

# Integration of Occupational Health and Safety in PBL

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## Abstract

Occupational Health and Safety (OH&S) and Risk Management are of a major concern not only to engineers but to all industries worldwide. A lack of education, training and understanding causes most people to de-prioritise Occupational Health and Safety. The best way to combat this is to introduce OH&S at the grass roots level of higher education and make it a topic for lifelong learning. This paper describes how students undertaking the electrical engineering program using the Problem Based Learning mode of delivery within the Faculty of Health, Engineering and Science at Victoria University, Melbourne Australia are introduced to Occupational Health and Safety and Risk Management practices from the onset of their studies as well as how OH&S is continually re-enforced as a priority throughout the electrical engineering program at Victoria University.

The paper describes the contents of the Occupational Health and Safety workshops that all students must attend in the first week of the program, as well as a looking at the OH&S manuals that are supplied to them. The paper also describes the Risk Assessment forms that all students must be able to complete as well as the Student Safety Contracts they must sign before starting their studies.

*Keywords:* Problem & Project Based, OH&S, Risk management, Engineering

## 1.0 INTRODUCTION

Occupation Health and Safety has become a major issue for all industries worldwide, Organisations and governments around the world are dedicating large amounts of time and resources to ensure that they have a safe and healthy workforce. In most cases these organisations are required to setup in-house occupation health and safety training for their staff or utilise external sources. Engineering graduates that are familiar with occupational health and safety and are able to integrate this into their work will have a distinct advantage. In 2006 the two schools of engineering at Victoria University began using the problem based learning methodology to deliver their courses. At this time there was a major emphasis on OH&S across all universities in Australia and staff that were dedicated to OH&S practices at Victoria University. This environment allowed a seamless integration of OH&S into the curriculum.

It was decided that, to make a lasting impression on the importance of occupational health and safety with the students, the students would attend an OH&S workshop right at the beginning of the program. In the workshop the students are introduced to the concepts of safety awareness of one's self and of others around them, risk assessment and risk management as well as a safety induction program.

## 2.0 PROBLEM AND PROJECT BASED LEARNING

Problem Based Learning (PBL) is a learning approach that is most commonly constructed around a series of problems selected by a teacher [1 – 3]. We believe that it will be particularly beneficial to the engineering discipline as it will produce engineers that are technically sound and as importantly, engineers that have the following generic competencies:

- Communication in all forms
- Mathematical and numerical ability
- Use of Information Communication Technology (ICT)
- Interpersonal and team working skills
- Improving own performance and self learning skills
- Problem Solving

In the engineering discipline, these problems will typically be industry related in an effort to emulate the work force [4, 5]. The PBL approach to teaching in the engineering discipline exhibits, but is not limited to, the following characteristics:

- Using stimulus material to help students discuss an important engineering problem, design task or issue,
- Presenting the problem as a simulation of professional industry practice or a real life workplace situation,
- Guiding engineering students to utilise critical thinking and direct and/or providing limited resources to help them solve the problem,
- Getting students to cooperatively work in a team to complement each others work, not compete with one another, in an environment where they have access to a teacher who facilitates the groups learning process,
- Getting students to identify their own learning needs and developing their information literacy skills to locate, evaluate and manage resources that are useful to help them solve engineering problems,
- Self-assessment to evaluate their learning process

## **2.1 The PBL cycle**

Many versions of PBL exist. In our version, students will be formed in groups of 20 where they will be allocated to work in a team of 5 within that group. Each group will have one respective supervisor (teacher). The same teams of students meet regularly throughout the semester in which they will work on a series of pre-defined problems. Each team will have one allocated "home room" in which they can work together and meet the supervisor on a weekly basis. In addition, students will have access to laboratories to run experiments. The PBL cycles involves five main steps (derived from the "Five Easy Steps" described in the PBL Handbook prepared by Dr Hugh Pross at Queens University in Canada) where steps 1 to 3 take place in team group work, step 4 involves individual study and online discussion with team mates and step 5 takes place in a team meeting setting [6].

### ***Step 1: Read the problem***

One team member reads the problem aloud to the group without comment at this stage.

### ***Step 2: Brainstorm***

- What do you know about this problem?
- What do you need to find out about the problem?
- What are the significant issues?
- What do you need to learn?
- What are your priorities? What is most important to learn?

