, and the overall effectiveness of the department and the institution' (Jenkins *et al.* 2007). Healey (2005) suggests that research and teaching can be linked by four separate mechanisms: research-led; research-oriented; research-based or research-tutored teaching. The classification depends on whether students form the audience or are participants in the research, and whether the approach emphasises the research content or processes and problems.

In FLS, teaching is research-led, particularly at the Final Level, where there is a large range and number of course units arising out of the research interests of the academic staff. This project aimed to link teaching with research within the Faculty and with external institutions, using Enquiry-Based Learning (EBL) activities. It was aimed at students in the FLS tutorial programme, primarily at Level 1, but it could also be applicable to Level 2 and Final Level. There are around 500 students per year group in FLS across a wide range of degree programmes from Anatomy and Plant Science to Biochemistry and Bioinformatics. All students attend small group, degree programme-specific tutorials of 6 -12 students, where learning is focussed on transferable skills. Writing skills are paramount in Levels 1 and 2, and in the Final Year there is a shift towards problem-solving skills as well. Students are currently involved in a variety of EBL activities, such as literature research for group presentations and posters, and individual dissertations. Faculty research seminars, delivered by internal and external experts, aim to encourage a broader scientific knowledge-base and an awareness of cutting edge research in both staff and students. Final Level students in particular are encouraged to attend, but in reality many students have never experienced a research seminar presented by an external expert.

# Rationale

Regular extra-curricular seminars are presented by experts on a wide range of research, which undergraduates often find complex to understand; this acts as a barrier to participation. The aim of this project is to utilise this valuable resource by rendering it more accessible to undergraduates. Since EBL is an active process that promotes deep learning, it is envisaged that the developed activities will stimulate interest in cutting edge bioscience, and give depth and breadth to students' knowledge, enabling them to make better interpretations of, and judgements on the relevance, importance and implications of biological research. Active learning is postulated to have many benefits. These include helping students to learn (Lawson 1995), increasing confidence with class materials (Townsend *et al.* 1998), ensuring students are motivated, learning at higher cognitive levels and retaining knowledge for longer (Nilson 1998; Watson *et al.* 1996).

This project was designed to 'bring the research seminar to the students' by the use of video technology to record the process, with subsequent editing of the session to produce 'bite-size' clips of video to stimulate EBL activities. We hoped to widen the appeal of Faculty Research seminars and perhaps entice more students to attend, but also to maximise their usefulness by incorporating them into the tutorial system, thereby exposing many more students to the content and give seminars 'added value'. This would increase awareness by students of current research and experts in the field, and broaden their biological horizons in preparation for project work, future research activities and possibly the Final Level general essay examination paper, in which students are required to write on a biological topic of more general interest. Further, we aimed to share any resources that we developed with the institution of the external speaker.

Benefits to students include not only broadening their understanding of current biological research, but enhancement of their transferable skills associated with the scholarship of enquiry-driven learning. These skills, including research and analytical skills, and the development of team and group working skills in a student-led learning environment, will be of benefit in their future careers. The framework for this project, and the EBL activities developed would be transferable to different Faculties/Departments (and institutions) in order to enhance the EBL experience of students across the University. Moreover, involvement of external speakers in the development of EBL activities would foster links between institutions and promote the sharing of resources and dissemination of EBL across the academic community.

Learning outcomes for students were to:

- work cooperatively in groups;
- identify scientific themes, questions and/or problems and issues from presentations;
- research issues and communicate these ideas in a variety of ways (posters, presentations, developing concept maps, abstract writing, etc);
- gain an understanding and an awareness of the breadth of the biological community and its research interests.

## Approach

Initially, approval for the project was sought from key Programme Directors, who coordinate tutorial activities. Programme Directors for the largest degree programmes in Biology and Biomedical Science were enthusiastic about the potential benefits to students and agreed to encourage their tutors to trial any resources that were generated. The IT team had already agreed to undertake the video recordings and editing activities prior to our request for funding for the project.

Next, seminars were identified that would have broad appeal, and not require detailed specialised pre-requisite knowledge. However, we encountered our first hurdle when we approached an external speaker to seek consent for the project, i.e. to video their talk and develop associated EBL activities. The first speaker that we selected was reluctant to participate because the talk contained unpublished experimental data. We realised that talks containing information on human case studies or animal experimentation may also present difficulties in terms of breaching confidentiality and evoking extreme responses. We, therefore, modified our approach and decided to focus initially on a public lecture delivered by Nobel Laureate Professor Sir John Sulston, who readily consented to our work. Subsequently, we decided to use a series of in-house seminars designed to showcase Faculty research: the 'Frontiers of Science' series. A list of speakers was obtained from the Faculty administrator who coordinated these seminars. It was hoped that students would be 'given the opportunity to see their teachers as real people and to be able to glimpse what they do, how and why' (Neumann 1994).

