



**A Practitioner's Guide to Enquiry and
Problem-Based Learning:**
Case Studies from University College Dublin



Edited by
Terry Barrett and Diane Cashman

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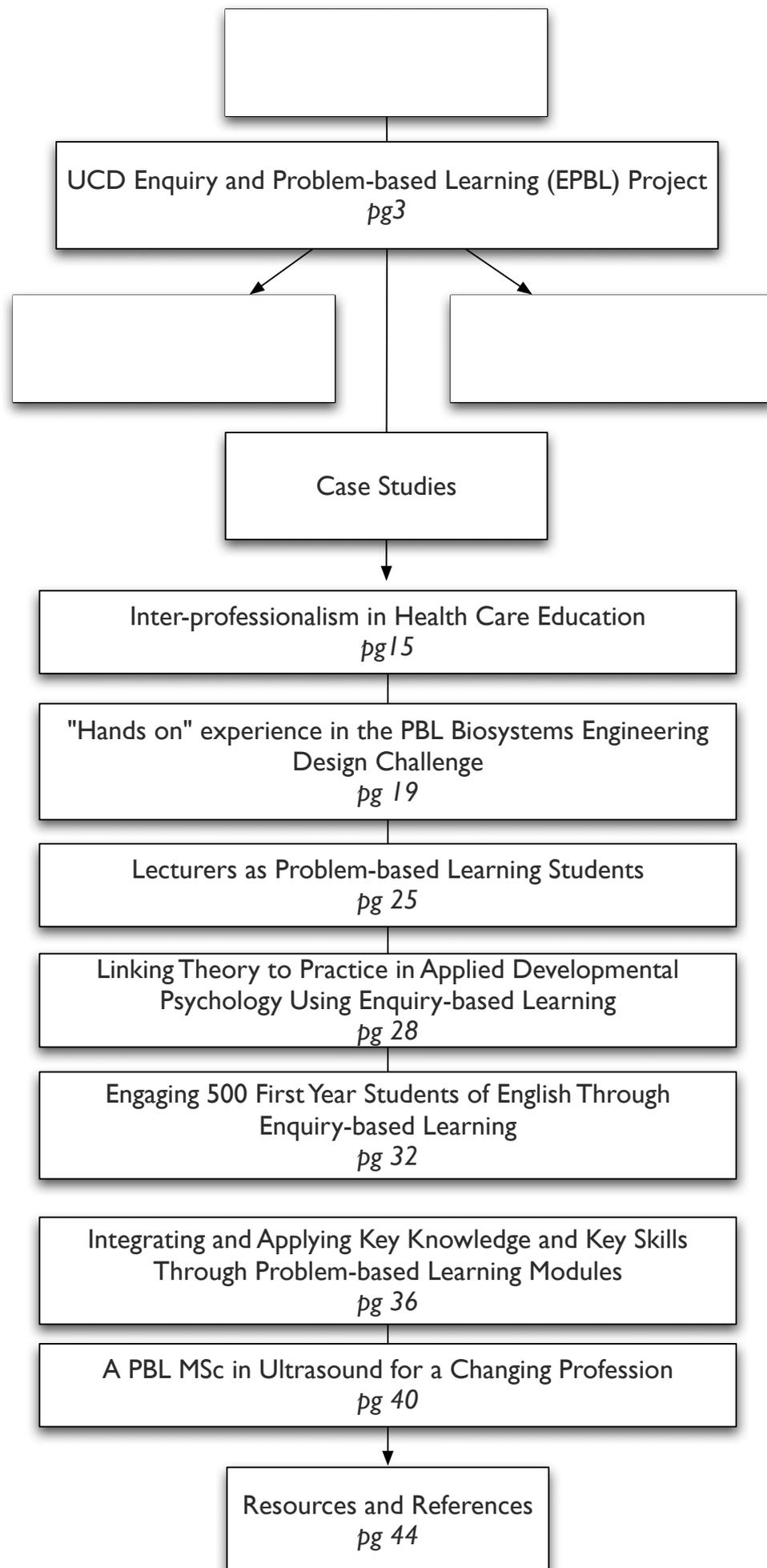
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About the Editors

Dr. Terry Barrett

Terry Barrett is a Lecturer in Educational Development at the Centre for Learning and Teaching, at University College Dublin. She has fifteen years experience of working with PBL as an education developer, programme co-ordinator and tutor. She has worked in the design of PBL initiatives in a range of disciplines including: nursing, physiotherapy, ultrasound, English literature, business and policing. She is joint coordinator of the Enquiry and Problem-based learning Project (Strategic Innovation Fund, Ireland) led by University College Dublin. Her doctorate thesis focused on what we can learn about problem-based learning from listening to how PBL students talked about PBL in tutorials. She has presented keynote PBL papers at conferences in Ireland, England, Australia and Finland. She has published in the areas of academic development, problem-based learning, creativity in higher education and peer observation of teaching. She was lead editor (with Iain Mac Labhainn and Helen Fallon) of Handbook of Enquiry and Problem-based Learning: Irish Case Studies and International Perspectives Galway: National University of Ireland Galway and AISHE (2005) Available at www.nuigalway.ie/celt/pblbook. She co-edited (with Sarah Moore) New Approaches to Problem-based Learning: Revitalising Your Practice in Higher Education which will be published by Routledge in November 2010.

Diane Cashman

Diane Cashman is an Educational Support Specialist for the Veterinary Sciences Centre, in the School of Agriculture, Food Science and Veterinary Medicine at University College Dublin. She has several years experience in the development of elearning across a range of disciplines in the Higher Education and private sector. Diane is currently developing taught graduate programmes for the veterinary profession that capitalises on educational technologies to deliver off-campus part-time education. Similarly for the veterinary undergraduate programmes Diane assists module enhancement projects by implementing blended learning strategies to support student learning. She manages the design and implementation of the veterinary curriculum evaluation strategy and finally assists staff in teaching and learning development.

Diane graduated from the Cork Institute of Technology with an Hons degree in Multimedia; and more recently completed a Graduate Certificate in University Teaching and Learning, and an MSc in Applied eLearning. Her thesis focused on processes of collaborative development of teaching resources and how technology supports can support collaboration.

UCD Enquiry and Problem-based learning (EPBL) Project

We hope that those of you new to enquiry and problem-based learning (EPBL) will find this practitioners guide useful in helping you design and implement new initiatives. For those of you familiar with EPBL we hope you will get some novel ideas to develop your modules or programmes.

Terry Barrett and Geraldine O'Neill



This guide is part of the Enquiry and Problem-based Learning Project funded by the Strategic Innovation Fund of the Higher Education Authority Ireland. Dr Geraldine O'Neill and Dr Terry Barrett from UCD Teaching and Learning were joint coordinators of the project. Project partners were: Probell (The Finnish PBL Network) and the Centre for Excellence in Enquiry-based learning in the University of Manchester. We are very grateful for their contributions to the quality of the project outcomes.

This guide contains some case studies from participants of the project and two case studies which were implemented before the project commenced.. We appreciate the contributions from authors of the case studies. These will be inspiring and useful to other enquiry and problem-based learning practitioners. We also thank Áine Galvin for proofreading the text.

The objectives of the Enquiry and Problem-based Learning Project were to:

- Increase the ability of students for enquiry-based tasks
- Develop students' self-directed skills
- Develop students' ability to work and function in groups
- Develop students' research and information retrieval skills
- Prepare students for 4th level
- Develop staff skills and knowledge in EPBL module and programme design
- Develop lecturer/tutor skills in facilitation of group work
- Develop of a centre of excellence in UCD for EPBL
- Disseminate best practice in EPBL nationally and internationally

Enquiry and Problem-based Learning Case Studies

Thirty three new enquiry and problem-based learning (EPBL) modules were designed and implemented as part of the EPBL project in UCD. Five of the case studies presented in this guide were part of this project namely: Collaborative Learning for Health Professionals, Applied Developmental Psychology, English Literature 1 and 2; Problem-based Learning in Higher Education; and MSc in Ultrasound. We also include two case studies of initiatives that were developed in UCD before the project namely: Biosystems Engineering Design Challenge and A Model of Problem-based Learning in Veterinary Education.

The first 4 case studies give examples of integrating EPBL in one module. The 5th and 6th Case Study provide examples of using EPBL in more than one module in the programme. The 7th and final case study is an example of using PBL for a full programme.

Project Sustainability

It was critical for the project team to ensure that the initiative was sustainable, therefore a number of initiatives were implemented in addition to producing this guide:

- 1. Modules, case studies and potential mentors** have been developed in a wide range of disciplines to support new initiatives in the future.
- 2. Educational development expertise** has been developed in UCD Teaching and Learning which will facilitate ongoing support to existing and new EPBL initiatives.
- 3. A staff development module** on PBL in Higher Education has been designed and delivered to UCD staff as part of the UCD Graduate Certificate / Diploma in University Teaching and Learning.
- 4. A new book** - *New Approaches to Problem-based learning: Revitalising your Practice in Higher Education*, edited by Terry Barrett and Sarah Moore will be published by Routledge in November 2010.



Image by UCD Media Services 2010

Introduction to Enquiry and Problem-based Learning

Terry Barrett

This introduction gives an overview of the following questions:

- What is enquiry-based learning?
- What is problem-based learning?
- Why use enquiry and problem-based learning?
- What are tutor and student roles in PBL?
- What does a PBL tutorial process guide look like?

What is enquiry-based learning?