The rules of brainstorming are that no evaluative comment is allowed as this stage. The aim is simply to get as many issues on the board as possible so that they can be prioritised and spilt/clumped in the next step. You'll need to identify one person in the group to act as scribe to write issues on the board as they raised. 4 30-Aug-06

### ***Step 3: Identify/discuss/assign***

- What are the essential learning issues (for everyone to follow up)?
- What are the specific learning issues (for individuals to follow up)?
- What resources are available?
- Who will look up / design / measure what (and report back to the group)?
- What are the overlapping issues?

Each member of the group needs to understand what all members of the group have agreed to research and what they as individuals must contribute to the group.

### ***Step 4: Individual reading/research/online discussion***

As you locate resources that are directly relevant to the learning issues, advise the other members of your PBL group by posting a message in the appropriate discussion group in WebCT/Fablusi (this is in addition to face to face meetings). This message must include:

1. enough information to allow others to locate the resource (for books and journals, bibliographic details; for Web resources, the URL or Web address);
2. a BRIEF summary (about one screen) of the content of the resource - cutting and pasting the abstract of a paper is often useful; and
3. a comment on why you believe the resource is relevant to the learning issue. In some cases, you may be able to attach a digital copy of the document itself but only do this if you are sure that you can do so without breaching the copyright law. For this reason, we advise against attaching copies of scanned chapters of books. As these resources accumulate, members of the group use the WebCT discussion tool to comment on and ask questions about the resources. Online discussion is an assessed task, with 20 marks allocated on the basis of the quality and quantity of contributions by each participant.

### ***Step 5: Conclude***

This is done at the final meeting of the problem for the team. As a team, you now review the problem, report and discuss each member's findings and agree on conclusions. The cycle finishes with the group reflecting on how effectively it tackled the problem and what they learned from this problem. How did things go? Any suggestions for next time? In this step, there will be a number of formative assessment tasks that need to be completed.

### ***Organisation***

These five steps are tackled in three main activities:

1. A first face-to-face team meeting to explore the problem, identify learning issues and allocate tasks.
2. Individual research and many face-to-face meetings and online discussion using WebCT/Fablusi.
3. A final face-to-face group meeting to review the group's findings and evaluate progress and process. Each week, students will meet with their respective supervisor for one hour in which an agenda will be discussed prepared by the students. The agenda should contain topics in which the students can obtain most guidance from their supervisor [7].

## **3.0 OCCUPATIONAL HEALTH AND SAFETY INDUCTION**

The School of Electrical Engineering within the Faculty of Health, Engineering and Science at Victoria University, Melbourne Australia is committed to providing a safe working environment for both staff and students. However, a high standard can only be maintained with individual awareness and co-operation. Thus, each student is asked to take responsibility for the safety of their own person and that of their colleagues whilst working in the laboratories. All students enrolled in its programs are required to attend an Occupational Health and Safety workshop at the onset of their studies. In the workshop students are introduced OH&S concepts, safety awareness and risk assessment as well as risk management. The students are issued with a safety induction manual, the manual outlines and covers topics such as protective clothing, hazard awareness, material disposal, health, building evacuation and the Laboratory safety regulations.

### **3.1 Student safety induction manual**

Before taking part in any practical work each student must agree to abide by the rules set by the School of Electrical Engineering in the student safety induction manual. A safety contract [fig 1] to that effect must be signed before any practical work is undertaken. In addition, you may need to undertake additional safety induction in certain laboratories to be permitted to work in them.

The first part of this document outlines general safety principles that are applicable to all laboratories. There are also more specific rules relating to individual laboratories you may need access to, which will be disclosed at induction at the beginning of them. At this early stage of your course, some of these rules and procedures will be unfamiliar to you. However, as you commence studies requiring access to any of our laboratories, your supervisors will discuss these specific safety rules with you again.

#### **3.1.1 Protective Clothing**

Laboratory coats may be worn at the discretion of the student however in some labs it is required that students wear full length pants or laboratory coat if shorts are worn. Safety glasses must be worn for all practical classes where soldering is undertaken or directed by the supervisor or technical staff. All students must wear suitable footwear in the laboratories. This means enclosed boots or shoes with preferably a non-slip sole. No student wearing open toed shoes, sandals or thongs will be allowed access to any laboratory. Hearing protection must be worn in high noise environments. This will be provided by the School and may take the form of disposable ear plugs. The School of Electrical Engineering will as required provide additional items of protective clothing and equipment. These items include fume extraction units, dust masks and hearing protection. The appropriate item must be used as directed by a staff member.

