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Pritchard, J., Matthew, B., Tierney, A., MacKenzie, J., Storck, L., Thomson, K., Hood, A., Carroll, J., Crothers, A., Wisbey, J., Fletcher, M., Hope, D., Morrow, L., Bridges, M. and Blanton, W.. (2008)
Developing the enquiring student and enhancing the research-teaching interface: student-led pedagogical research and educational initiatives in enquiry based learning. Practice and Evidence of the Scholarship of Teaching and Learning in Higher Education, 3 (1). ISSN 1750-8428

<http://eprints.gla.ac.uk/39240/>

Deposited on: 23 September 2010

**Developing the Enquiring Student and Enhancing the Research-
Teaching Interface: *Student-led Pedagogical Research and
Educational Initiatives in Enquiry Based Learning***

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Abstract

This paper describes the progress of a project running at the University of Glasgow to develop elements of Enquiry Based Learning (EBL) in undergraduate degree courses across a range of disciplines. It focuses on the second part of the project but an

overview of the first part is also given. During phase 1 of the project, in the summer of 2007, seven undergraduate students spent four weeks working together exploring enquiry based learning (EBL) in the institution's central, educational development unit. This phase was approached as an EBL exercise itself; the student groups were given full responsibility for the process with the proviso that by the end of this phase they would have developed a guide for staff and students about EBL. The second phase of the project continues throughout the academic year 07/08. Here, each student worked alongside a member of staff from their department of study to develop discipline specific EBL activities taking a research-informed approach to this development. All pairings were charged with introducing EBL such that no major course change procedures had to be followed; this hopefully ensured the sustainability of such adjustments. Staff and students involved in the project represent dentistry, chemistry, biology, theology, law and psychology and the courses under development range from large first year classes to small honours level courses. An overview of the range of enquiry-based learning developments within the courses will be described.

Key words: Enquiry based learning, staff-student partnerships, course design

Introduction

This paper describes the progress of a project running at the University of [x] to develop elements of Enquiry Based Learning (EBL) in undergraduate degree courses across a range of disciplines. The project has two distinct phases and is characterised by staff and undergraduate students working together to undertake the curriculum developments as both consider appropriate to the discipline and particular course in question. An outline of the first phase is given but the paper will focus on the progress of the project in phase two.

This work directly addresses the University's Learning and Teaching Strategy by engaging students in developing EBL activities within their courses alongside staff.

'As an institution, we are committed to international excellence in research and a belief that our research activity informs student learning in a myriad of ways which deliver a high quality student learning experience. We want our students to have a rewarding and fulfilling time in Glasgow, and to provide them with a rich learning environment. We will engage them with teaching and approaches to learning which support their development as motivated learners, independent and critical thinkers, and promote confidence and awareness in their skills, knowledge and understanding. We will promote a learning environment that develops and values these attributes'.

Learning and Teaching Strategy 2006-10, University of Glasgow

EBL describes an environment in which learning is driven by a process of enquiry owned by the student (Kahn and O'Rourke, 2004, Hutchings, 2006). The tutor establishes the task and facilitates the process, but the students pursue their own lines of enquiry, draw on their existing knowledge and identify the consequent learning needs. They seek out relevant evidence and take responsibility for analysing and presenting this appropriately, either as part of a group or as an individual supported by others. They are thus engaged as partners in learning (Hudspith and Jenkins, 2001).

This project is an example of bridging the research-teaching interface within this research-intensive university and further embedding EBL across the university from the students' perspective and creating a university of enquiry at all stages of the undergraduate programme. Matthew and Pritchard (forthcoming, 2008) consider what, for them, is the fundamental position of enquiry within the academy:

'After all, surely the focus of the university is to foster and support a culture of enquiry and preparing students for life beyond the disciplines' (p. 118).

Healey (2005) has described the four main conceptions of the research-teaching relationship as,

- Teaching can be **research-led**: the teacher structures the students learning based on the students learning about the content of their research areas. This is described as teacher-focused practice with an emphasis on research content.
- Teaching can be **research-oriented**: here the teacher structures the learning to make more explicit the processes of research, i.e. inquiry and research ethos through the teachers' experiences. This is described as teacher-focused practice with an emphasis on the research process and problems.
- Teaching can be **research-tutored**: here the focus is more on the student than before and the student engages in activities such as writing and discussing papers or essays.
- Teaching can be **research-based**: here the focus is on the student engaging more fully with the research process and more enquiry-based activities are evident. A two-way relation between the students and teacher comes to the fore.