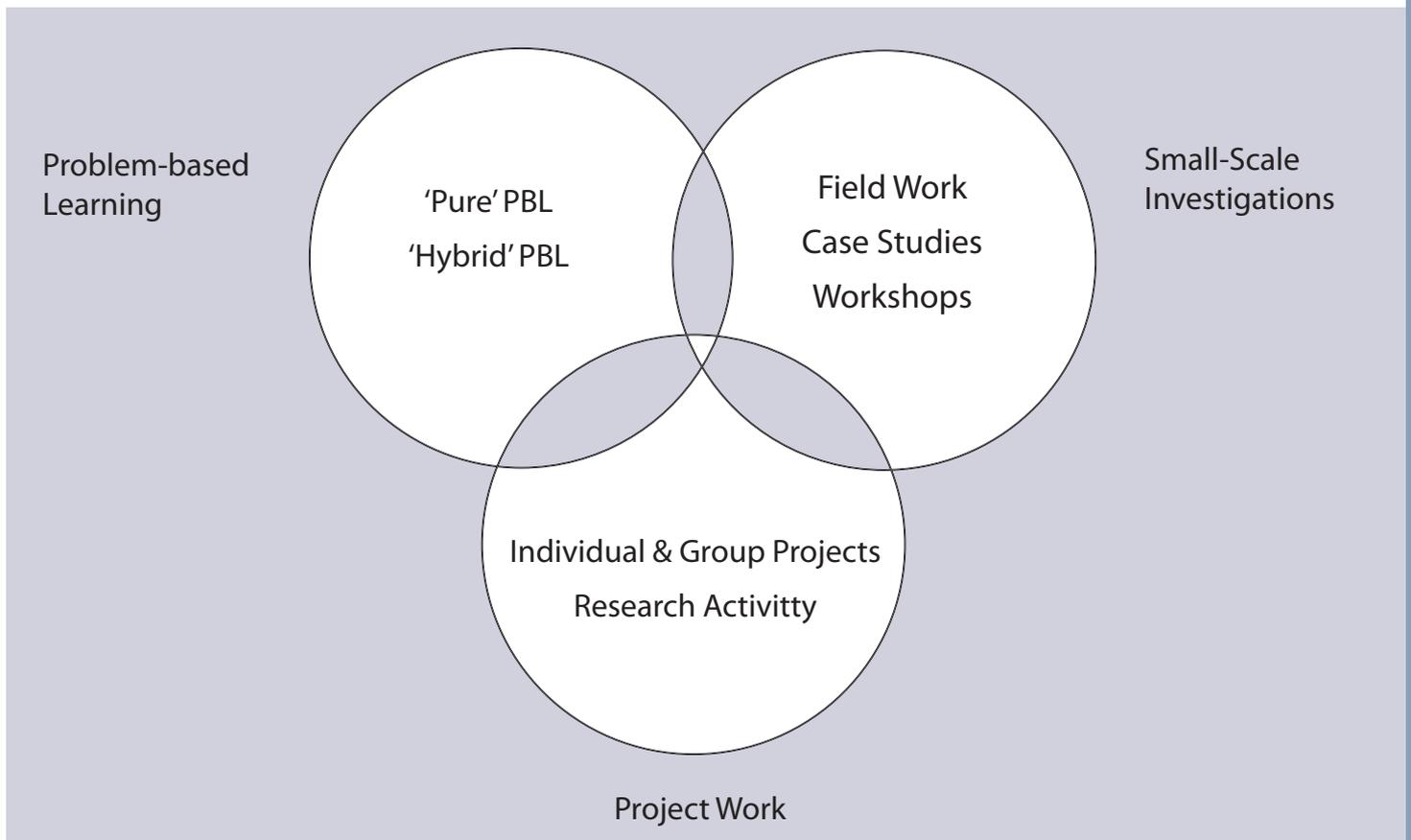
In the UCD Strategy for Education and Student Experience 2009-2013 there is a commitment to supporting the student's "Journey of Discovery" as they advance through higher education. There is a requirement that "in all our education activities, we focus on developing the student's capacity for enquiry, independent learning, innovation and critical discourse" p.4. In this guide enquiry-based learning is used as a broad umbrella term that includes all forms of learning stimulated by enquiry including: project work, small-scale investigation and problem-based learning.



In this guide there are two case studies of undergraduate enquiry-based learning one in Psychology and one in English literature, supporting the early stages of this journey of discovery. They combine the use of lectures with group work in tutorials. They share the following common characteristics of enquiry-based learning:

- Engagement with a complex problem or scenario, that is sufficiently open-ended to allow a variety of responses or solutions.
- Students direct the lines of enquiry and the methods employed.
- The enquiry requires students to draw on existing knowledge and to identify their required learning needs.
- Tasks stimulate curiosity in the students, encouraging them to actively explore and seek out new evidence.
- Responsibility falls to the student for analysing and presenting that evidence in appropriate ways and in support of their own response to the problem (Kahn and O'Rourke, 2005 p.2).

Approaches to learning covered by the term Enquiry-Based Learning (EBL)
Kahn and O'Rourke 2005 p.4

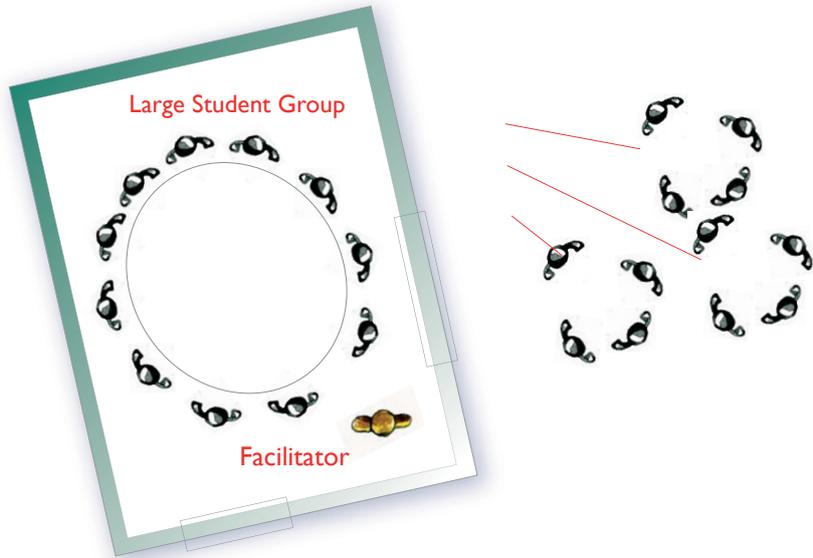


Four different approaches to organizing group work for enquiry-based learning are represented visually and discussed by O'Neill and More 2008 p.79 (<http://www.nairtl.ie/documents/EI2wholebook.pdf>) namely:

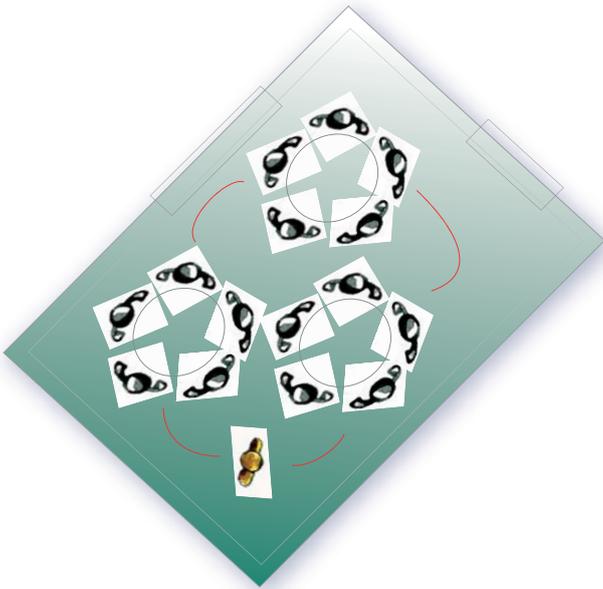
1. Independent sub-groups from a large group
2. The roving tutor
3. Training the trainers
4. Combining the roving tutor and train the trainer

These approaches are illustrated on page 7. The practitioners in this guide use or adapt one of these approaches depending on their context and resources.

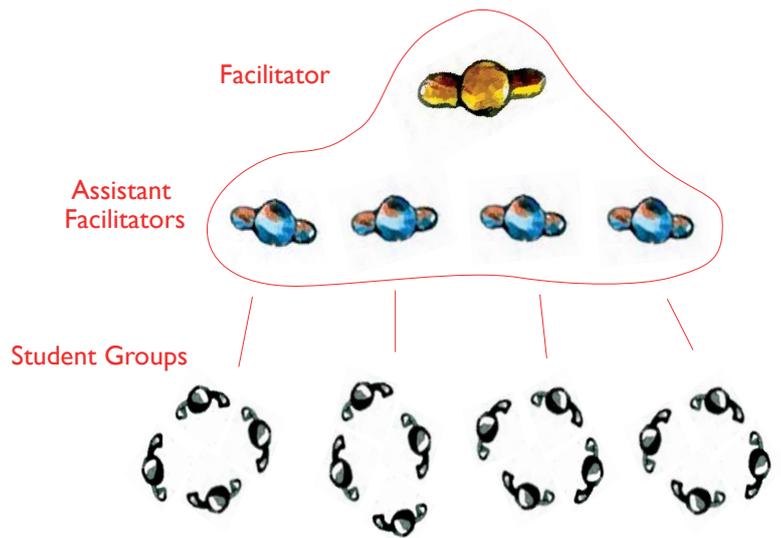
Independent sub-groups from a large group
O'Neill and More 2008 p.79



The roving tutor
O'Neill and More 2008 p.80



Training the trainers
O'Neill and More 2008 p.81



Combining the roving tutor and train the trainer
O'Neill and More 2008 p.82



What is problem-based learning?

Problem-based learning is a specialised form or subset of enquiry-based learning. The classical definition of problem-based learning is:

the learning that results from the process of working towards the understanding of a resolution of a problem. The problem is encountered first in the learning process (Barrows and Tamblyn 1980: 1).

In designing problems for PBL initiatives it is important to involve a range of stakeholders in designing problems that focus in key concepts and align with learning outcomes. Variety of problem formats is important for student learning. This guide shows examples of a variety of problem types including: scenarios, DVD clips, dialogues and cartoons.

Problem-based learning is a total approach that has four interrelated dimensions:

1. An ill-structured challenging problem is presented to students at the start of the learning process. The sequencing of presenting the problem before any other curriculum inputs is a key and distinguishing characteristic of PBL.
2. Students work on the problem in small PBL tutorial teams generally with 5-8 students per team. The role of the PBL tutor is to facilitate the learning process. Ideally there is one tutor per group. Where resources are more limited a roving tutor moves between teams.
3. PBL compatible assessments aim to ensure that authentic assessments are aligned with learning outcomes and the problem-based learning process.
4. PBL is underpinned by a philosophy of higher education that focuses on students learning rather than teachers teaching. In each context it is underpinned by a philosophical understanding of the nature of the specific discipline/profession.

This inter-relationship is outlined in a 7 Step PBL Process Guide used by the PBL Masters in Ultrasound on page 9. All the PBL case studies in this guide share these four key dimensions. Their specific strategies for designing and implementing PBL are discussed.



7 Step PBL Process Guide



Why use Enquiry and Problem-based Learning?

Developing specialist knowledge

- Students are motivated to learn specialist knowledge
- Students learn specialist knowledge in context
- Students link prior knowledge to new knowledge
- Students elaborate new knowledge in small groups

Developing key transferable skills for work and social life

- Critical thinking skills
- Problem solving skills
- Research skills
- Creative thinking skills
- Communication skills
- Teamwork skills
- Information literacy skills

Enhancing the student experience

- Engaging students, especially first years
- Students identifying with discipline/school/profession
- Improving student retention
- Students making friends, having fun and enjoying challenging learning experiences

Linking research and teaching

- Students engage in research-led learning by: identifying the kernel of the problem, clarifying what they know, naming research questions, identifying sources of information, evaluating resources, synthesising information, marshalling evidence to support an argument and presenting findings
- Having experienced this research activity students are well prepared for further research including masters by research and doctorate work

What are tutor and student roles in PBL teams?