#### **3.1.2 Hazard Awareness**

In the laboratories you may, at times, be dealing with material and equipment that could be hazardous to your person or health in varying degrees these potentially hazardous materials and equipment may include "Sharps" e.g. Needles, scalpels which can cause possible injury or disease, Chemical substances can cause burns, allergies and injury. Operating equipment can cause burns, and injury. Plant machinery such as drill machines, and bandsaws can cause serious injury. The school staff endeavours to minimise these hazards by carrying out a risk assessment on the experiments the student perform. Chemicals that are used have safety information available in the form of a MSDS (Material Safety Data Sheet). The MSDSs form the basis of our risk assessments for Chemistry.

We also minimise risk by ensuring that the students are taught methods of safe handling and operation as part of the relevant subjects. Students should view this information as part of a practical class preparation and familiarise themselves with the chemicals you will work with.

### **3.1.3 Material Disposal**

The general rules with material disposal is throwing nothing down a sink or place anything in a general purpose rubbish bin unless Okayed by your teacher. Some chemicals are very hazardous to the environment and must not find their way into the waterways. Special containers will be provided in the practical class to collect hazardous wastes. Sharp objects such as broken glassware, needles and scalpel blades can cause injury to staff and students when mixed up with general rubbish. Each laboratory has a dedicated bin for broken glass. Special containers for scalpel blades, needles etc are provided to the relevant classes. Never place broken glass or sharp objects into a general rubbish bin. The Department is bound by Government legislation to dispose of waste materials safely and correctly.

### **3.1.4 Health**

In case of scratches and cuts cover all wounds with band-aids prior to practical activities. Hands must be washed before leaving a laboratory. Any student who is aware that they suffer from asthma or an allergy must provide their own medication and carry it with them at all times. An ambulance will be called immediately for a serious allergic reaction. Students are encouraged to inform the supervisor of potential allergies or illnesses they may suffer from, if they feel it may impact on their time with us. Should information be given to us, it is treated in strictest confidence. Information is not made available to other staff without the student's permission. Workstations should be left tidy. Your supervisor will direct you to dispose of all waste in the correct receptacle and to wipe over benches. Equipment should be returned to the point of collection.

### **3.1.5 Building Evacuation General Considerations**

The school of electrical engineering encourages its students to familiarize themselves with the emergency plan and evacuation maps displayed in all laboratories; these contain emergency numbers and a map for assembly in case of fire at the Footscray Park campus of Victoria University, Melbourne Australia.

1. Fire Alarm ringing. Pack up your valuables, switch off all electrical appliances and stand by for further instruction. Do not leave your classroom at this stage. (The alarm may not be for your building)
2. Evacuation Signal. Leave your classroom in an orderly fashion and pay attention to your Teacher and/or the Fire Wardens coordinating the evacuation [8].

The students are encouraged to always remember the following important points:

- Don't panic
- Leave the upper levels of the building by using the stairs only.
- Do not use the lifts under any circumstances
- Leave by the nearest exit to your room
- Regroup with your class members and your supervisor at the designated assembly point or area designated by the fire warden as soon as you are clear of the building.
- Do not wander off from your group until your supervisor marks you off the roll
- Do not re enter the building under any circumstances until the "All Clear" signal has been given by the Fire Brigade or Fire Wardens

### **3.1.6 Laboratories rules**

Below is a list of rules which are regularly shared with students. The rules are a list for the general behaviour and safety expected by the students within the school of electrical engineering, due to the fact that they are so general in nature they may be used in a variety of different laboratories.

1. Familiarise yourself with all laboratory safety and warning instructions. Always follow the instructions from your laboratory demonstrator/supervisor and from within the laboratory manuals.
2. Do not put yourself, or others, at undue risk of injury. Do not run in the labs, lean back on chairs or stand on tables and benches. Behave sensibly and concentrate at all times. Horseplay has no place in a laboratory. Unruly behaviour is strictly forbidden.
3. Food and drinks are not permitted in the laboratories. Food and drink containers should not be placed on laboratory benches. Do not decanter chemicals or solutions into food containers or drink bottles. All containers with chemicals or solutions must be clearly labelled. Laboratory glassware must never be used as kitchenware even outside the laboratory.
4. Do not enter the laboratories when intoxicated or incapacitated in any way.

