Generation of EBL Materials to Support Second-Level Practicals and Final-Level Tutorials

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Abstract

Phase II of the Faculty of Life Sciences (FLS) CEEBL project in 2007-8 aimed to generate Enquiry-Based e-Learning resources by Final-Level project students, themselves using an enquiry-based approach in project work. In addition, we aimed to revise the FLS Final-Level tutorial programme (in preparation for implementation in 2008-9) and to incorporate additional EBL activities. 33 students opted for e-Learning projects and they attended a dedicated course to train them in project skills. They developed a range of e-Learning resources to supplement Second-Level practicals and other FLS course units. They used a variety of software and other technologies to create a range of learning designs, such as scenario-based resources and problem-solving activities. The designs were then evaluated using their chosen target group. Although project students produced individual projects, they worked in project groups in a blended fashion (i.e. online and face-to-face) to support each other and critically review their project materials. Contributions to online discussions were used by supervisors to help assess Project Performance (20% of the project mark). Project scores were comparable with those obtained by laboratory project students. The overall quality of e-Learning resources was high, which was attributed to improvements in the training course, such as the introduction of creative and critical thinking activities.

Final-level tutorials have traditionally concentrated on preparing students for degree programme-specific problems and essay examination papers. Tutors are guided by programme directors on the material to be covered and on the scheduling of tutorials, which has led to an inconsistent experience for students across the Faculty. This project aims to collate materials that can be used by Final-Level tutors to set up a repository of information which is easily accessible to tutors and students. In addition, new generic

activities, such as investigating different careers, will be developed that will equip students better for life after university.

Background

The first phase of the FLS project in 2006-7 comprised an audit of current EBL practice in the Faculty, a pilot project to generate e-EBL resources to support Second-Level practical classes (Laboratory Skills Modules, LSMs, and Research Skills Modules, RSMs) and identification of other potential EBL (Enquiry-Based Learning) opportunities to enhance the Final-Level tutorial programme, in particular.

The target groups of the Faculty Project are Second and Final Level students across the whole range of Bioscience degree programmes, from Anatomy to Molecular Biology and Plant Science to Biotechnology. There are approximately 500 students per year group, and all are involved in Second-Level practical classes and Final-Level Tutorials. A minority of Final-Level students (33 students in 2007-8) are involved in e-Learning Projects (rather than laboratory-based projects) in which they generate these e-Learning resources. The Faculty project is now at the end of the second year of a three-year term.

Rationale

The evolution in technology over the last decade, coupled with changing expectations of students, has led to a demand for online teaching and learning materials. The process began, for example, with posting basic lecture notes and practical manuals online and developing bulletin boards. The challenge for FLS is not only to introduce an element of e-Learning in all course units, but also to provide a genuine e-Learning experience for students by embedding the principles of enquiry within the e-Learning resources. Second-Level practicals are housed in two stand-alone course units, rather than forming an integral component of 'theoretically' taught course units, and there is a need to supplement laboratory manuals with additional materials. Therefore, a component of the CEEBL-funded Faculty project is to develop online EBL materials to support Second-Level practicals, such as pre-lab preparation, extension or practice activities in data handling and problem solving, as well as *ad hoc* resources to support other undergraduate course units. These resources may also be of use in Final-Level

tutorials to help prepare students for their Final General Examination Papers, which require a general biological knowledge for the General Essay Paper and an ability to solve problems in the General Problem Paper. We piloted a project in 2006-7 where e-Resources were generated by final-year students, who constructed e-Learning materials for their projects rather than undertaking traditional laboratory-based research projects; and this initiative continued this year in 2007-8.

A second component of the Faculty Project is to generate a generic tutorial programme for Final-Level students that will incorporate practice in essay-writing and problem solving (in preparation for the General Examination papers outlined above). The programme will also provide optional EBL activities that are designed to prepare students for the world of work beyond their degree, such as developing an awareness of research in FLS (by investigation of Faculty research groups and their publications), preparation of CVs (in conjunction with Careers Service and alumni) and practice in interview techniques (in preparation for potential vivas and job interviews). Current tutorial provision for the Final Level is somewhat inconsistent regarding the contact hours and availability of resources to tutors in the different degree programmes. We aim to address this issue by integrating Course Materials into the Blackboard VLE under a new Tutorial Course Code banner (BIOL30000), and ensuring that all tutors have access to course materials, guidelines on their delivery (i.e. suggested timetable, additional activities and past examination papers) and model answers to aid feedback to students.