The role of the tutor is to:

- Facilitate the PBL process, not to give a mini-lecture
- Listen very attentively to what students are saying and the learning that is taking place in the team
- Encourage a welcoming and challenging learning climate
- Ask questions that encourage critical thinking
- Encourage student to link theory and practice
- Encourage students to be responsible to complete high quality independent learning
- Facilitate students to reflect on their learning, the development of key skills and the performance of the team
- Facilitate the review section of the tutorial

Students all work on the problem and in addition some students take on the roles of: chairperson, scribe, reader and timekeeper.

The role of the chairperson is to:

- Encourage the participation of all team members
- Not necessarily to talk first and certainly not to talk at length
- Facilitate the team to make and work within agreed ground rules
- Stimulate the debate by encouraging discussion of different viewpoints and asking questions
- Use the PBL process as a scaffold for the team to work on the problem
- Ensure that someone summarises at the end of a tutorial
- Check that everyone is clear what learning issues the team has decided to work on.

The role of the scribe is to:

- Record the ideas of the team on the whiteboard so that this can be used as a shared learning environment

- Write the learning issues that the team decide to work on clearly
- Work both verbally and visually on the whiteboard and invite other team members to write on the whiteboard if they want to illustrate a point
- Summarise and synthesise the learning from the problem on the whiteboard

The role of the reader is to:

- Read the problem aloud at the start of the process
- Re-read the problem again when the team decide this is useful
- Draw the team's attention to key elements of the problem

The role of the timekeeper is to:

- Help the team to manage their time in tutorials
- Remind the team appropriately about how much time they have left in the tutorial

In different contexts it is decided to use other roles e.g. observer, photographer or roles that mirror specific professional situations.

In PBL students are often given a PBL tutorial process guide of steps to act as a scaffold for learning. Page 9 shows a PBL process guide used by students on a masters programme in ultrasound in UCD. PBL itself needs to be problematised, adapted and re-invented for different contexts and professions.

The best way to learn PBL is to do it!

Collaboration and Sustainability: Integrating Information Literacy into Enquiry and Problem-based Learning Initiatives in UCD

Lorna Dodd

The development of generic skills is often cited as one of the benefits of introducing both enquiry and problem-based learning. One of these skills is information literacy, which is the ability to identify, find, evaluate and use information in an ethical way. Not only do students develop this skill as a result of participating in enquiry and problem-based learning, it is necessary for them to be able to become effective information seekers in order to successfully negotiate their way through the process. So it is important for academics and librarians to work together at all stages of any initiative.

Integrating information literacy into the curriculum is the most effective way to allow students to develop these skills. Although there can often be challenges such as finding space in a busy timetable, the collaboration required between academics and librarians can result in a productive and long lasting relationship between faculty and library, resulting in a sustainable partnership. Moreover, the opportunity to develop information literacy enables the student to gain skills which can be applied not only to their other academic courses but also to their work life into the future.

There are several ways in which information literacy can be integrated into a problem-based or enquiry-based curriculum. The method chosen will be influenced by factors such as the number of students, the available facilities and the

available space in the timetable. However, any change in educational approach requires all aspects of student instruction to adjust accordingly and this includes the delivery of information literacy instruction. Some approaches to this are outlined in the poster on the next page.

In UCD, information literacy has been integrated into both problem-based and enquiry-based curricula. One of the key features of this success has been collaboration between academics and librarians. This collaboration has meant that the library and schools have worked together in partnership, designing and evaluating each initiative. The collaboration between library and faculty continues and it is this that has brought about sustainability in delivering and supporting these initiatives.



COLLABORATION



Enquiry and Problem Based Learning and the Information Literate Student

Lorna Dodd and Susan Boyle, UCD Library

In EPBL, the development of generic skills is considered one of the most beneficial outcomes. Students are required to become independent information seekers, a skill that can be applied to all aspects of academic and professional life. In order to become effective self-directed learners, students must be information literate. Therefore, it is important that students are equipped with information literacy skills so that they can successfully participate and engage in the EPBL process in a meaningful way.



Challenges Integrating Information Literacy into EPBL

- Finding space in the timetable
- Sustainability
- Value to Students
- Librarian understanding the EPBL process

Integrating Information Literacy into EPBL - The Student Gains:

- Ability to find relevant information quickly and effectively
- Understanding of how to use information ethically
- Ability to efficiently evaluate information and its source.

How to Avoid Potential Problems via Collaboration between Librarian and Academic

- Involve librarian in curriculum design
- Librarians can make excellent tutors
- Involve librarians in assessment criteria and evaluation process
- Create an ongoing partnership between librarian and faculty
- Include the librarian in EPBL training days for academic staff

For more info, see www.ucd.ie/library/pbl

The Library at UCD
An Leabharlann, An Coláiste Oileáire, Baile Átha Cliath

Enquiry Based Learning
What is Enquiry Based Learning? EBL & Information Skills | Further Information
UCD is currently involved in several student centered approaches to teaching and learning. These include Enquiry-Based Learning, Problem-Based Learning and Large Class Projects

The Library can support EBL in a variety of ways

- Delivering Information Skills Classes.
- Acting as a Group Facilitator

I am a life-long learner

I know how to find information when I need it at work/for future learning

I am a self-directed learner

I am a critical and reflective thinker

Strategies for integrating information literacy

Any change in educational approach requires ALL aspects of student instruction to change including delivery of information literacy instruction.

- ### 1 Workshop Approach

Definition: Students work in their groups on the problem. They report to wider group on the value of resources used. Librarian guides them through the resources. Groups search for information again.

Best Use: After students are introduced to their first 'trigger'/problem they can start gathering relevant material.
- ### 2 Problem Approach

Definition: Students are presented with a 'trigger' or 'problem' with development of information literacy skills as the main learning outcome.

Best Use: If there is no space in the timetable for information literacy instruction a problem approach can be used during orientation.
- ### 3 Fixed Resource

Definition: Students request a traditional class on a specific area they are struggling with, e.g. information seeking

Best Use: At the point of need, students request help.

The Ultimate EPBL Student

Illustrations: Erica Crangle, Poster Production, Advantage Point Promotions

Case Studies from University College Dublin

Inter-professionalism in Health Care Education

Tara Cusack

Inter-professional education can be defined as 'occasions when two or more professions learn from and about each other to improve collaboration and quality of care' (Centre for the Advancement of Inter professional Education. www.caipe.org.uk). Inter-professional education is crucial to the development of mutual professional respect and trust. It was considered that inter-professional education could be best introduced by means of problem based learning module.

Current Health Service Executive (HSE) policy concerns the development of health offices that provide/will provide Primary Community and Continuing Care (PCCC). This means that health and social services are/will be provided in health facilities and communities all over Ireland. The multidisciplinary nature of these facilities (medicine, physiotherapy, nursing) will necessitate health care professionals working together in an even more integrated way than ever before. This initiative was sparked by the realisation that despite the fact that the

Health Science Disciplines in UCD had been accommodated in a state of the art facility, we had not as yet followed the lead of our international counterparts and established a mechanism by which inter-professional learning could be achieved. In order to improve inter-disciplinary communication it is important to introduce cross discipline interaction during the undergraduate education years. A module on Collaborative Learning for Health Professionals was designed for first year students.

Module Coordinator:

Tara Cusack
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Curriculum Development Team:

Marie-Louise Butler
Kathryn Smith
Cliona O'Sullivan
Catherine Blake
Ann Sheridan
Geraldine O'Neill



Beginning the initiative

Informal discussion took place initially at the Life Sciences Teaching and Learning Committee. Inter-disciplinary meetings took place between the Heads of Teaching and Learning of the disciplines that had agreed to participate in the module. The module outcomes were established through this inter-disciplinary discussion group. UCD Teaching and Learning advised that a student-centred, collaborative approach to learning would be achieved by means of problem based learning.

The problems were designed by means of an inter-disciplinary group of academics and clinical nurses, physiotherapists, radiographers, doctors, students and librarians. The development of the problems was facilitated by educational developers Geraldine O'Neill and Terry Barrett from UCD Teaching and Learning. The 'problem design' group was initially given an introduction in terms of the requirements of 'good problems' and constructing problems in different media. The module learning outcomes were used as the basis for problem development. A matrix was established to ensure that the module learning outcomes were achieved by the problems included in the module. The development of this module commenced nine months in advance of the module being offered for the first time.



Module Name

Collaborative Learning for Health Professionals [PHTY 10130]

Type of EPBL

Problem Base Learning Module

Discipline

Cross discipline Health Sciences module: Nursing (Midwifery, General Nursing, Children's and General Nursing, and Psychiatric Nursing), Physiotherapy, Medicine, Diagnostic Imaging.

Level

UCD Level 1 (Elective Module)

College

UCD College of Life Sciences

Student Numbers

50

Learning Outcomes

On completion of this module students will be able to:

- Clearly articulate the role of their discipline and that of others.
- Demonstrate the ability to work collaboratively as a simulated health care team.
- Differentiate between healthy and unhealthy health care team functioning in areas of, communication, decision making, conflict management, leadership.
- Demonstrate emergent team building skills, and an appreciation for the role and value of other health care disciplines.
- Make recommendations for teambuilding.
- Examine the potential impact that differing professional and personal values, and codes of ethics have on team functioning.
- Develop ideas in relation to how a multidisciplinary team interacts with other agencies.
- Be information literate and be able to search for identify and retrieve relevant information, evaluate the usefulness and quality of the information and use the information in an ethical way.

Using the Learning Outcomes as a Basis for Designing Problems

In all, five problems were used to achieve the learning outcomes of this module. The first problem “When I Grow Up.....” encouraged students to reflect upon their choice of profession and role they see for themselves in the future. This problem arose through discussions with students who identified that a number of students may for example have found themselves doing physiotherapy, diagnostic imaging or nursing when in fact their first choice may have been medicine.

The second problem is a case-based problem building on the learning achieved in problem one where students develop their understanding of their role as a health care

professional within a multi disciplinary team and addressing the issue of communication directly. A case-based ‘respiratory problem’ is used as the third problem and is detailed below. The fourth problem concerns ‘Synchronous Teamwork and Asynchronous Teamwork’. The final problem is a progressive disclosure problem whereby students receive a letter from their principal asking them to return to their school to deliver a health sciences career talk for transition year students. Students are encouraged to work together to develop their presentation using interesting and varied media that would be both engaging and educational for individuals in transition year.

Problem 3: Breath Taking...

Part 1

At 9.30 pm on 16th October the junior hospital doctor (JHD) was bleeped by the duty staff nurse to see a patient admitted earlier that evening. Her patient notes are as follows:

On arrival in the ward the JHD sees the following:
65 year old lady admitted complaining of respiratory difficulty. She was on 6 litres / minute of humidified oxygen via nasal airway.