5. Ensure a safe working area by keeping it tidy and clean. Always clean up your workbench after you have completed your experiments, and turn off all equipment.
6. Do not operate any equipment (electrical, mechanical, optical or other) if you are not familiar with it. Always seek the assistance of the laboratory demonstrator/supervisor or technical staff before using equipment that is unfamiliar to you.
7. Use equipment and facilities only for their intended purpose.
8. Always use personal protective equipment (PPE) including safety glasses, lab coats and gloves where necessary. Ensure you are wearing enclosed toe footwear in all laboratories.
9. Ensure that your circuits and electrical equipment are not short circuited before turning them on.
10. Access to the laboratories is restricted to enrolled students
11. Familiarise yourself with exit routes in case of emergency.
12. All accidents and chemical spills must be reported immediately to your supervisor so that appropriate action can be promptly commenced.
13. A First Aid report must be logged for all accidents, however small.
14. Loose, long hair is hazardous when using machinery, power tools or when working with chemicals and contaminated materials. Please tie long hair back for all practical activities.
15. Practical classes will require a certain amount of movement around the laboratory to collect equipment and to set up your experiments. It is therefore very important to keep aisles and walkways clear of chairs and bags. Chairs should be pushed under benches when not in use.
16. Move slowly when you are carrying equipment and reagents around the laboratory. Be aware that there are other people moving around a relatively confined space as well.
17. Wash hands before leaving the laboratory
18. Ignoring safety rules endangers others as well as yourself. Students found in violation of any safety rules may be subject to disciplinary action.

#### 4. RISK ASSESSMENT AND MANAGEMENT

The workshop covers some of the more important aspects of risk assessment and management. Students are introduced to the risk assessment forms as shown in figure 1.

<b>Risk Assessment</b>	Task Name:				
	Assessor(s):				Date:
	Those at risk:				
	Risk:	Before:	After:		
Process/Job Description:					
<b>Task</b>	<b>Events</b>	<b>Controls Already in Place</b>	<b>Risks To Health? Yes/No?Not sure?</b>	<b>Action (Hierarchy of Control)</b>	

Action (Hierarchy of Control): Elimination, Substitution, Isolation, Engineering, Administration, Personal Protective Equipment  
 Risk: 1 - Low, 2 - Medium, 3 - High, 4 - Very high, 5 - Extreme

FIGURE 1: Risk Assessment form

The risk assessment form has been developed to make it easy to follow by students, and gives students an initial awareness of possible hazards involved in performing particular tasks. The workshop gives students the ability to identify risk and is the important feature of the workshop. The risk assessment form is a tool to help students identify and list the risks and control measures. The first section of the Risk Assessment form allows the

students to identify the task, the assessors, those at risk and before and after risk rating from 1-Low, 2-Moderate, 3-High, 4-Very high and 5 for Extreme risks [9]. The second section of the risk assessment form is for listing the tasks followed by:

Events: Accidents that can possibly occur.

Controls already in place: Processes already in place to reduce the risks

Risk to health: To indicate whether there is a possible risk of injury

Action (Hierarchy of control): Allows the students to list extra control measures to reduce or eliminate the risks.

The ultimate control measure allows the elimination of a risk completely but is not always possible, so significant reduction of risk is the aim of the exercise. To signify the seriousness of risk management, laboratory safety and to ensure compliance with the rules and policies of Victoria University, the students are required to sign a Student Safety Contract illustrated in figure 2.

EE2008 Laboratory Safety

VICTORIA UNIVERSITY A NEW CHALLENGE SINCE 1828

Victoria University  
School of Electrical Engineering

**Student Safety Contract**

I, \_\_\_\_\_  
(name, please print clearly)

have attended the safety induction session run by the School of Electrical Engineering.

I have read and understood the safety rules of the School.

I agree to abide by the safety rules as set down by the School of Electrical Engineering at all times.

I acknowledge that I may be subject to disciplinary action if found to be in breach of these rules.

Signed: \_\_\_\_\_

Student I.D. No.: \_\_\_\_\_

Date: \_\_\_\_\_

Laboratory Safety Student Contract

Issue date/Feb 2008  
Contract SE2008.doc  
Edited by: Abdambaset Kutucua

Last amended: Jan 2008  
Ref: D:General  
Ref: B: Division SF7022  
Ref: J: Angletons ACN18022

FIGURE 2: Student Safety Contract

## 5. CONCLUSION

The occupational health and safety workshops have become a valuable part of the Engineering curriculum in the school of electrical engineering at Victoria University, Melbourne Australia. Occupational health and safety is not just a topic to cover in an educational environment but requires lifelong learning and action to truly make a difference. The business case for occupational health and safety is very strong. Not only does OH&S save organisations money, it also provides an invaluable defence in the event of prosecution and graduate engineers with knowledge of occupational health and safety practices will be in the forefront of this defence. To this end the school of electrical engineering at Victoria University has taken a pro-active step forward.

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