Griffiths (2004) adds a further category, one of **research-informed**, where the teacher is looking into the pedagogy itself and enquiring into the teaching and learning process itself. We can see from the above descriptors of the many possible ways of linking research and teaching that the project described here focuses on **research-based** activities in the courses. However, it could be said that the engagement by both staff and students in considering not just the content (the *what* of the course) but also how it is taught allows us to consider that both staff and students are engaging in a manner with **research-informed** curriculum design.

The EBL project was aimed at encouraging both staff and students to create spaces within their courses to enable students to experience this research-based approach to their learning.

Similarly, as Barnett (2000) stated:

'The issue is whether lecturers adopt teaching approaches that are likely to foster student experiences that mirror the lecturer's experiences of research' (Barnett 2000 p.163)

The project was also designed with the aim of raising staff awareness of a research-based approach to teaching. It is anticipated that the collaborative nature of the EBL course development will have a two-fold effect: first, to enhance the level of student-led enquiry providing more opportunities for ways of thinking and practising reflective of the discipline to occur (Entwhistle, McCune & Hounsell, 2002) and secondly the process of staff working with students will encourage both groups to consider the *how and what* of our teaching practices and provide room and feedback from both students and teacher around teaching and learning activities. At this stage no formal evaluation of the whole project has been implemented, however, an informal monitoring of the presence of EBL across the institution will be maintained as well as the individuals involved and their practice.

Phase One – The Summer Projects Office

The project was initiated through a collaboration between staff in the Learning and Teaching Centre (first and second authors) and the Faculty of Biomedical and Life

Sciences (AT). Funding was obtained from two sources: GU's Chancellor's Fund and the Higher Education Academy Centre for Bioscience's Teaching Development Fund.

Phase one of the project took place during a four week period in summer 2007 when the Learning and Teaching Centre, University of Glasgow housed a summer projects office for seven GU undergraduate students (employed as student associates) from different disciplines and years of study (Table 1). During this stage the seven undergraduate students worked under the guidance of the project leaders (first and second authors) to undertake an EBL exercise around 'what EBL is.' During this phase the group visited the Centre for Excellence in Enquiry Based Learning where they spent two days working alongside the centre's team and talking with student interns around their experiences of being a student in an EBL environment. The group also experienced an EBL group exercise on privacy (a subject not familiar to any of them) and this again allowed them to reflect on the relative merits of this approach to supporting learning as well as some of the potentially negative areas regarding time and resources.

The anticipated outcome of this phase of the project was a student-authored guide about EBL for staff and students of the institution. By the end of this phase, in addition to the guide, the group had also produced posters highlighting the benefits of EBL for both staff and students and a website resource,

<http://www.gla.ac.uk/services/learningteaching/goodpracticeresources/enquirybasedlearningebl>)

Phase Two: Staff-student EBL course development

Phase two of the project is currently progressing and will continue throughout the 2007/08 academic year. It involves each student working in partnership with a member of academic staff from their department of study to co-design elements of EBL for inclusion into their courses. The students are paid a stipend for this period to support their work (equivalent time of 0.5 day a week for 2 semesters). Each staff-student pair is further supported by a member of the academic development unit within the University's Learning and Teaching Centre (see Table 1) .

Table 1. Participants in phase 2 of the EBL project

Discipline	Student and year of study	Staff member	Academic Development Unit Staff
Biology – 1 st year	Lisa Storck (3 rd year, Chemistry) Kate Thomson (3 rd year Zoology)	Anne Tierney	Jane MacKenzie
Biology – 4 th year	Alistair Hood (4 th year)	Anne Tierney	Jane MacKenzie
Dentistry	Jacqueline Carroll (2 nd year)	Andrew Crothers	Mary McCulloch
Law	Jamie Wisbey (3 rd year)	Maria Fletcher	Mary McCulloch
Psychology	Daisy Hope (4 th year)	Lorna Morrow	Jane MacKenzie
Theology and Religious Studies	Madeleine Bridges (3 rd year)	Ward Blanton	Sarah Mann

During discussions early in phase 2 of the project it was decided that a key factor to enable a successful outcome from this phase of the project was to avoid any arduous course change administrative procedures. Thus, all changes are considered 'minor' as far as the quality assurance documentation is concerned. This was considered vital if project participants were to encourage colleagues to introduce more EBL approaches

in their courses and thus, hopefully, ensure the sustainability of the EBL activities beyond the lifetime of the current funding.