Aims for 2007-2008

- To generate a bank of online EBL resources to supplement Level 2 practicals using EBL Final-Level projects.
- To produce a draft tutorial programme and additional resources for Final-Level, to be implemented in September 2008.

Approach

Part I: EBL Resources – Carol Wakeford

Selection of Project Students and Supervisors

In 2007-8, 33 Final-Level students opted for an e-Learning project by filling in the appropriate project selection form on the Faculty intranet. These students were supervised by a total of 25 academics (some supervisors had more than one project student), and 10 of these (out of a possible 16 potential supervisors of Level 2 practicals identified in 2006-7) were involved in the design and delivery of Second-Level practicals. (The remaining six potential supervisors could not be matched by academic discipline to e-Learning project students and did not participate this year.) Despite marketing the projects both on the Faculty intranet and at a dedicated talk on Final-Level Projects given by the Senior Tutor, no Biochemistry students volunteered for e-Learning projects. Supervisors not involved in Level 2 practicals (but who opted for an e-Learning project student) were encouraged to focus on tutorial materials where appropriate. Excel spreadsheets were used to record details of supervisors and their assigned students, degree programmes, project titles and attendance at BIOL30ELP (a training course for project students).

Meetings

A meeting was then held for project supervisors to explain the rationale for the CEEBL project; to request their cooperation and support; to give details of the training programme; to present ideas for projects; and to field questions. Supervisors were reassured that they did not need expertise in technology, e-Learning or EBL, but a general enthusiasm would be helpful! Guidelines for e-Learning projects were provided for both staff and students on the Faculty intranet.

Recruited supervisors were then informed if their students did not attend the dedicated training course for e-Learning projects, BIOL30ELP; this was only necessary a couple of times as most students had excellent attendance. In the past the training course had proved essential in ensuring that all students are able to produce a usable e-Resource by the Easter vacation deadline.

Supervisors were e-mailed throughout the year to remind them of deadlines and procedures relating to projects (such as assessment criteria).

Supervisors were also mailed (July 2008) to elicit feedback on the training programme and to ask whether they intended to use their student's resource in their teaching activities.

Regular contact (at least weekly) was maintained between students and the e-Learning team, particularly in Semester 6, when students needed more support in the technical aspects of their projects.

BIOL30ELP e-Learning Projects

All e-Learning project students attended the compulsory training course (BIOL30ELP e-Learning Projects) spanning Semesters 5 and 6 to equip them with appropriate project skills (such as project planning and instructional design, copyright, statistics and the use of a variety of software applications), which was facilitated by Carol Wakeford and supported by Ian Miller and his e-Learning team. This course was a revised and re-branded version of BIOL30CAL that was used in 06-07. The course was also available online in WebCT. The course ran over the latter 6 weeks of Semester 5 and up to the Easter break in Semester 6 (12 weeks), and took place in a computer cluster in a dedicated project lab. As in Year 1 of the FLS Project, face-to-face workshops were accompanied by online goal-oriented tasks within a 'virtual laboratory' environment, where students developed their projects, collaborated and supported each other in groups (Figure 1).