On Examination:

Respiratory rate: 32 breaths per minute
Heart Rate 112
O2 Saturation: 78%
Breath sounds: crackles left lower lobe
Weak non productive cough
Temperature: Normal
BP: 110/57.
Neurological status: sleepy

Part 2

www.youtube.com/watch?v=9C5RFb1qWT8&feature=related

Tutor Guidelines

1. Encourage students to consider this lady's condition....
2. Briefly consider what the elements identified in the Dr's report mean for the patient..
3. What part would each member of the team play in this lady's recovery....
4. Encourage students to consider the role of other team members other than their own....
5. In terms of being a MDT who will they need to liaise with prior to planning this lady's discharge? Particular consideration needs to be given to other individuals and agencies outside the acute hospital setting....
6. What components of teamwork are essential to ensure that this lady's admission proceeds seamlessly....

What did the students say?

Was good...

'Getting feedback early in the semester'

'The ability of the group to decide on their own learning outcomes'

'Interaction with students from different classes'

'...mixing with other health-care professions, I am not as timid with other students now'

'That you got to learn how to research articles and books effectively...'

Needs improvement...

'Very time consuming'

'Less assignments'

'Timing of assignments...it was quite hard to get the information and do the assignment in such a short time frame'

'Maybe different problems in relation to each area in health care'

'There should be strict rules pertaining to attendance'

Reflections of a Module Coordinator

In my opinion what is hard about this module:

- Encouraging students to believe what they already know is valuable and worth sharing...
- Encouraging students to seek information for themselves...
- Encouraging students to engage with the library resources...
- Encouraging students to look for good quality resources to inform their learning outcomes...
- Encouraging the chairperson to lead the group...
- Handing over control & staying quite myself
- Being a good facilitator...

In my opinion what is great about this module:

- Working with and getting to know students and staff from different disciplines...
- Student-centred and student-directed approach to learning...
- Learning is being undertaken by students in and outside face-to-face contact time...
- Encourages attendance...
- Encourages good practice for continuing professional development...
- Seeing progression in students learning through their written assignments...

“Hands-on” experience in the PBL Biosystems Engineering Design Challenge

Tom Curran

“

The great thing about this course is that it is “hands on” and that it provides a great opportunity to meet people from other courses.

[Student Quote]

It’s a really good experience that won’t disappoint anyone, you get real hands-on experience in everyday world problems. You get to learn how to be part of a team which will also look good on your own CV and you get to make new friends.

[Student Quote]

”

The Biosystems Engineering Design Challenge (BEDC) gives an early opportunity to Stage One Engineering students to get “hands-on” experience on a relevant real-world problem. The initiative was launched originally as a competition to coincide with the first intake of students to the Biosystems Engineering degree programme in 2004. It provided a platform to highlight the connection between engineering and biological systems. Due to its initial success and positive student feedback, it was decided to offer it as an academic module in 2005/06 in the new semesterised system. It also aligns well with the University’s policy to introduce alternative teaching and learning strategies compared to the conventional lecture and examination. The module now runs in both semesters.



Curriculum Design

The main focus is to simulate a situation where a multi-disciplinary team must work on solving a real-world problem within particular constraints such as time, budget, device dimensions, materials and system performance. It was also vital to have a problem relevant to the discipline of Biosystems Engineering; the initial objective was to design, build and operate a biologically-based, bench-scale system to treat domestic greywater but the specified problems changed each semester.

It is considered important to start with an initial introduction to the technical specifications, principles of teamwork and time management. Guidelines are drawn up on a timeline of expected activities each week. It is also important to align with Engineers Ireland accreditation criteria on developing problem-solving and research skills within a team environment.

Biosystems Engineering Design Problems

Since the introduction of the module the following problems have been presented to students.

Design, build and operate a bench-scale device for:

1. Treatment of greywater from domestic buildings;
2. Water-driven electricity generation;
3. Biofiltration of malodours from food waste.

Assessments

The assessment criteria include teamwork, minimisation of expenditure, device design, innovation, operational safety, system performance, project journal, poster design, report writing and appropriate use of biological and recycled materials. Three external experts (engineers and scientists) visit UCD in the final week of the semester to meet the teams and mentors, and examine the devices and posters; cash prizes are awarded to the best teams. Subsequently, individual academic grades are awarded based on feedback from the external adjudicators and discussion between the mentors and the co-ordinating committee.

Module Name

Biosystems Engineering Design Challenge
[BSEN 10010]

Type of EPBL

Problem Based Learning
One module runs in both semesters

Discipline

Biosystems Engineering

Level

UCD Level 1

College

UCD College of Life Sciences

Student numbers

Started as an academic module in 2005/06 with 23 students. Current academic year 2009/10 has capacity of 56 students per semester = 112 per academic year.

Learning Outcomes

- Describe the principles of engineering design, time management and teamwork.
- Solve a practical engineering problem.
- Locate materials, construct and operate a working bench-scale device.
- Use effective communication skills in writing a group report and presenting a poster.

Implementing the Module

“ *Teamwork is essential. Without it, we would never have succeeded as we did. Working alone would have been a failure on so many levels, and again, I think this is relevant to our futures...be they social or professional, or both.*

Although our team finished joint fourth I wasn't disappointed because I knew how hard the other teams worked to make their projects a success.

[Student Quotes]

”

A mentor is allocated to each group of up to seven students. Guidance is given to new mentors about their responsibilities. All information is provided electronically through presentations and guidance documents. Groups are given a budget of 50 euro each for materials used to construct the devices. Posters are submitted electronically and printed in UCD by the module co-ordinator. The waste management company Greenstar

sponsor these costs and prize money for best teams. Blackboard is used to provide information. Students tend to use direct email correspondence for discussion rather than online boards. Students must submit individual project journals each week on Blackboard. The module is run in both semesters. There are two weekly 50-minute slots per semester with a total capacity of 16 teams per academic year.

“ *An innovative module allowing students to come up with imaginative, creative and functional designs. I look forward to seeing the final projects each year.* [Dr. Enda Cummins, Lecturer]

This module enables students to develop practical solutions to engineering problems. It challenges the students to work in teams towards a common solution in a structured learning environment. I enjoyed working through the students' solutions. [Dr. Kevin McDonnell, Lecturer]

”



2009 Winners - Clearwater

“ *It is now well known that early exposure to design is essential for successful outcomes in engineering education. The BEDC provides students with an exciting introduction to engineering design that provides motivation and encouragement for the rest of their studies.*

[Prof. Nick Holden,
Head of Biosystems Engineering]

”

Schedule of Learning Activities

The Challenge Management Committee strongly encourages each team to pay close attention to the following suggested schedule.

Week Number	Milestones to be met
1	Initial meeting, start team formation
2	Information skills seminar
3	Define problem; Brainstorming for alternative designs
4	Development of alternatives completed
5	Critique alternatives, select final design
6 / 7	Parts sourced, construction plan made
8	Start assembly of prototype (Engineering Workshop 020, UCD Engineering and Materials Science Centre)
9	Prototype ready (Engineering Workshop 020)
10	Final changes made to assembled unit (Engineering Workshop 020)
11	Performance testing of device
12	Electronic version of report and poster submitted by email to Tom Curran

Developing The Module Over The Years

In the early years, the mentors were academic staff but later graduate students took over these roles. A weekly online project journal was developed to track individual student learning. Another recent change in the module was an early introduction to literature research because students tended to depend too much on the internet for references in their reports rather than on textbooks and scientific journal articles.

A discussion now takes place in the middle of the semester to evaluate the group process dynamics with a view to improving team performance for the remaining period. Guidance is also given at this stage on report writing and poster presentation students reflect on the personality traits they bring to their teamwork. The most recent change was the introduction of an online personality profile assessment.

It is considered that having graduate students as mentors works better with them being able to relate well with undergraduates and also relieving pressure on academic staff time. Positive feedback has been received on the mentoring scheme and the opportunity to adopt a “hands-on” approach to problem solving. Students said that they liked not having to take a written exam at the end of the semester.

The experience to date would suggest that assessment appears to be one of the main concerns in problem-based learning. Further efforts have been made to be more concise in allocating marks to the various assessment criteria to allow the process become more transparent and clear to the students, mentors and external adjudicators.

“

The students get an opportunity to develop and display their skills in many ways from solving a practical engineering problem to designing a poster. I feel their talents should never be underestimated.

[Dr. Tom Curran, Module Coordinator]

”



Extract From “Guidance for Student Teams” Document

Team Building Hints:

A team is comprised of individuals, each of whom possesses different strengths and weaknesses. Whether the team is a design team of engineers, a sports team of footballers, or a sales team of marketing specialists, each team member has as his or her highest priority the accomplishment of team goals. It is relatively easy to put people together to form a group; but it can be relatively difficult for a group to behave as a team. Being able to work effectively as a team member is an essential skill every engineer must acquire. It is rare indeed that engineers work alone. More likely than not, engineers do their work as a member of a team. Frequently, team members include non-engineers, too.

An essential element for any successful team is respect. Team members must respect each other and especially their individual strengths and differences. Truly great teams arise when diversity is genuinely appreciated, for it is from diversity of ideas and skills that come inspired performance, whatever the goal. Team members that complement (and compliment!) each other are a coherent group. To be effective as a team, each team member must contribute to an atmosphere where each member’s contributions are valued. Likewise, each team member has the responsibility to his / her colleagues to do their share of the work.

The sequence of team building has been described as one of “forming”, “storming”, “norming”, etc. In the forming process, people with different talents come together for an agreed reason. In the “storming” stage, team members get to know each other better, sometimes through heated (or stormy) conversations. As team members learn each other’s strengths and weaknesses and become more comfortable with each other, the team matures to the “norming” phase, in which everyone gets on with the work to hand as a normal routine. The “performing” stage happens when the team begin to achieve the objectives of the group. Committees are one type of team with which almost everyone can relate. In the engineering profession, engineers are often members of project teams or quality circles. Project teams are assembled to develop or significantly modify a product or process. Quality circles are used within industry to promote continuous improvement. Engineers also serve on teams called task forces, as experts with specialist knowledge to help make in-depth enquiries or studies.

Regardless of the type of team or its purpose, all teams have a leader, if for no other reason than to facilitate decision-making by the team. A leader usually possesses the ability to work easily with others and is comfortable accepting

responsibility. Leaders vary widely in the styles by which they operate. Although a leader is necessary for effective teamwork, equally necessary is the commitment and participation of every team member. After picking a leader, deciding who is going to be responsible for what is a team's next biggest piece of business. The ability to share responsibility among team members is one of the key reasons that teams exist. However, as said time and again, teams are only effective if each team member does his / her part in the team's work.