To illustrate the current progress of phase 2 within each discipline specific projects occurring with each staff-student grouping the students and staff have written their own accounts of their projects and their progress. It was decided that it would be more powerful for them to describe their own work in their own voice. What follows are 6 narratives each giving an account of their of their progress to date as well as their future plans.

EBL in 1st year Biology: Lisa Storck (Undergraduate 3rd year Chemistry) and Kate Thompson (Undergraduate 3rd year Zoology) and Anne Tierney (University Teacher)

The focus of this work has been on developing the molecular biology content of the Level 1 laboratory course. In 2007/08 the class comprises 750 students. During Level 1, students are taught the biomolecular units in the second semester, with the first semester focussing on the biology of whole systems. We have been designing an exercise on experimental design and a laboratory class with a focus on enzymes.

An important aspect of EBL that we wanted to emphasise in these exercises was building on the students' previous knowledge. In the experimental design exercise, students will be working in small groups. Typically, a lab class is made up of 48 students in three benches of 16. Each bench is divided into two groups. Firstly, they will be asked to consider what they think good experimental design encompasses. Each group of eight students will then be given a description of an experiment, that demonstrates an example of poor practice, and asked to analyse the experimental design. As a conclusion, the groups will present their findings to the rest of the class, defining the errors apparent in their example and suggest improvements. As a class, a list of good practice in experimental design will be put together which the students can use as a reference in future lab classes.

The enzyme lab experiment is to replace an existing lab exercise. The exercise currently used asks the student to conduct an experiment investigating the action of heat and detergent on the enzyme catalase. A major problem associated with this lab is that that the students predict the outcome before they do the actual experiment. We have decided to shift the focus to look at enzyme action in general. They will be asked to find out about the denaturation process of enzymes, having available a serious of written resources and the Internet. They will then design an experiment to confirm their findings, using catalase. Hence, they will still be conducting an experiment, but they will be focusing on enzyme action in general, rather than on one specific enzyme. Finally, they will produce a lab report, which is then peer-assessed.

Through these exercises, we hope that students will feel a little challenged by asking them to conduct work more independently, rather than following step-by-step instructions. We also wanted them to gain more experience presenting to other people, but in an informal environment. Also, when they are working as a group, they will be asked to clearly define each person's role within the team, to aid them in gaining good practice team-working skills. Having previously done the course that we are helping to redesign, we, the students, find that we have strong opinions on what we would like changed. In discussions with our supervisor (AT) it sometimes emerges that the intention of the lab from the staff point of view is not always transparent to the students. The major challenge we have faced is having no previous experience in course design. This forces us to really consider what we hope the students will learn, and adapting the material in such a way. The exercises designed will be piloted, and if successful, introduced in the next academic year.

***EBL in 4th year Biology: Alistair Hood (Undergraduate 4th year Anatomy) and
Anne Tierney (University Teacher)***

Business and the Bioscience was introduced as a final year (L4) option for students in the Faculty of Biomedical & Life Sciences in 2006, as a means to introduce undergraduates to business, in a science context. The course is taught by a mix of industry experts and academics, each bringing a unique perspective to the course. Students are required to work in groups to produce a business plan, which they pitch in a "Dragons' Den" session, which is assessed by a panel of staff who teach on the course. In 2006 seven students successfully completed the course, rising to nine students in 2007.

There is a strong case for the use of Enquiry Based Learning (EBL) within a business subject e.g. the Level 4 Business and the Biosciences course. Encouraging EBL will function to improve what is an already first-rate course and give students the chance to tune up core graduate competences all the while experiencing something new in the Business and Bioscience course.