Session	Learning Outcomes	Task
Initial briefing with project supervisor	Identify an area of interest.	Explore topic and research the literature.
Introduction to WebCT	Familiarise with the WebCT environment and course.	Email project title to course tutor. Post response to discussion board (DB) 2.
PBL and EBL Resources	Appreciate the attributes of a good e-resource.	Review attributes of e-resources (DB 3). Construct flowchart for a scenario (F-2-F Group Activity).
Principles of e-Learning	Understand the pedagogy of e-Learning, and learning styles.	Identify your learning style using the online resources (DB 4). Begin reflective diary.
Project planning: ADDIE principles	Plan your skills development programme and generate a plan.	Develop project storyboard. Perform skills audit (DB 5).
Survey and Questionnaire design	Formulate evaluation question.	Identify target audience (DB 6). Perform needs analysis.
Copyright and intellectual property	Comply with copyright regulations.	Complete copyright declaration. Check images etc comply.
Literature review	Research the literature; produce a written review.	Reflect: post a notice to DB 8 outlining your progress.
Tools for authoring	Select Software tool for resource development.	Explore the software (group activity). Post your decision to DB 9.
Building your Homepage	Understand attributes of web authoring tools.	Construct a homepage. Peer review; DB10.
Dreamweaver and pblinteractive	Use software to develop resource (EBL or PBL).	Upload project materials for peer review.
Graphics for the web	Manipulate images and produce a simple animation.	Engage your audience: design interactive features.
On-line Quiz design	Evaluate learning outcomes.	Assess your audience using a Quiz, Questionnaire, etc. Test your hypothesis.
Statistical analysis	Select appropriate statistical test(s) and tools.	Analyze and evaluate project data.
Report writing	Plan and write a project report.	Submit report. Liaise with your supervisor.

Figure 1 BIOL30ELP Course Overview.

Students were allocated to project groups on the basis of the type of resource they were developing, so that they would be better able to help each other. In addition, this blended delivery gave students the opportunity to communicate and support each other away from the formal classroom setting. Project supervisors provided face-to-face academic expertise in the traditional manner.

We continued to develop an enquiry-driven approach (which is evident in laboratory projects) to both the training programme and to the design of e-Learning resources. Students selected their project topic (under supervision) and were encouraged to use a scenario- or data-driven problem-based approach to produce an interactive EBL resource on their particular topic of interest (Juwah 2002). They used a variety of software packages and design formats to generate these resources, in addition to other technologies such as audio, video and assessment tools. They formed a hypothesis to test the learning of their target group, which might, for example, compare before and after test-scores for statistically significant differences, or correlate scores of different groups of students with attributes such as degree programme. In addition, students worked in groups (face-to-face and online) and developed criteria to evaluate EBL resources, and performed online peer review of project materials to promote critical thinking. Hence, EBL materials (scenario or problem-solving) were developed using a process of EBL (students choose their topic, work in groups as well as individually, and participate in critical evaluation during peer review). Constructive alignment of course content with assessment of discussion contributions for the project performance score provided an incentive to participate in the online process (Dalgano 2001).

Assessment

All projects in FLS are equivalent to 30 credits, with a further 10-credit Literature Review on the fundamental science underpinning the project submitted in Semester 5 in advance of the project. In Semester 6, students reviewed project materials for each other in online groups. The aim was to troubleshoot design and usability issues, but also to enhance and demonstrate the critical thinking skills of the project students. Contributions to discussions were available to supervisors (who were responsible for assessment) to help them assess their student's performance, which contributed 20% towards the final project score. In addition, the e-Learning resources produced by the students were also evaluated this year for the first time; they carried a further 20% of the overall project mark. Written guidelines and assessment criteria were provided to both supervisors and external examiners.

Project scores followed the same distribution as those for other types of projects (principally, laboratory projects), Figure 2.