Time, like money, is a scarce resource and always limited in supply. Whether it is a football match or a design challenge, teams always must work within a given allotment of time. So, together with deciding what must be done and who is going to

do it, a team must set a schedule that will allow them to achieve their objectives within the allotted time available. One approach to scheduling is to first identify the tasks to be accomplished and then assign dates to when these tasks will be completed. Although this is a somewhat arbitrary approach (because it may not take into account the time actually required to do something), it is a good starting point. In real life, engineers make use of much more sophisticated methods of planning a project. You will learn about these as you progress from year to year at UCD. Of course, to be really successful, a schedule must be followed, i.e. intermediate deadlines (or milestones) must be accomplished on time, meaning, "when scheduled."

Building on the Success of the Module

The students who participated in the Challenge in 2005/06 were invited to submit a paper for the UNACOMA Vision Award, an event organized by the European Society of Agricultural Engineers (EurAgEng) to provide an opportunity for younger people to demonstrate their vision of agricultural and biological systems engineering in the future. Eight of the students came forward to co-author a paper "Integrating Engineering and Biology – The Final Frontier". The students demonstrated a significant commitment to the task by meeting several times during the summer vacation to discuss their collected literature. The submitted paper dealt with how the Biosystems Engineering Design Challenges on treatment of greywater and polluted air could be used in the design of closed loop environmental control systems in a space

station. The proposed model contained four components in the life support system: Controlled Environment, Regenerating and Resting, Eating and Drinking, and finally Working and Energy Production, (C.R.E.W). It was suggested that each module should specifically cater for one need but also provide overlap for other regions to maximise recycling potential between modules.

The paper was presented by one of the UCD students to an audience of over 200 delegates at the World CIGR Conference closing ceremony in Bonn, Germany in September 2006 and finished a highly commended runner-up in the UNACOMA Vision Award. All eight students travelled to Bonn courtesy of UCD and thoroughly enjoyed the experience.

Module Coordinator:

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Curriculum Development Team:

Ms. Colleen Doyle, (Student Adviser)

Dr. Enda Cummins,

Dr. Kevin McDonnell,

Prof. Nick Holden



Lecturers as Problem-based Learning Students

Terry Barrett

Participants learn about problem-based learning by becoming PBL students for this module. They work in small PBL teams on a problem about problem-based learning. They experience how the PBL tutorial process works. Thus both the content and the process are problem-based learning. The experience of having been PBL students for a module gives participants a strong basis for designing and facilitating PBL initiatives for their own students.

Why a Problem-based Learning Module in Higher Education?

Problem-based learning has been characterised as the most important innovation in the education of the professions in the last few decades (Boud and Felletti 1997). There are many PBL initiatives in Ireland at module and programme levels. This module facilitates students taking development and leadership roles in PBL practice and research.

The aim of this module is to empower students to design, facilitate and evaluate

problem-based learning initiatives in ways that are informed by research, best international practice and students' understandings of their own education contexts together with the creativity of their curriculum teams. The module also aims to facilitate students exploring potential PBL research projects.

This module is taken as part of a Postgraduate Certificate or Diploma in University Teaching and Learning. Lecturers from a variety of schools in UCD and some lecturers for other institutions undertake this module. Some students take this module as part of their doctorate programme.

Module Coordinator:

Terry Barrett
Terry.Barrett@ucd.ie

Curriculum Development Team:

Terry Barrett
David Jennings
Geraldine. O'Neill
Lorna Dodd



How is the module assessed?

There are two summative assignments for this module:

1. A team presentation
2. An individual resource review

These are both Pass/Fail grade.

ASSIGNMENT 1: Team Presentation

(Based on the PBL Problem, page 27)

The presentation is for 30 minutes and you are free to use any media. It will be followed by questions.

ASSIGNMENT 2: Resource Review

Each person should identify a PBL issue that is interesting to them and phrase it as a question. The resources used to address the question should include journal papers, web resources and PBL practitioners. Each resource review should include a concept map. The word count is 4000-5000 words.



Module Name

Problem-based learning in
Higher Education

Type of EPBL

Problem-based learning
Module

Discipline

Higher Education

Level

4

College

Human Sciences

Learning Outcomes

On completion of this module, students should be able to:

- Critically reflect on what they have learned from the experience of being PBL students
- Design authentic, engaging, creative, deliberately ill-structured problems/triggers/scenarios in a variety of media
- Compare and contrast the role of the PBL tutor with other teaching roles
- Debate current issues in problem-based learning research and practice
- Suggest possible PBL research projects
- Identify their own learning issues and resources to work on these issues
- Debate the philosophical principles underpinning PBL
- Critique and adapt PBL processes for their own contexts
- Decide on specific transferable elements of the PBL process that they wish to integrate into their other teaching strategies.

What learning processes are used in this module?

As problem-based learning students, participants experience PBL tutorials. They set the ground rules for effectively working as a team. They define the problem. They brainstorm their ideas about the problem. They identify what they don't know about the problem and need to research. They phrase these learning issues as questions. Between tutorials they research these learning issues as they relate to the problem. Teams share the research they have done and work together towards a resolution of the problem and to produce the product required. See opposite page for the problem trigger students from the last cohort were presented with.

In addition to these PBL tutorials students participate in workshops that help their work on the problem and in designing PBL initiatives for

their own students. These workshops included: problem design, embedding education technology and evaluation. Students also have the opportunity to listen to PBL case studies presented by PBL module and programme co-ordinators. They saw these people as an important resource and asked them questions about the team problem and their own PBL initiatives. Key resources on the research on PBL were presented in the module handbook. Lorna Dodd (the librarian) facilitated information literacy sessions on accessing research literature on PBL. Terry Barrett facilitated a session on trends in PBL research and presented some of her own PBL research. Each student worked on a question on PBL they were interested in through working on a resource review. Some students submitted this as a paper to a journal.



Interested in finding out more about this module?

The first cohort of students completed this module in 2009. If you are interested in getting more information or registering for this module when it is offered again or in completing other modules on the Certificate or Diploma in University Teaching and Learning contact:

Contact:
teachingandlearning@ucd.ie

One misty Friday morning in October 2009, at a secluded location, the elite team came together over steaming coffee and chocolate croissants to plan the design of a new PBL programme. . . . The deadline for the review meeting of 20th November, where a sample full PBL module package will be presented loomed large. . . .



We don't have the staff!

Linking Theory to Practice in Applied Developmental Psychology Using Enquiry-Based Learning

Suzanne Guerin and Eilis Hennessy

We introduced an enquiry-based learning (EBL) approach to overcome the difficulties some students had in linking theory and practice in developmental psychology. The aim was to encourage independent student research into topical issues relevant to children's lives. We wanted to provide an opportunity to facilitate small group interaction in undergraduate students.

Curriculum design was informed by an analysis of past students' experiences and learning in an existing module that had been co-taught for a number of years previously. This analysis was based on a review of and reflection on essays, student feedback and class discussion and indicated that students had difficulties in linking theories in developmental psychology with applied research topics. We were, therefore, looking for an approach to curriculum design that would help students to bridge the gap between their understanding of theories of child development and the research studies that they were reading about.

Enquiry based learning seemed to offer students a way of working in small groups to formulate links between theory and research. Also, given the applied nature of the module we were aware that students would be able to draw on their own knowledge of the module topics in studying the area. In addition, the group format of enquiry-based learning seemed to

offer the possibility of encouraging students from different disciplinary backgrounds the opportunity to learn from one another. The fact that the module was a popular choice as an elective for students from outside the single honours degree in Psychology had given rise to this feature of the module.

Curriculum Design

The module was offered in the first semester of the academic year and planning began mid way through the second semester of the previous academic year with initial meetings between the staff involved as well as additional discussions with experts in EBL. Geraldine O'Neill from UCD Teaching and Learning worked with academic staff on the initial design of the module.

The module was delivered by two full-time members of academic staff and a graduate student provided administrative support in keeping track of assignments. The module also

involved one session from the School of Psychology liaison librarian who brought students through the databases used in Psychology, an introduction to how to critique web-based material and information on how to source APA referencing guidelines

The module focused on three themes that are central to applied developmental psychology:

- The contribution of theories of human development to research on children's lives.
- The importance of research in guiding practice in these areas.
- The value of adopting a developmental perspective on applied research on childhood.

Three applied topics were selected to form the basis of the module content, and these were considered in relation to the three themes outlined above:

- Adoption and early deprivation
- Children and advertising

Module Evaluation and Development

The staff developed a Learning Experiences Survey for students, which was completed at end of the module (n = 38). It had qualitative and quantitative components which looked at Engagement & Social Interaction, Knowledge & General Experience and Satisfaction. Student ratings were very positive with marks on most areas in the high range (>7/10)

In addition to positive comments for the students as exemplified by some of their quotations in the case study the feedback also highlighted a number of limitations such as the way in which the group process worked for some groups and the number of assessments.

Geraldine O'Neill from UCD Teaching and Learning observed both staff teaching at their request. Feedback from this external peer observation in the first year of the sessions highlighted the clarify of instructions and the staffs' comfort with small groups but stressed the need for staff to be supportive of group discussion without influencing the processes too much.

Module Name

PSY30060: Applied Issues in Developmental Psychology

Type of EPBL

Enquiry based learning, one module, delivered as part of the Psychology Major and Minor structures on the BA programme and also available as an elective module.

Discipline

Psychology

Level

UCD Level 3

College

UCD College of Human Sciences

Student numbers

50

Learning Outcomes

On completion of the module students should be able to

- Evaluate the contribution of theories of human development to issues relevant to children's lives.
- Evaluate the importance of research in guiding practice in these areas.
- Assess the value of adopting a developmental perspective on applied research on childhood.
- Critically review relevant research.

Problems to Stimulate Students Linking Theory to Practice

- The topic on adoption and early deprivation used a press cutting from the Daily Mail (23/4/1998) detailing difficulties an adopted child was experiencing.
- The topic on children and television advertising used a clip from the film 'Jingle all the Way' which shows parents desperate to find a particular toy as a Christmas present.
- The topic Cyberbullying used a press cutting from the Irish Times (30/10/2006) discussing steps taking by the social networking site Bebo to combat bullying, and an excerpt from a focus group with second-level school pupils on Cyberbullying.

“ ***The topics that we covered were very interesting and I think were very relevant to contemporary society.*** ”
[Student Quote]

Trigger for Adoption and Deprivation Topic

CASE STUDY: Cezarina Adopted from Romania Aged 10 Years

To a stranger Cezarina seems pretty, polite, charming but, most of all, normal. Yet her hidden handicaps pose both dangers and disadvantages.

Jean, her mother says: 'She understands the survival instinct and fear, but not affection or love. Her relationships are entirely superficial and she doesn't attach to people. If a potential friend comes round, she cannot get it into her head that she has to include her in some activity. Instead she carries on with whatever she is doing. Nor can she conceive that her friend might be upset. Cezarina is also unable to process information. She cannot follow more than one instruction at a time. If you tell her to dry the dishes, then put the milk bottles out, she will manage only one of the tasks. She has no sense of the passing of time and takes everything literally. The first time I told her to get up at 7.30am she stayed up all night waiting for the clock hands to go round. Even after nearly seven years of daily nagging, she still cannot remember to turn off taps. The fact that she is intelligent, and that she is going to take eight GCSEs, makes it all the more frustrating.'