The option is currently taught in the form of 3-hour long lectures over an intensive two-week period in the first two weeks of semester 1. This should enable students to construct and present a Business plan at the end of the 2 weeks. Areas which have been identified as opportunities for implementation of EBL according to:

The current course feedback:

1. lecture length - too long
2. not enough student involvement
3. too little emphasis on group work on the Business Plan

There is a common feeling that the course seems hard to digest and it was very ambitious to expect students to learn and understand all necessary parts of the course in two weeks all the while preparing a business plan to present at the end. To combat this some of the more lecture intense parts of the course will be transformed to Enquiry Based Learning where the focus is on the process of learning and inherent skills involved with this would be emphasised. Three areas have been identified for which EBL exercises are being developed:

1. SWOT and PEST analysis: In this EBL session, students working in groups, will first of all carry out SWOT (Houben, Lenie, and Vanhoof, 1999) and PEST (Sargeant and Jay, 2004) analyses by brain-storming a famous brand, e.g. Coca-Cola or McDonalds. By using a brand that is well-known the students have recourse to their own experience of the brand, as well as topical information. Students will present to the class as a whole their findings, feeding back to one another. The students will then carry out the same analyses on their own product.
2. HOSHIN planning (Tennant and Roberts, 2000): This is used to assign tasks during a project. While this is currently taught as theory in the course, it has not been used explicitly to plan the group task (business pitch). Using EBL, each member of the group will take on responsibility for the individual tasks involved in the group business pitch. They will then draw up a timetable of events, and work to it, ensuring that the pitch is completed on time.
3. Cash flows: In this scenario it is anticipated that students will be able to use their own spending to see how a budget works. They will then work in groups to brainstorm the items that are required for a business cash flow, presenting their findings to one another for feedback, and building on their own knowledge.

EBL in Dentistry: Jacqueline Carroll (Undergraduate Year 2) and Andrew Crothers (Senior Clinical University Teacher)

Dentistry could be considered to be a practical apprenticeship in the guise of a degree course; this poses many interesting challenges when implementing Enquiry-Based Learning into the curriculum. In many respects the theory behind the practical techniques can be learned in this way and is what we have chosen to focus on in the course development phase of our project.

Operative techniques is introduced into the second year of the Bachelor of Dental Surgery course, it therefore seemed logical to target this year group and introduce enquiry-based learning early in the clinical techniques course to build a strong foundation. The topic we identified, the reasons for the use of lining materials in restorative dentistry, was one not taught in a specific lecture but in conjunction with many different topics. This topic was mainly covered in operative technique classes through discussion and recommended reading along with small pieces of information in lectures.

Our thinking was to create a project of some form, probably an essay or presentation where the students investigated this topic and identified when and why they should use these materials in restorative procedures. However, this would still be very similar to other coursework assignments and we didn't feel it fully encompassed the process of enquiry. Therefore we wanted to introduce an element of critical thinking and appraisal and we are currently working to create a fixed resource list for this project so that students are encouraged to think more about the sources they are using and consider their relevance or accuracy in relation to the specific topic. This is very much an ongoing exercise and we have considered resources from the recommended course texts and both paper and online journals. Another dimension to the selection of resources is the country of origin as this can greatly influence the writer's perception and understanding of the topic.

There were also other small ways in which we were able to implement EBL into operative techniques sessions. For example, in a session where students were expected to use their previous knowledge to design and cut a cavity on a tooth, they were also asked to create a list of reference criteria for assessment of their cavity preparation. This was an interesting exercise because although every student had been given a CD containing all the reference criteria for all operative techniques not many had read this. It also encouraged students to be critical of their own work, and instead of being told their cavity was 'good' they thought about why it was 'good'. The ability to be self-critical is an essential skill for students as it prepares them for working in clinics; it is these reference criteria that they must work to and will be advised on by staff. This exercise took twenty minutes including a ten minute feedback session with the tutor yet the skill it focussed on will be of critical importance for the rest each student's working career.