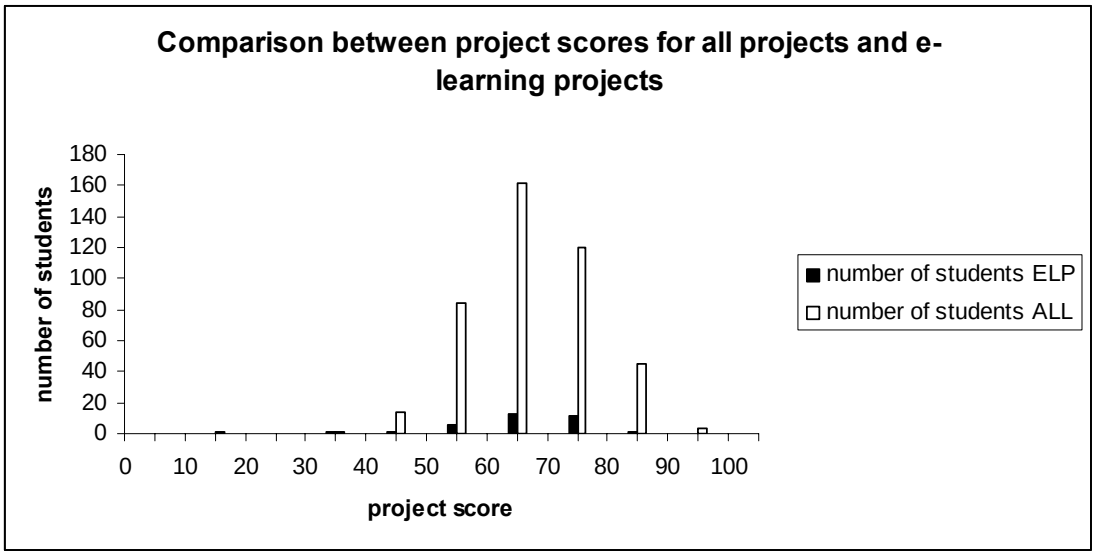

Figure 2 Comparison between project scores.

Evaluation

Students created useful e-Learning materials to complement a range of activities in the undergraduate curriculum, local secondary schools and even the Manchester Royal Infirmary, Figure 3.

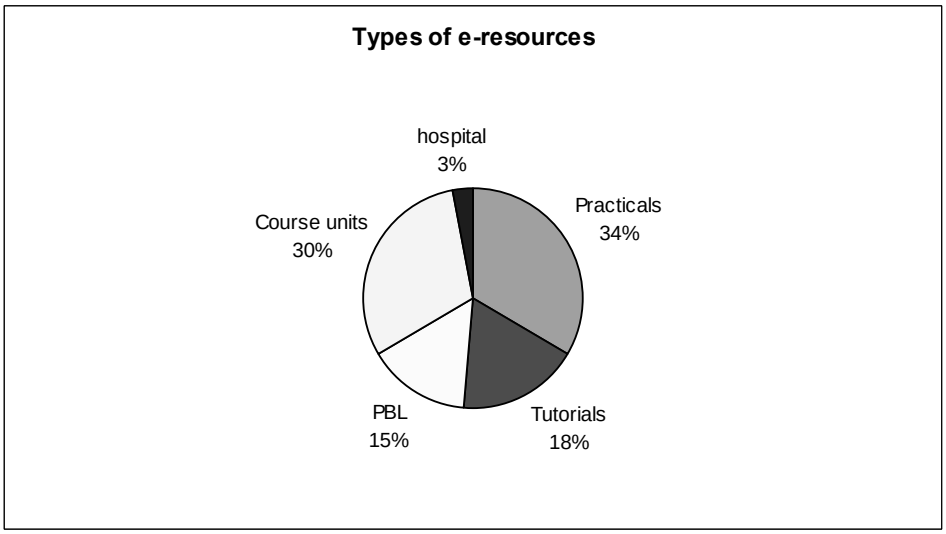

Figure 3 Types of e-Resources.

They used a variety of web-authoring software and other technologies, Figure 4.

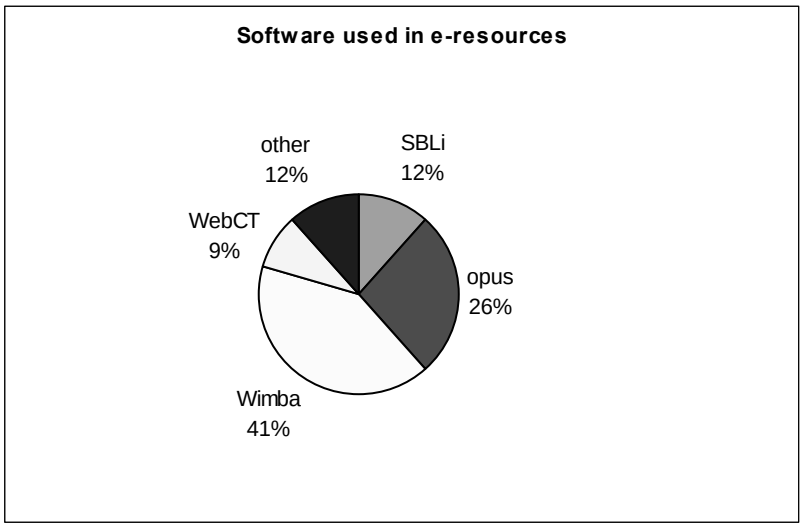

Figure 4 Software used in e-Resources.