The pilot seminar was recorded and copied to CD. The content was analysed section by section, and three main themes were identified. These were used as the basis for the EBL activities. The themes were: Genes and the Human Genome Project (HGP); Genes and Genetic Equity; and Global Medicine. Tutorial activities were constructed around questions arising from these themes, supporting references were researched and tutor notes were produced giving key points as indicators. We were assisted in this task by the FLS CEEBL intern, a Second-Level student who was enthusiastic about the project and keen to help with the development and evaluation process. CDs were produced containing edited film clips of between 2-5 minutes in length, accompanied by a series of optional activities for each theme, Figures 1a and 1b. These were distributed to participating tutors.

## A. Genes and the Human Genome Project (HGP)

### Aims

To appreciate the importance of fundamental scientific research

### Outcomes

- To understand the significance of sequencing the *C. elegans* genome
- To appreciate the similarities and differences in genomes
- To know how to investigate genomes
- To know about the discoveries culminating in the sequencing of the human genome.

### Activities

- Activity A1, A2 or A3
- Activity 4

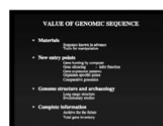


Figure 1a Screen shots from the Video Tutorial.

## B1. Cooperation or competition?

- Discuss the pros and cons of scientists competing for scientific discovery or cooperating in scientific discovery (with particular reference to the HGP).
- Is genetic information in the private or public domain?
- What are the pros and cons of private versus public ownership of genetic information?
- What is the Bermuda statement?
- What are the public genetic databases?



Figure 1b Screen shots from the Video Tutorial.

Tutors were required to select a theme and activity with their students as appropriate. The suggested format was for activities to run over two or three weekly tutorials – the first tutorial should be an introductory session, with tutors showing the recorded material relevant to the chosen activity and allowing students the chance for discussion and questions; students should then formulate learning objectives in order to structure their research; the second tutorial should be used to discuss the material gathered from individual research, revisit the recorded material if necessary and start preparing for the presentation in the final tutorial. The CD was trialled on two groups comprising a total of fifteen students.

Example activities:

- a) Working in groups, you should investigate the experimental methods that lead to the elucidation of the sequence of the human genome.
- b) Consider what discoveries were made as a result of using these techniques.
- c) Consider how different discoveries were related to each other. (Names of scientists (from Mendel onwards) would be useful here).

Presentation: Verbal presentation by each member of the group who takes on the role of one of the 'key players' in the history of DNA and genes (role play) OR Poster of a time-line illustrating the progression of scientific discovery culminating in the sequencing of the human genome.

## Assessment

FLS tutorials are compulsory, non-credit bearing courses. However, non-attendance and/or non-submission of essential course work results in loss of compensation rights for any failed examinations. Level 1 students are already assessed on their performance in group-based activities and also on oral presentation. The activities associated with this pilot project were not assessed in this instance but could, in future, form a component of the tutorial assessment process.

## Evaluation

- Students' experiences of the activities were evaluated by questionnaire. They were asked whether the activity related to their selected course units, how much they enjoyed the exercise and whether they felt inspired to attend future seminars.
- Staff questionnaires were designed to evaluate staff perception of how students engaged with the activities, how easy it was to navigate around the CD and how useful the tutor notes were.

From the small sample of responses received so far (three tutorial groups), students appeared to enjoy the activity and felt it was relevant to their chosen course units. None of the students questioned had ever attended an extracurricular seminar but 50% said they would be more likely to attend seminars in future. Staff commented that students worked well together on the piloted activity. However, there were problems with navigating through the CD and it was not possible to rewind or spool through recorded clips. The CDs have been updated in response to this feedback and the revised versions will be used in 2008-9. In order to evaluate the success of these activities as learning tools, it may be pertinent to compare the examination scores of Final Level students in

the General Examination papers (based on non-programme specific material of a general biological nature) with those of previous years.

## Challenges

It is essential to have good quality video recordings of seminars that capture a good balance of shots of the speaker as well as slide material. The audio needs to be of sufficiently good quality so that the video can be watched by 6-8 students in a tutorial room. The clips need to be carefully selected to provide interesting and relevant content to support the activities and to provoke discussion, preferably with some interesting anecdotes. All themes chosen should relate broadly to the curriculum. Aims, intended outcomes and tutor notes need to be clear and comprehensive, and the resources to support the activities need to be easily accessible (i.e. students need to be able to find supporting papers or websites relatively easily). It took much longer than anticipated to create the CD and activities – hence only one pilot CD has so far been generated. This project has also required a large amount of support from IT services. Ideally, we would have met up with the IT support on a weekly basis for progress to be faster, but other commitments limited the time spent on the project.

## Further Development

We have already received video recordings from four other 'internal' seminars from the 'Frontiers of Science' series. These are:

Owen Jones	<i>How do we get epilepsy and what can be done about it?</i>
Rosalie David	<i>Ancient Egyptian Mummies: a resource for studying disease in ancient and contemporary Egypt</i>
Andrew Loudon	<i>Genes which control your biological clock: when to get out of bed</i>
Mike Dixon	<i>Craniofacial anomalies from bench to bedside</i>



We hope to progress to recording external speakers. However, as stated above, this may require some negotiation if they are worried about unpublished data being circulated.

The task of developing similar tutorial activities could be undertaken by Final Level project students. This project work would, by its nature, be enquiry-based, as students would need to identify themes for themselves and do the research to collate suitable resources for tutors.

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