EBL in Law: Jamie Wisbey (Undergraduate year 3) and Maria Fletcher (Lecturer)

Our intention is to introduce an EBL element into a level 3 (30 credit) law course 'Institutions and Judicial Control of the European Union (IJCEU). This is a non-compulsory course and has typically attracted between 40 and 50 students; the maximum for the course is 50. The course examines the institutional framework of the EU and explores, in detail, policy-making processes and constitutional principles which underpin EU law and, through a series of case-studies, the role of the European Court of Justice. The course is composed of 15 two-hour seminars offered on a weekly basis over two semesters. Students are required to come prepared to discuss various questions in class – these questions are given in advance in conjunction with a reading list. The course tutor facilitates discussion in class, sometimes through the use of small group work. The course is assessed by way of a 3000 word discursive essay and a 3-hour examination (in which students are expected to answer three questions out of a choice of eight.)

For the past two academic sessions, some of the students on the course have been able to take up the opportunity to visit the European Parliament in Brussels. This trip is financed by the office of a Scottish MEP, Elspeth Attwooll. Numbers on this trip have been limited to 25 and so not all students who apply are able to come. Students are chosen on a purely random basis – names "out of a hat." On the most recent trip 2-5 December 2007, students were also able to visit the Council, the Commission, the Scottish Government office in Brussels and an international law firm.

There is currently no 'course work' element to this field trip and it is our intention to introduce an element of enquiry. We are conscious of the fact that not all students on the course are able to attend the field trip and so for reasons of equity and inclusivity any EBL element will have to take account of that.

We have conducted two mini-focus groups, the first with students who attended the trip in session 2006-2007 and the second with students on the trip this session. In both cases there was support for an element of enquiry in order to provide an academic focus to the trip and as an "incentive" to participate actively rather than passively. There was also support for the idea to tie the EBL element directly to the written assessment of the course i.e. set an essay question that is at least in part related to the topic of the EBL. Once again, this would have the advantage of motivating students and would hopefully encourage responsibility for their own learning, in line with the spirit and principles of EBL.

In terms of the topic of enquiry, we believe it would make sense to choose the topic of 'Parliaments and the EU.' This would allow those students who stay in Glasgow to explore the role of the Scottish Parliament in EU affairs and those in Brussels to examine the role of the European Parliament. The 'home' team could try and organise a trip to the Scottish Parliament or try and organise interviews with relevant persons to assist them. In order to avoid a split in the group we thought we would ask the 'home' team to prepare a set of enquiries/questions for the 'Brussels' team to explore/answer and vice versa. Sufficient time must be set aside in class both before and after the trip to ensure that this can be done effectively and it may be helpful to split the two groups into smaller sub groups.

*EBL in Psychology: Daisy Hope (Undergraduate 4th year) and Lorna Morrow
(University Teacher)*

There are two distinct strands to the work in the Psychology department. The first was to undertake an investigation into the impact of EBL on learning as the focus of the honours project of one of the student authors (DH). Initially, informal interviews were carried out with a number of staff involved in both teaching and course design in the Psychology department, to obtain some feedback on our booklets and their thoughts on EBL as a learning/teaching initiative. From the talks with these staff members, there is evidently a concern that EBL cannot be used to effectively teach course content. However, one of the benefits of EBL claimed in the literature is improved self-efficacy beliefs of the students. Although improved self efficacy has been found to be the case in studies of PBL courses (e.g. Dunlap, 2005), there is little conclusive evidence to support this so far for EBL activities. To attempt to resolve the ambiguity in these areas, we aim to compare both information retention and self-efficacy ratings resulting from either attending a "traditional lecture" or a lesson incorporating EBL. An hour-long EBL session has been designed to cover the intended learning outcomes of a lecture on Borderline Personality Disorder. Retention will be tested in the form of a multiple-choice and short answer question quiz intended to assess both recall and understanding of the information. A self-efficacy questionnaire will be administered to give an estimation of students' perceptions of their ability to perform tasks (e.g. define key concepts etc.) relating to the material they have learned. In addition to immediate testing, the intention is to re-test students at a 2-week follow up session to capture any enduring effects of the two approaches.

The second strand of the project in the Psychology department is the design of teaching sessions. Two EBL tutorials have been designed. The first is a cognitive psychology tutorial for groups of about 12 level 2 students focusing on language development and the critical period hypothesis. The second is a session on critical thinking in psychology for level 3 students. This is intended to be an optional class to help students read and criticise journal articles in psychology.