They used various learning designs to engage the target audience, stimulate enquiry, and/or provide practice in the skills associated with enquiry, Appendix I. Many of these resources are being uploaded to the e-Learning tab of the appropriate Course Unit description on the FLS intranet/Blackboard site. Project students demonstrated their own EBL skills in conducting and evaluating their projects and writing their Literature Reviews and Project Reports.

Various aspects of the FLS Project were evaluated as follows:

- Evaluation of the effectiveness of individual resources in enhancing student learning was undertaken by project students and included in their project reports.
- Evaluation of the training course by staff and students was by questionnaire. Feedback was positive overall from both students and supervisors.
- Evaluation of the parity of e-Learning and laboratory projects was by comparison of project scores.
- Evaluation of the EBL content of e-Learning resources generated by Final-Level project students was by assessment of resources against criteria for EBL.

Challenges and Benefits

The challenges with the FLS CEEBL project have mainly evolved around issues relating to engagement of staff and students in the programme, which was not particularly surprising; we anticipated some opposition to changes in the tutorial programme, for example. Moreover, it was disappointing that fewer students than we would have liked opted for e-Learning projects that focused on practicals; but we are confident that the e-Learning resources will gradually develop into a useful repository of supporting course materials over the next few years.

We were encouraged by the students' achievements since the majority of them gained project scores that were higher than their unit average score in their Final-Year examinations, suggesting that the quality of projects is being maintained.

One of the most difficult aspects for students has been in the design of EBL materials. In 2006-7, students tended to research their chosen topic and write as much as they could about it in the online environment. This was not what we wanted from students; rather, we wanted them to select specific problems or concepts and integrate these into an interactive learning experience. In order to encourage this, we developed various activities this year to help students understand EBL and learning design. These support activities included brainstorming, critical review of selected external resources and focused questioning with the e-Learning team; these were intended to help students consolidate the ideas generated and focus their efforts in a particular direction. One surprising outcome of this approach has been the development of my (Carol Wakeford) interest in both critical and creative thinking, and how students might be encouraged to think more 'outside the box' (Figure 5).

Activity	**Outcome**
Brainstorming (groups)	Generate ideas
Mind-mapping (individual)	Lateral thinking
Group discussion (real time and online)	Formulate new ideas (focus)
Share resources (online)	Divergent thinking
Peer evaluation and review (online)	Reflect, modify and improve

Figure 5 Creative and critical thinking activities.

In fact, this approach is being taken forward next year, and I have been invited to participate in two Higher Education Academy (HEA) events: one, in December 2008 (problem-solving) and the other, in April 2009 (creativity).

An important challenge was to maintain project standards and ensure that the project students displayed the skills traditionally associated with laboratory-based projects, such as an ability to analyse, evaluate and judge data. This is an aspect of non-lab projects that external examiners have criticised in the past. All students were encouraged to select a target group, formulate a hypothesis relating to the effect of their resource on aspects of the learning of that group and design assessments to test their hypotheses. Moreover, they were encouraged to develop enquiry- and problem-solving activities in their resource that would demonstrate their own problem-solving abilities. We feel that this was much more successful this year, and attribute this to changes in the taught course that developed critical and creative thinking skills. The relationship between the skills of enquiry and those involved in the scientific method is an interesting one; enquiry, in its purest form, involves investigation and research according to a student-directed agenda that might be quite open-ended. It is difficult to visualise this process in the online environment, since the subject of enquiry is presented (rather than being selected), along with additional resources and possibly problem-solving activities to facilitate understanding. However, skills of analysis, research and critical thinking can all be facilitated by e-Learning, and we hope that practice in these areas will enhance student enquiry in more general terms.

The training course was based on pedagogy related to the facilitation of enquiry (Justice *et al*. 2002), particularly in an online environment (Boud and Prosser 2002). We aimed to encourage deep learning, critical thinking and reflection by challenging and engaging students in self-directed and active learning, which is demonstrated through the clear communication of their ideas, both on the web and in their project reports. However, we found that additional elements were essential in order for the students to develop their projects in a more imaginative manner. Hence, we would suggest modifications to the 'Grammar of Inquiry' model of Justice *et al.* (2002) and to the framework for online learning of Boud and Prosser (2002) to include activities to promote creative thinking, in particular, in order to move students away from using the online environment in a largely text- and information-based way. This element of the FLS CEEBL project will be expanded in Phase III in 2008-9.