Jean describes when she first met Cezarina in the orphanage in Bucharest: 'She was about the size of a five-year-old and weighed just under 3st. She'd had Hepatitis B and TB, was obviously starving. She dragged her leg, was cross-eyed and had a chronic ear infection. She'd also been physically, sexually and emotionally abused.' Cezarina remembers the orphanages clearly. 'They were dirty and unfriendly. I was hit a lot with a stick on the soles of my feet and my arms. I also had to sleep with a blanket over my face.'

Based on an article published in DAILY MAIL (London). April 23, 1998

This Enquiry-based Learning Module in Practice

The format each week was the same with one of the lectures being devoted to a large group session (lecture or whole class discussion) guided by the staff members and the second devoted to students working in their own small groups (approx. 5-6 in each group).

The module involved three topics, which were split between the two academic staff. Each topic covered three weeks, and for each topic week 1 involved the students working through the process guide in small groups, week 2 involved a lecture in which the staff member presented some of the current issues in research, while week 3 involved a guest lecture from an individual working/researching in the topic area.

There were short assignments to be delivered each week either from individual students or from each small group. This meant that all small group work was focused on a particular activity. Staff circulated among the groups and entered into discussion about the group process.

Student Assessment

The assessment strategy was grouped into individual and group assignments.

1. The group assignments focused on the three topics and for each topics students had to work in small groups to complete three tasks:
 - To identify three questions relevant to the topic to be answered by the group and three articles that could help answer those questions (5% per topic)
 - To write a short 150 reflection on the application of the modules three core themes to the current topic (10% per topic)
 - In addition the groups were asked to complete a group reflection task midway through the module that encouraged them to consider the key strengths and limitations they had noted in their group work and, importantly, to propose solutions to any difficulties in advance of the next task (5% overall).
2. Individual assessment strategies included a major essay that focused on one of the three topics of the module (accounting for 45%), and a short individual reflection on the nature of applied developmental psychology which was set in Week 1.

“ The group work. People often don’t want to speak out in a large class. I think when in a group it is easier to interact and give your thoughts on the topic and hear others thoughts. [Student Quote] ”

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Dr Eilis Hennessy



Dr Suzanne Guerin

Engaging 500 First Year Students of English Through Enquiry-based Learning

Danielle Clarke

We wanted students to forge lasting relationships (social and intellectual) with their peers, and thus for them to develop a disciplinary identity as students of English engaged in shared academic endeavour and to challenge the individualist model of much work in the humanities. We wanted students to achieve some traditional outcomes (a sense of chronology; an understanding of genre; a realisation that texts are produced and made, and that this process changes over time; a fuller understanding of how the language of texts functions to produce meaning), through non-traditional means hence facilitating their transition to active learning.

We acknowledge the crucial importance of the acquisition of research skills from the beginning of students' college careers, focussing on hands-on introduction to the various resources available (online and print) and the development of the ability to evaluate, critique and present evidence. The development of scholarly responsibility, and an understanding of the ethics of the intellectual community (questions about ownership, collaboration, citation) is important. We wanted to give students the opportunity to work outside of the conventional parameters defining academic work; to encourage them to be creative and imaginative and to put their non-academic skills to work to the end of producing lively, interesting work.

“ Many materials provided directed us in a myriad of directions. It was very interesting to take charge of our own specific areas and elaborate on these by researching different points of view
[Student Quote]

”

Old Globe Theatre



Image by Mckaysavages photostream. <http://www.flickr.com/photos/mckaysavage/2997795552/>
Accessed 15.12.09

Getting Started with This Initiative

We began with our learning outcomes and tied everything we did to them, using them constantly as the benchmark against which we judged whether the problems were appropriate and so on. We had in mind the chronological spread we were aiming at and located the problems within these parameters. For this particular project, with all of its operational complexity, the problems were the starting point, and the core of what we did; everything else in the module was then designed to support and facilitate students in the execution of those problems. Each problem was designed in the first instance by two academics with a specialism in the area, circulated to the team, and then tested and tried out by groups of tutors in training. The latter was a doubly helpful exercise – tutors identified key areas of difficulty, ambiguity and potential misunderstanding, whilst themselves learning ‘on the job’ about EBL. It also gave them a more direct stake in what they were to be delivering in class.

From the initial decision to use EBL to delivery took a full 18 month period of planning, designing, testing, reworking, with regular review sessions in the year since we first piloted EBL for English. These sessions are to be ongoing. Three academics from the English division of the School of English, Drama and Film were fully involved in the design of both modules, with indispensable input from Terry Barrett, UCD Teaching and Learning, from Karen O’Rourke (then at Manchester University), and from library staff (Lorna Dodds, Valerie Kendlin, Ursula Byrne and Evelyn Flanagan). The latter in particular made the delivery of these modules possible.

Old Globe Theatre



Image by Howard Gees photostream. <http://www.flickr.com/photos/cyberslayer/1915852858/sizes/l/>. Accessed 15.12.09

Module Name

Literature and Context 1; Literature and Context 2

Type of EPBL

Enquiry Based Learning, 2 modules, pre-requisite for major

Discipline

English Literature

Level

UCD Level 1

College

UCD College of Arts and Celtic Studies

Student numbers

500+

Learning Outcomes

- A basic knowledge of the material and historical context of literary production
- Ability to identify key trends in literary culture from 1100-1600
- Ability to identify some of the factors behind the construction and celebration of particular texts, of authors and consequently of literary canons
- Development of the ability to differentiate various registers of language from different periods and to analyse them critically
- Critical understanding of the relationship between words and meanings, and a basic grasp of the significance of language change
- A knowledge of the key resources and their limitations
- An ability to work in teams, to share work fairly and to meet the obligations set by the group
- An understanding of how to undertake basic independent research and to evaluate findings

Implementation

The 500+ students were organised into groups of 25, and then into 3-4 groups within that. Groups of 6-8 was felt to be appropriate, given some inevitable attrition. We did intensive training – one information day for interested tutors, a 2 day training session for those appointed, and regular meetings during module delivery and assessment, plus email contact.

Overview of Problems

Literature and Context 1

Two problems were involved:

- (i) students were to write a newspaper feature promoting the writings of Chaucer to the general reader; and
- (ii) students were to adapt or rework a scene, speech or character from a selection of Shakespeare plays in order to encourage teenagers to engage with the Globe theatre in London.

Literature and Context 2

Allowed students to build on develop the skills they had learned in Literature and Context 1 to deal with a larger and more complex problem

- (i) Students had to propose an idea for a literary periodical from a key era (Victorian, modernist etc) to a potential backer, and produce a sample issue with contents appropriate to the style of periodical and to the historical period.

Debating the Renaissance

The Globe Theatre in Southwark, London, is seeking a PR team to promote its activities, and you have been invited to pitch an idea for a promotional campaign based on an issue, character, idea or theme found in Shakespearean drama. The campaign must be based directly on a speech (or speeches), dialogue or scene from one of Shakespeare's plays (see list below), and the excerpt must be, in your opinion, key to understanding the play as a whole. It must be suitable for an international (but English-speaking) audience of teenagers (13-16yrs), and is intended to engage their interest in the theatrical culture of Renaissance London as well as in Shakespearean drama specifically. You can consider a variety of formats for your campaign, such as conventional drama, a storyboard, a cartoon, a website design, a blog, an advertisement or a networking site, but it must be based directly on the original language of the play, although you may depart creatively from it or adapt it to a new setting.

Assessment

For Literature and Context 1: 20% group assessment for Chaucer, 20% group assessment for Shakespeare, 20% reading journal kept over the semester, 40% final exam. For Literature and Context 2, 40% for the group project, 30% for the reading journal and 30% for final examination. Each assessment was graded with reference to the learning outcomes for each problem, and was fully moderated, internally and externally.

“ *At the beginning I thought the assignments were too hard and like nothing I've done before but being in a group helped*
[Student Quote] ”

“ *It introduced us to Chaucer and Shakespeare in a completely different yet fun way*
[Student Quote] ”

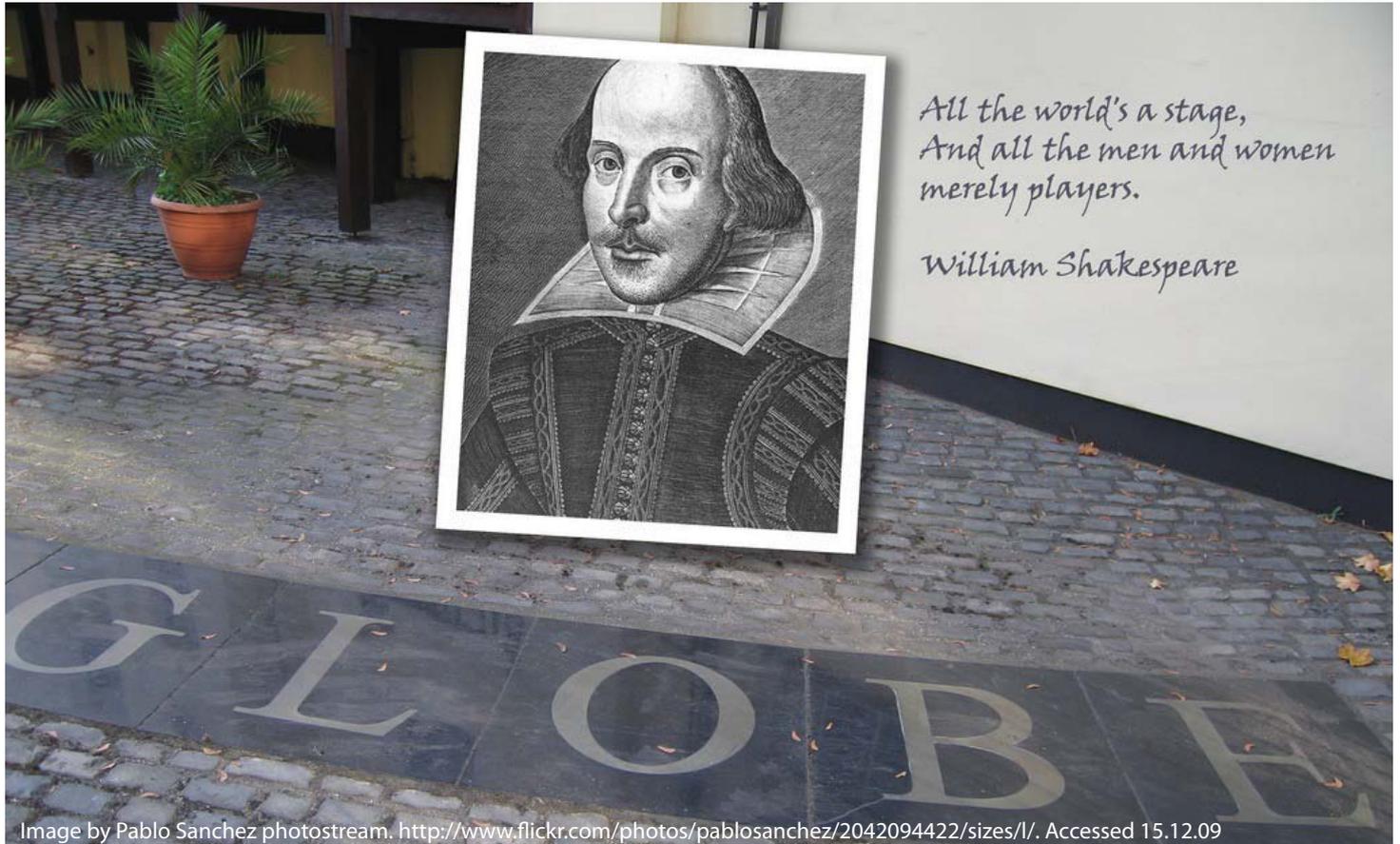


Image by Pablo Sanchez photostream. <http://www.flickr.com/photos/pablosanchez/2042094422/sizes/l/>. Accessed 15.12.09