Next term, we hope to design a level 2 psychobiology lab class which runs over 2 2-hour sessions over 2 weeks. Also, we would like to look into setting up an essay competition for Level 1 and 2 students so encourage EBL outside of university contact hours.

EBL in Theology and Religious Studies: Madeleine Bridges (Undergraduate 3rd year) and Ward Blanton, (Lecturer)

We have been working together in a course about the Bible and media history, considering different media environments shaped the development of the religious imagination. For instance, changes in communicative and postal practices within the ancient Mediterranean world shaped new religious imaginations of angelic messengers and "scribes in heaven."

EBL has been applied to three main areas in this class. Firstly, the teacher (WB) uses short 'experiments' at the beginning of the class where he sets the scene for the topic that is to be discussed that week. These experiments may not necessarily have an obvious link to the topic, but they encourage students to think for themselves, ask questions and think more widely on the subject. Following this, a lecture is given where questions are welcomed. For example, we analysed a scene from the film, *Good Will Hunting*, in which a Harvard student attempts to intimidate intellectually someone who never went to university. This discussion then set the stage for our discussion of the look of "intellectual authority" in ancient contexts as well.

Secondly, the essay topics are written in a very open way, allowing students to delve into whatever are a they find most interesting. Furthermore, students are given the opportunity to write their own essay title if they wish, whilst checking this with the lecturer, if their topic of interest does not figure in the list of questions. This allows students who, through the experiments and discussions, have become interested in a specific field, to investigate it in detail. Some have used our discussions and readings of religion and media in ancient contexts to inform analysis of contemporary religious phenomena like Hillsong Church, which uses media in surprising and savvy ways.

Lastly, in order for students to compare notes and to expand their knowledge of these topics, each student presents their research on the papers to the rest of the class. Two to three presentations are given per class, allowing the lecturer to continue covering lecture material while also allowing students to benefit from hearing what others have done in their research. For example, the student partner in this project investigated news in the ancient Mediterranean world, considering how it would be transmitted and how these practices were reflected in the way Christians described their speaking about Jesus as 'Good News'.

Later on in the year, we will gather staff from the department, and give a short presentation on our EBL experience. This will enable staff to see in practice how such applications of EBL can easily be applied to courses in Theology and Religious Studies.

Summary

This paper has provided an overview of a project to enhance the elements of EBL within one institution from the starting point of staff-student pairings working together on course development. Students involved in the project immersed

themselves in learning about EBL during phase one of the project in the summer of 2007. Phase two of the project, which is on-going at the time of writing, has had a dual purpose. First, enabling students to work in partnership with staff members has allowed both parties' to further develop their awareness and conceptualisation of EBL. And, secondly, it has provided the necessary momentum to bring about the introduction of elements of student enquiry in the courses involved in the project. It is of note that aspects of EBL have and will be introduced into a range of courses representing a wide spectrum of different disciplines, different year groups from 1st through 4th year and different teaching contexts both small and large classes. Thus, the project has demonstrated the potential for further development of greater enquiry-based teaching and learning spaces throughout the institution. All changes made thus far have avoided the need for formal course change procedures; this has been considered to be a great enabler in ensuring the success of the 'enquiry-innovation'. As the move to enhance research-teaching linkages within institutions continues apace this project is just one example of acknowledging the student voice in shaping the HOW of what we teach as well as the WHAT of the teaching and learning environment. Students here are not just accessing the discipline specific research but also work collaboratively with staff on enquiring into the pedagogy of the subject.

Acknowledgements

The authors would like to acknowledge the support provided by the University of Glasgow's Chancellors Fund as well as the Higher Education Academy Bioscience subject centre. Additionally the authors would like to thank colleagues in the Learning and Teaching Centre, University of Glasgow for their support during phase one and especially Heather Keating and Pauline Kennedy-Allen for sorting out the summer projects office with computers and ensuring the students were paid! Thank you to Karen O'Rourke and her colleagues at the Centre for Excellence in Enquiry Based Learning, University of Manchester for hosting us for 2 days in June 2007.

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