Further Developments

2006-7 and 2007-8

- Benefits to project students were investigated by analysis (using NVivo) of evidence of critical thinking in the peer review process. This preliminary study was presented in September 2007 at ALT-C 2007 (Association for Learning Technology). In addition, a poster was also presented at this conference on the use of teaching spaces for EBL.

- Preliminary meetings with Caroline Bowsher (Programme Director for Biology) and Liz Sheffield (Senior Tutor) have explored the need for scenario-based online tutorial problems to support students for their Problem-Based Honours Paper, and these members of staff also signed up for e-Learning project students. However, their allocated project students did not want to undertake e-Learning projects and so neither of these key staff members participated in the programme this year. Caroline Bowsher did, however, manage to secure a problem from a past examination paper for my own project student to adapt into an online resource.

- Collaboration (established in 2006) with the developers of SBLi (Scenario Based Learning interactive) to exploit the use of this software for the production of teaching and learning material (Geoff Norton, University of Queensland, Australia) has been maintained this year, and four students used SBLi to generate their project resources.

- Teaching staff have been contacted by e-mail in order to encourage them to participate in the e-Learning projects programme; a general mail was sent out to suggest that staff involved in LSMs and RSMs might like to generate e-Learning resources, as well as staff involved in other teaching activities where online materials could be of use.

- Again, e-Learning projects were marketed to students via a talk presented by Liz Sheffield to current second-year students about their final-year projects. In addition, documents are available on the FLS intranet (BIOL30ELP Course Materials).

- Preparations are underway to revise the timetable and content of BIOL30ELP (in response to feedback) and to incorporate it into the new Blackboard VLE.

Additional emphasis will be placed on creative thinking in project students and new activities will be incorporated to encourage this.

- Supervisors from 2007-8 have been asked to check the content of student resources for accuracy if they require them to be uploaded to the intranet for e-Learning. Validated resources will be located under the e-Learning tabs of course units. In addition, an externally-facing website has been developed to showcase e-Learning in the Faculty, and three student projects will be hosted as exemplars in the forthcoming year.

Dissemination

The Faculty Project has been showcased at a number of events, both within and external to the University, as follows:

- Faculty Teaching Boards
- Blended Learning Conference 2007, University of Hertfordshire
- Enquiry-based e-Learning: a true blend? (paper and poster)
- ALT-C 2007, Edinburgh (Association for Learning Technology)
- Evaluating online peer review with NVivo (paper)
- Environments to promote engagement, interaction and enquiry (poster)
- London SoTL 2008: 'Thinking outside the box' for a creative, enquiring mind (paper)
- Higher Education Academy Bioscience Regional Forum, University of Manchester, June 2008: Enquiry and Creativity: Tools of the Trade (workshop)
- CEEBL Project Holders Symposium (FLS CEEBL Project)
- ISSoTL, Alberta, Canada, October 2008: Questions of policy, pedagogy and practice: a Faculty perspective (paper)

Part II: Final Level Tutorials – Tristan Pocock

Approach

Currently, Final-Level tutorials are delivered in Degree Programme-specific groups (6-8 students per group). The format and content of tutorials are governed by the Programme Directors, but the universal aim is to prepare students for their final programme-specific examinations (a general essay paper and a problem paper which tests largely data-handling and comprehension skills). Final-level tutorials differ from 1st and 2nd level tutorials in that there are no assessed assignments and students do not receive any compensation for attending. There is no generic timetable for tutors to follow, and no tutorial handbook for guidance. As a result, some students receive less advice than others – this is largely dictated by their degree programme. This project was set up to address the inconsistencies arising from this practice, and also to provide guidance to students not only in preparing for exams, but also for future employment or postgraduate study. Furthermore, provision of a generic 'handbook' will make the planning and organisation of tutorials easier for Final-Year tutors.