For further information see

Clarke, Dillane, Long McAreavey and Patwell (2009) Literature in Context : Enquiry Based Learning for First Year Students. www.nottingham.ac.uk/english/working_with_english/5/. Accessed 14.2.2010

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Fionnuala Dillane

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Terry Barrett

Karen O'Rourke



Integrating and Applying Key Knowledge and Key Skills Through Problem-based learning Modules

Stephen Carrington

Two PBL modules (Applications and Integration 1 and 2) were implemented in first and second year of the Veterinary Medicine undergraduate programme in 2000. The aim was to facilitate students integration of knowledge from other modules, and to develop students generic skills that will be of relevance to their future role as veterinary clinicians. As such, the initiative utilises clinical or related problems as triggers for logical analysis, encouraging skills such as reflection, investigation, information retrieval, and the ability to integrate relevant subject material from diverse sources. The modules are not used as a primary means to disseminate new core factual subject matter. Nevertheless a great deal of factual learning is indeed promoted and encouraged, along with the skill-base to allow this to happen on a lifelong basis. This balance helped greatly in promoting the concept of problem-based learning to teaching staff, some of who were initially sceptical of its benefits in 'imparting core facts.'

Curriculum Team

Initially, academic staff from across the veterinary programme, were involved in the initiative in order to promote and explain its objectives to students. A small team of committed senior academics worked with Dr. Philip Bushby (Mississippi State University Veterinary School) on the planning and implementation. Initial positive feedback from staff and student surveys was helpful in embedding the initiative. UCD Teaching and Learning has been involved in the development of this initiative. The library staff are highly committed to the support of the initiative, and were involved since the initial planning. Currently many of the PBL tutors are doctorate students who are trained by academics.

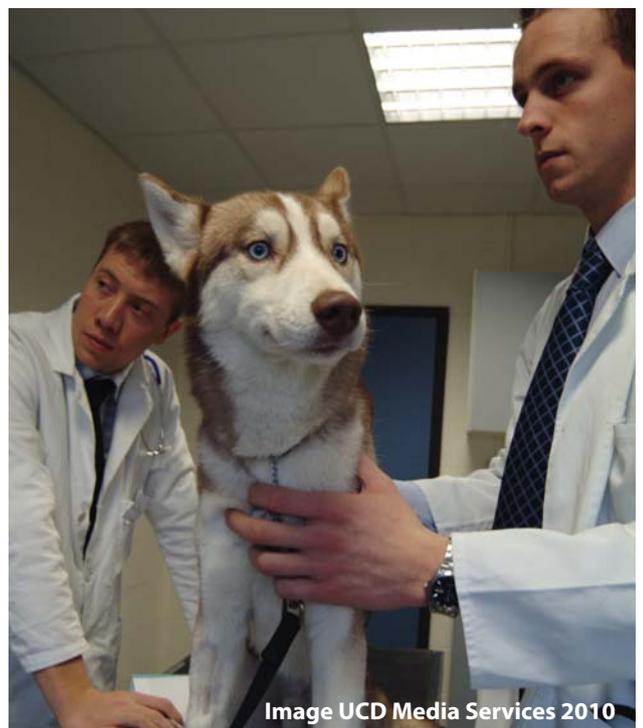


Image UCD Media Services 2010

Curriculum Design

The curriculum design was founded on a model developed at the Bowman Gray School of Medicine of Wake Forest University in the United States.

The problems are released in the form of a clinical problem as it is revealed to, and investigated by, a clinical veterinarian. As each page of the problem is released, the students sequentially review: facts, ideas, learning issues, and plans. The cases are designed to correlate (where possible) with the students' current learning context in the basic veterinary sciences. This allows them to apply factual knowledge acquired through the more didactic parts of the veterinary curriculum, and to proactively investigate issues that go beyond this basic underpinning of facts and concepts.

Finally, trained PBL tutors facilitate the tutorials.

Assessment

The key challenges of designing the assessment is to ensure that it

- is concordant with the intended (generic) learning outcomes
- is not unduly time consuming for students or examiners
- does not encourage students to focus on 'collecting facts' from the cases.

The current assessment strategy combines a viva examination with marks for the PBL tutorials. The students receive 10% of the marks for attendance and active participation (tutor assessed). The remaining 90% of the marks are made up of a viva examination of one (of three) of the cases allocated from during the term (40%), and a 'short' case solved in real time, which is given to groups of up to 16 students 2 hours before the examination (50%). While a sound basis of underpinning factual knowledge is required and arises from proactive research, the assessment criteria emphasise systematic analysis, efficient research, logical prioritisation, and intelligent integration of adjunctive knowledge. Through this the student is, above all, expected to 'define the right question' rather than necessarily 'get the right answer'.

Module Name

Applications and Integration 1 & 2

Type of EPBL

Problem-based Learning

Discipline

Veterinary Medicine

Level

UCD Level 1 & 2

College

UCD College of Life Sciences

Student numbers

90

Learning Outcomes

On completion of this module students should be able to:

- Adopt a critical, analytical approach to any problem, correctly identify the facts presented which are relevant to solving the problem and generate useful ideas on how to solve the problem.
- Identify, source, synthesize and communicate information required to solve problems presented to them.
- Analyse and integrate information from many disciplines and use it correctly for problem solving.
- Work and communicate effectively as a member of a team.
- To promote "deep learning" of the basic veterinary sciences
- To foster professional and ethical values

Clinical Case Scenarios

Clinical case scenarios, act as 'veterinary detective stories'. These are released in stages to the students, and included a range of information from e.g. lab test results, radiographs, echo-/electro- cardiograms etc. Each problem is supported by a detailed facilitator's guide, which provides a brief but detailed analysis of the problem to allow facilitators to stay a step ahead of the students. It also provides suggested questions or issues that can be used to initiate or restart a 'stalled' session where student interaction is deemed to less than optimal.

In practice, a well-designed problem usually acquires sufficient momentum so that intervention by facilitators is minimal. Indeed the facilitators are exhorted and trained (in an annual training workshop) to intervene as little as possible and, where necessary, to provide open questions as prompts, and never the answers to direct questions. Normally, the students undertake 3 cases per semester. Each comprises 4 sessions of 2 hours each, with intervening time for research and discussion. The consuming task during the set-up of the project was the design and production of cases. The initiative has been re-worked and re-designed based on experience and feedback several times since it started. These have been directed towards reducing academic workloads, and improving the concordance of the assessments with the intended learning outcomes.

Extract from PBL Facilitator Guide

At the start of the first session

Ensure all students know each other (and you!) and explain your expectations of them:

- Pro-activity; Participation; Logical analysis; Teamwork; Research/follow-through.

At the start of all subsequent sessions

- Get students to place what they know about the case in the context of their recent research
- Ask them "What are the most important things that you found out and how do they relate to the case?"
- Appoint a scribe and a reader

During the session

Progressively distribute the pages relating to the problem followed by:

- Collective discussion of the information provided
- Use a whiteboard and an appointed scribe to consider and capture:
 - FACTS – those facts particularly relevant to the case.
 - IDEAS – what they think is happening with the patient's problem(s)
 - LEARNING ISSUES – a list of what needs to be known in order to completely understand and deal with the patient's problem(s)
 - PLANS – actions that must be taken, such as diagnostic/therapeutic steps, in order to progress towards completion of the case

At the end of the session

- Ask a student to summarise the case so far.
- Ensure that students know that they are responsible for researching the learning issues, and that they should all return competent to discuss these (and their relevance to the case) at the start of the next session



Supervised Students Authored Problems

Two veterinary undergraduate students hired over the summer vacation period undertake case authoring. These students are academically supervised, and their output is subjected to academic editorial input before use. We try to ensure that the majority of cases are new each year. The use of supervised student authors for the development of problem cases benefits both the authors (who gain new perspectives on learning), the academics coordinator(s) of the programme (who save time), and the students who undertake the PBL (who get new and interesting cases). We try to combine a junior and a senior student to get the best from both bottom-up and top-down perspectives. We ask them to write a short case to judge baseline proficiency before selecting them. Many students apply for these positions.

Basic guidelines for the students are:

- Try to match the case material to the ongoing other modules if possible, do not be too obsessive about it.
- Try to ensure that the cases used have more than one clinical condition, as this makes for a more challenging and interesting case.
- Do not be frightened of introducing ethical or moral questions.
- Do not produce excessively long facilitators' guides (max 20 pages)
- Swap cases, proof read, and correct thoroughly.
- Seek detailed academic feedback on at least the first case.
- Design a flow of information that engenders the maximum level of enquiry
- Do not provoke a question in the minds of problem solvers to which the answer is provided on the same page of the problem. Always ensure that it is on a subsequent page, so that enquiry, reflection, and discussion will take place before any solutions are provided or implied.

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A PBL MSc in Ultrasound for a Changing Profession

Marie Stanton

In the Ultrasound context technology is constantly changing. New modes are frequently introduced, recent examples include three and four dimensional ultrasound. Existing capabilities are developed for example the resolution of ultrasound scanners is constantly improving, this improves visualisation of smaller and less obvious pathologies and the recognition of finer anatomical detail. These and future developments require the ultrasonographer to adapt their knowledge, thinking and technique. Many other changes are occurring in the wider healthcare environment that affect ultrasound. These include: increased obesity levels, the higher age profile of the population, the development of the National Cancer Strategy, increases in hospital acquired infections, increasing patient expectations, medico legal challenges, and reduced resources to deliver services to patients.