Generic Online Handbook

Programme directors were consulted about the possibility of producing a generic handbook and the idea was also presented to the two FLS Teaching Boards. There was a large amount of support but some apprehension that tutors might be expected to do more work! Programme directors were also asked to provide examples of past papers that could be posted on the Blackboard VLE alongside the generic handbook for use by tutors. Many programme directors were happy to supply this information, provided that the answers were not made available to students. The idea is that programme-specific problem papers will only be available to tutors from relevant programmes. However, essay papers often cut across more than one programme and, therefore, could be made available to tutors from different programmes.

In order to create a generic online handbook, it has been necessary to create a new course unit code. The advantage of this is that all Final-level tutorial material can be posted in one place, making it more easily accessible to both tutors and students. The handbook has been produced using the same format as the 1st and 2nd level handbooks and includes suggested activities and a suggested timetable for tutors. In

addition to preparation for exams, there are slots in the timetable for oral presentations, which are useful preparation not only for writing up literature reviews and projects, but also for interviews and vivas (Figure 6).

Week	Activity
1 - 2	Careers information – students encouraged to access careers exercise; Introduction to exam essay writing exercise.
3 - 4	Go through problem paper.
5 - 6	Essay paper under exam conditions.
7 - 8	Presentation of literature review.
9 - 10	Discussion on programme-specific scientific topics.
11 - 12	Go through problem paper.

Figure 6 Suggested timetable for 1st Semester. N.B. Students are expected to prepare their answers to problem papers/essay plans in advance of tutorials in order to discuss these.

Careers Exercise

It has long been an objective of the tutorial programme to provide 'careers advice'. However, in reality, many students enter the Final Year with little idea about what they will do after graduation, despite the fact that the University of Manchester Careers Service is highly acclaimed. This apparent ignorance about career opportunities is, therefore, likely to stem from either apathy or difficulty in finding specialist, FLS-specific information. A careers exercise is being prepared with the help of the Careers Service and some FLS alumni have been recruited to write case studies about their jobs. The exercise aims to get students to focus on the options available to them, to think about the skills required to do the jobs or training, and how to set about applying for specific jobs. A link to the Careers Service will be created to provide information that is directly relevant to FLS students (e.g. deadlines for applications, careers fairs, funding opportunities, etc).

Assessment

Final-level tutorials have no formal assessment component and students are not penalised (formally) for non-attendance. However, it is stressed to students that unless they attempt the assigned work they will not be able to get feedback. It may be difficult

to get students engaged in activities (e.g. careers) that are not assessed, even if completing them will benefit them in terms of finding a job or postgraduate training post.

Evaluation

It will be difficult to evaluate the implementation of a structured Final-level tutorial programme in a quantitative manner because the aim is not for students to achieve higher exam marks, rather that they improve their transferable skills base and increase their chances of employment or obtaining a place on a postgraduate course. Furthermore, it is hoped that tutors find it easier to structure their tutorial programme. Students will be asked to complete a questionnaire at the start of their Final Year and again at the end to determine whether or not they accessed the optional material (e.g. careers exercises) and how useful they found it. Tutors will also be polled about the accessibility of information.

Dissemination

If the generic exercises are successful then they may be adaptable for use in other Faculties. The idea of a structured Final-level tutorial programme, available to both students and staff is easily transferable into other disciplines.

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Additional Resources

Used as reference for development of e-Resources:

http://dea.brunel.ac.uk/GATC/	(Follow the *Topics* link on the side menu)
http://www.sblinteractive.org	(Look at some of the scenarios)
http://learn.genetics.utah.edu/	(Look at the Biotechniques Virtual Laboratory)
http://www.napa.ufl.edu/2005news/vrpatientph.htm	(a virtual patient)
http://edoctoring.ncl.ac.uk/System_Check/	(e-Doctoring)
http://www.nlm.nih.gov/research/visible/visible_human.html	(the visible human project)
http://www.bioquest.org/icbl/cases.php	(some text-based scenarios)
http://www.millerandlevine.com	
http://www.webquestuk.org.uk/	