“ ***PBL mirrors the kind of problems encountered in real clinical ultrasound practice which require careful thinking.*** ”
[Student]

A programme that prepares students for this constantly changing environment is essential if graduates are to practice, manage and direct ultrasound services optimally throughout their professional career. The PBL Programme aims to facilitate students in the development of their clinical competence in ultrasonography, while simultaneously developing generic skills such as team working, critical thinking, problem solving and information literacy. This should enable our graduates to adapt to changing professional contexts.



Feedback from lecturers on the existing course included a consistent and worrying opinion that students seemed to be becoming more passive in their learning. Lecturers involved in teaching on this programme selected PBL because they wanted students to learn in a more active way, which would promote a deeper level understanding of their practice.

Designing Problems with Clinicians and Other Professionals

This is a fully problem-based learning programme that includes 17 PBL modules. Students do some mandatory modules and specific elective modules depending on their clinical contexts.

An interesting and important feature in our curriculum design process was to invite a multidisciplinary group of stakeholders to write authentic and challenging triggers to stimulate student learning. The participants in the problem design days included: clinical specialist radiographers, clinical midwife specialists, lecturers in ultrasound, librarians and an educational specialist in PBL. The clinicians were asked before the day to bring ultrasound problems or cases with them. The aim of the problem design days was to use the skills of the participants to develop the clinical cases to direct student learning towards particular programme outcomes. The participants designed problems that were evaluated as very effective by our students. The student outcomes from these problems included developing specific ultrasound knowledge and clinical competence together with more generic outcomes related to developing students' team working, higher order thinking skills and information literacy.

Students' comments on working with the problems:

“

PBL encouraged me to look deeper at issues arising in clinical practice and interact skillfully with others.

PBL encourages students to work together discussing, comparing, reviewing and debating what they have learnt in an active and interesting atmosphere.

”

Programme Title

MSc Ultrasound

Type of EPBL

This is a fully problem-based learning programme, which includes 17 PBL modules.

Discipline

Diagnostic Imaging - Ultrasound

Level

UCD Level 4, NQAI level 9

College

College of Life Sciences

Student numbers

20

Learning Outcomes

On completion of this programme students should be able to:

- Demonstrate high level clinical skills;
- Synthesise specialist theoretical and conceptual knowledge;
- Demonstrate an ability to interact effectively as a participant and a leader in problem solving groups and inter professional teams;
- Conduct applied research that demonstrates well developed information literacy and self directed learning;
- Reflect on the social and ethical implications of professional issues;
- Effectively self evaluate their performance in relation to their professional development.

Designing a Variety of Problem Formats

We use a wide range of problems. Some focus on very specific learning e.g. ultrasound imaging of a particular pathology. Others are more open and trigger students to learn more about the context of ultrasound practice. Our most common type of problem is a clinical case, a variety of cues may be included such as: the patients clinical background; ultrasound images; a communication or psychological issue; an issue related to protocols or techniques; a technical problem related to the ultrasound scanner; a management issue. The learning issues generated typically involve searching the literature for a range of relevant research such as normal and abnormal ultrasound image appearances; communication theories e.g. how to interact with an angry patient; optimisation of the ultrasound image; and ethical & cultural issues etc.

Other problems include illustrations of a conversation between individuals, which are designed to trigger discussion around a particular issue. For example a discussion between two ultrasonographers regarding the need to introduce a quality assurance programme. One is very enthusiastic, the other more reluctant due to the already high workload in the department. Physical objects are used for some problems. For example a pair of children's runners with flashing lights in the heel are presented to the students. They have to work out that the lights are produced by the piezo-electric effect in a similar way to the way ultrasound is generated and detected in medical ultrasound.

A completed crossword has been used, students were expected to assign themselves the task of writing clues. This worked well for the beginning of the Technology of Ultrasound module when



we wanted students to learn some of the basic terminology of ultrasound physics. Mindmaps have been used on the current MSc Ultrasound Programme for two problems related to ultrasound technology. Working on problems presented as mindmaps has helped students understand the inter-relationships between terms and concepts related to ultrasound physics.

A recent problem was presented as a letter to a Clinical Specialist in ultrasound seeking her proposals for the development of a new ultrasound service. A number of problems are presented as interactions between healthcare staff and patients or other healthcare staff. These often contain some inappropriate or provocative statements, which serve as excellent triggers. Opposing views from the literature or professional bodies also provide effective cues to learning. For example exposing students to a range of views regarding ultrasound safety provokes enthusiastic debate, and motivates a strong desire to search the literature for an answer to the question "Is ultrasound safe?"

Comments from lecturers:

"The students ask a lot of question, the questions are at a high level and are very relevant. They seem genuinely interested"

"This initiative has given us all a new enthusiasm for our teaching work"

Comments from hospital clinical staff:

"The PBL programme has motivated the whole department to update their knowledge and skills, each week we all get involved in the learning issues our students comes back with"
[Manager of a clinical ultrasound department]

Evaluating the Programme

Ramsden (2003) suggests that evaluation is a way of understanding the effects of our teaching on student learning. The evaluation strategy for this programme differs from the typical evaluation applied to traditional lecture based courses. The key difference in problem based-learning as a student-centred design is that evaluation relates more to the students and their learning than to lecturer activities. The evaluation must evaluate the key elements of the problem-based learning curriculum including the problems, the facilitators, the modules and the whole programme. However the focus in each type of evaluation is on how each affected student learning. Feedback in problem-based learning programmes can also be gained in an informal fashion due to the lecturers increased opportunities to interact with students.



Problem Evaluation. At the end of each semester students are asked to complete an evaluation sheet with reference to each problem they have completed.

Evaluation of Facilitators. At the end of each semester students are asked to evaluate their group facilitator by completing a validated instrument "The Maastricht Tutor Skills Questionnaire".

Module Evaluation. At the end of each semester students are asked to evaluate each module they have studied via small group discussions. Feedback is recorded by the group facilitator.

Programme Evaluation. At the end of semester 1 and at the end of semester 3 students are asked to give programme feedback via the STOP, START and CONTINUE process. Issues raised during this meeting are discussed by the students and the academic course team, the purpose of the discussion is to refine and prioritise any issues raised through this process.

Following completion of the first programme in January 2009, the course team evaluated the programme with reference to staff, student and external examiner feedback. The overwhelming majority of the feedback we received was positive with no major changes suggested by staff, students or the External Examiner. The following are a couple of changes we have made:

- Issuing of all assignments for the semester during the first week of term.
- Giving students a break from problems mid semester when the assessment load is highest.
- Offering Endnote training at the beginning of the programme.

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Resources and References

Web Resources

General Enquiry and Problem-based Learning Handbook

Barrett, Terry, Mac Labhrainn. Iain and Fallon, Helen (eds) (2005) *Handbook of Enquiry and Problem-based Learning: Irish Case Studies and International Perspectives*. Galway: Centre for Excellence in Learning and Teaching, NUI Galway in association with the All Ireland Society for Higher Education <http://www.aishe.org/readings/2005-2/contents.html>

Enquiry-based learning websites and web-resources

Australian University Teaching Committee Learning Designs

<http://www.learningdesigns.uow.edu.au/index.html>

Centre for Excellence in Enquiry-Based Learning, University of Manchester

<http://www.campus.manchester.ac.uk/ceeb/>

Learning through Enquiry Alliance

<http://www.ltea.ac.uk/>

O'Neill, G and Moore, I. Strategies for Implementing Group Work in Large Classes: Lessons from Enquiry-based Learning. In B.Higgs and H. McCarthy (eds). *Emerging issues II: The Changing Roles and Identities of Teachers and Learners in Higher Education*. Cork: NAIRTL. <http://www.nairtl.ie>

Pavlidis, M (2009) 'Enquiry Based Learning for Health Professionals' in *E-Handbook: Target your study skills, optimize your learning; Faculty of Health Sciences, La Trobe University, Australia* http://www.latrobe.edu.au/sss/handbook_html/chapter_13.html

Tosey, P et al (2008) *Enquiry Based Learning: A resource for higher education, Higher Education Authority*. ESCalate: UK. <http://escalate.ac.uk/4746>

Problem-based learning websites and web-resources

McMaster University Canada, where problem-based learning started

<http://www-fhs.mcmaster.ca/mhsi/problem-.htm>

University of Maastricht PBL site

<http://www.unimaas.nl/pbl/>

University of Maastricht Problem-based Learning in Action

<http://www.youtube.com/watch?v=XB7M5c6MUuo&NR=1>

List of some discipline specific PBL websites

<http://www.udel.edu/pbl>

General Problem-based Learning Books

Boud, D. and Felletti, G. Eds (1997) *The Challenge of Problem-based Learning*: London: Kogan Page

Duch, B., Grah. S. and Alien ,B. (Eds) (2001) *The power of problem-based learning: a practical "how to " for teaching undergraduate courses in any discipline*. Sterling VA: Stylus Publishing LLC.

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Schwartz, P. Mennin, S and Webb G (Eds) (2001) *Problem-based learning: Case studies, experience and practice*. London: Kogan Page

Wilkerson, L and Gijsselaers (Eds) (1996) *Bringing Problem-based Learning to Higher Education Theory and Practice*. San Francisco: Jossey-Bass.

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Gijsselaers W. (1996) "Connecting Problem-Based Practices with Education Theory." In *Bringing Problem-Based Learning to Higher Education. Theory and Practice, New Directions for Teaching and Learning*. Number 68. L. Wilkerson and W.H. Gijsselaers (eds.) San Francisco: Jossey-Bass: 13-21

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Hmelo-Silver, C.E. (2009). What do we know about Problem-based learning?: Current Status and Future Prospects. *Proceedings 2nd International PBL Symposium Republic Polytechnic Singapore*, June 10-12.

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Savery, J. and Duffy T. (1995) "Problem-based Learning: An instructional Model and Its Constructivist Framework." *Educational Technology* 35 (5) 31-38

Problem Design

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Mauffette, Y., Kandlbinder, P. & Soucisse, A. (2004). The problem in problem-based learning is the problems: But do they motivate students? In M. Savin-Baden and K. Wilkie (Eds.), *Challenging research into problem-based learning* (pp. 11-25). Buckingham: SRHE and Open University Press.

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EBL/ PBL and Assessment

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EBL/PBL and Technology

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EBL/PBL and Creativity

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PBL and Critical Thinking

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Philosophy of PBL

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If you want to:

- work with an educational developer to develop new enquiry or problem-based learning modules / programmes
- get information on forthcoming workshops
- find local and international partners in your discipline
- discuss research on enquiry and problem-based learning
- gain a qualification in University Teaching and Learning

Contact

UCD Teaching and Learning

Tel +353 1 716 2034

www.ucd.ie/teaching/resources/innovativeteaching/smallgroups/EPBL_Guide.pdf