Additional Reference Material

Faculty intranet – course materials and information, staff details

CEEBL resources – literature

Teaching materials – laboratory manuals, tutorial booklets

BIOL30ELP course unit for e-Learning projects

Appendix 1: Examples of Student Projects

Project Title	Project overview	Design features
Gap Junctions, Connexins and Pannexins: Bridging the Gap?	To facilitate learning of channels and transporters alongside final-year lecture units (Channels & Transporters: Molecule to Function, Channels & Transporters: Health and Disease, and Cardiovascular System in Health and Disease).	Built with OPUS and includes animation, video, 'mouse-overs', 'pop-ups', audio.
Stroke	An e-Learning resource about stroke and speech difficulties, aimed at medical students and students of Mind and Movement unit.	Constructed in OPUS and includes 'mouse overs', 'pop-ups' and a scenario-based assessment activity.
The Diabetes e-Learning project	An E-Learning resource to complement the OGTT (Oral Glucose Tolerance Test) practical taken as part of Level 2 Endocrinology and Reproduction Laboratory Skills Module.	Constructed in OPUS and includes 'mouse overs', 'pop-ups', video and scenario-based assessment activities.
The secretory pathway and the Vesicular Stomatitis virus	A resource aimed at Level 2 students doing the Cell Biology Research Skills Module, to help them understand the secretory pathway, using the vesicular stomatitis virus G protein (VSV-G) as an example.	Resource generated in Wimba Create and containing analysis and evaluation of experimental data.
The Use of Molecular Biology techniques to investigate the function of a sequenced gene	The aim of this project is to increase students' knowledge and appreciation of different molecular biology techniques that can be used to elucidate a gene's function. This is primarily for Level 2 students taking the Molecular Biology Research Skills Module.	Constructed in OPUS and includes 'mouse overs' and 'pop-ups' to format question and answer sections illustrating different experimental methods.

Blood Pressure	This project aims to facilitate understanding of blood pressure The relationship between pressure and flow. How high blood pressure is investigated. Problem-based learning.	Clinical scenario presented via SBLi and incorporating clinical data.
Lung function variation	A resource for medical students to facilitate the understanding of lung function variation, measurement and assessment.	A resource constructed in Wimba Create and based in WebCT using an online audio lecture medics with analysis of personal results using Excel. Discussion and evaluation of data via Discussion forum.
Protein Purification	A WebCT resource on the methods to purify proteins using fluorescent proteins as an example.	Online problems with data analysis (problems, graphs) including hints and 'how-to-do-it' instructions (pop-ups) based on 5 experimental procedures.
Awakenings: A Resource on Encephalitis lethargica and Parkinson's disease.	A scenario-based resource that aims to improve students' knowledge of Parkinson's disease and Encephalitis lethargica. It is based on the research by Dr Oliver Sacks and the film Awakenings. It is targeted at Life Science and Medical students.	Includes video, case histories, lab/clinical data, imaging and film extracts. Assessment by quiz.
Molecular Cloning	The aim is to improve knowledge of molecular cloning (the pros and cons of using bacteria as a host, the steps involved in producing a recombinant plasmid, and the most commonly used expression systems).	Constructed with OPUS and includes U-tube videos, animations and 'pop-ups'.
Morpho J Support Documentation	The aim is to provide support for users of Morpho J software, which has been developed for the Analysis of Organismal Form unit. This unit is taken by students from across the world, and is taught primarily via WebCT.	Constructed in Wimba Create. By using a series of screenshots and recording the actions taking place on screen, the functionality of the software has been described in a step-by-step guide.

Mendelian Inheritance Patterns, Chromosomal Gene Locations and Gene Mutations	A learning module for Dentistry students covering Mendelian Genetics, inheritance patterns, gene location on chromosomes and types of gene mutation.	Opus scenarios using case histories presented in cartoon form.
Invasion	The aim is to introduce Level 2 immunologists to the concept of lipid kinase signalling within the innate immune system.	Scenario-based carton resource with problem solving focus (SBLi).
Peptide transporters: a Final-Level problem	A resource to facilitate problem solving.	A paper-based problem converted to an online form with formative feedback, helpful hints, explanations and diagrams as 'pop-ups'.
Lymphocyte migration and in vivo cell imaging	A resource to support final level students studying immunology in 'Advanced Immunology' and 'Immune Response and Disease'.	Includes problem solving and calculations based on multi-photon intravital microscopy and video of lymphocyte movement.

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