Tutorial Proposal

Problem-based Design Studios for Undergraduate SE Education

Jocelyn Armarego
Murdoch University Australia
jocelyn@eng.murdoch.edu.au

Sally Clarke
University of Auckland New Zealand
s.clarke@auckland.ac.nz

Abstract

Both the increasing knowledge needed to practise as a professional, and the accelerating rate of change within the discipline suggest that traditional learning models may not address the requirements of learners. Problem-based learning (PBL) and design studios (DS) are two approaches that focus on learners developing characteristics of lifelong learning. This tutorial explores a Problem-based Design Studio (PbDS) model of learning. The goal is to enable participants to gain some understanding of the model so as to evaluate its' applicability in their teaching/learning context.

1. Introduction

In traditional models applied to professional education students first study basic science, then the relevant applied science [1], so that learning may be viewed as a progression to expertise through task analysis, strategy selection, try-out and repetition [2]. The formal roles of lectures, tutorials and laboratory classes are intended for knowledge transfer using essentially uni-directional modes of teaching. In this model, the purpose of the practical work students are presented with is to apply knowledge learned earlier in the curriculum to real-life problems: the students deal with know-how problems that can be solved by knowledge acquired in their lectures. Students become experienced in the use of disciplines and theories considered necessary/relevant through the practical work that supports this knowledge.

However, with the on-going increase in knowledge in the discipline, and the accelerating rate at which this increase is occurring, students cannot learn all the material required to practice as professionals in their disciplines.

Problem-based Learning (PBL) and Design Studios (DS) are two approaches that focus on centering the learning environment on the student. Student responsibility and independence help to develop characteristics of lifelong learners - motivation, self-evaluation, time management and the skills to access information. Together PBL and DS provide mechanisms and processes for the teacher to build a learning environment that encourages a community of learners to interact to define and solve problems, and to garner skills that enable them to become self-directed learners.

2. Characteristics of PBL

In contrast to the stronger emphasis on teacher-direction and the coverage of academic content found in most traditional models, Problem-based Learning [3] incorporates many of the practices that are now

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considered the *desiderata* of good teaching: it is student-centered, fosters intrinsic motivation, promotes both deep and active learning, taps into students' existing knowledge, encourages reflection on the teaching/learning process, develops collegial learning skills, and can support student self-assessment and peer-assessment. In a PBL environment students are self-directed, independent and interdependent learners motivated to solve a problem [4].

Evaluation [5] of this learning model confirms that having authentic (ie feasible in the real-world practice of the discipline) problems assists students in understanding and later deploying their new knowledge. Skills acquired in this way are transferable to professional practice. When undertaken in the group environment advocated, students also develop generic interpersonal skills to draw on after their formal education is completed.

3. Design Studios

Studio-styled learning models have evolved from the master-student relationship of the classical apprenticeship. They are commonly used in a wide variety of professional education disciplines including:

- architecture (and other creative arts) – where groups of students work with the architect "master" across all aspects of a design task. This style of education is widely used and well recognised in architectural education as being highly desirable, if not essential, as a means of achieving the essential learning outcomes for the graduate
- clinical professions, including medicine, dentistry and veterinary science – where exposure to the processes of observation, diagnosis and treatment in a face-to-face environment is taken as being an essential part of the education process. We can also include a number of the para-clinical professional in this category, for example psychology, chiropractic science and physiotherapy
- the profession of teaching itself is generally recognised as requiring exposure to real-life work situations as a part of the training process.

Examples of the implementation of PBL are reported, with the McMaster model well documented (see, for example Woods [5]), as is the implementation at Rensselaer Polytechnic Institute [6]. In an engineering context, the University of Aalborg reports the development of the application of project- and problem-based learning over a 20 year period. The Aalborg Model has been extensively reviewed, both by their University but also by the external examination panels that form the basis of their international recognition [7, 8]. In particular there has been a direct comparison between the graduates from Aalborg University with those from the Technical University of Denmark, where a more traditional teaching programme in Engineering is used.

The engineers from Aalborg

- were assessed to be stronger in problem-solving, communications, co operation and general technical knowledge
- perceived a convincing agreement between the composition of the knowledge and experience used in the project-oriented education and in the professional engineering practice
- after three years of employment still derived their applied professional knowledge from their project work rather than from taught courses, colleagues or postgraduate courses.

4. Tutorial programme

This tutorial will explore the Problem-based Design Studio (PbDS) model of learning.

The goal is to enable participants to gain some understanding of the model so as to evaluate its' applicability in their teaching/learning context.

Objectives include:

- exploring issues around PbDS in some detail, both from

- a student perspective and
- implications for the teacher

- designing a small problem on the SE discipline
- evaluating issues concerned with implementing PbDS.

A Programme for the day is attached as Appendix A

The tutorial itself will model a PbDS in action. The implication of this is that, while some presentations are included, they will usually take the form of summarising the discussion undertaken. The bulk of the tutorial will be based around activities and resource exploration in the context of a PBL process. Resources and a workbook will be provided to participants.

5. References

[1] L. J. Waks, "Donald Schon's Philosophy of Design and Design Education," *International Journal of Technology and Design Education*, vol. 11, pp. 37-51, 2001.

[2] W. Winn and D. Snyder, "Cognitive perspectives in psychology," in *Handbook of Research for Educational Communications and Technology*, D. H. Jonassen, Ed. New York: Simon & Schuster Macmillan, 1996, pp. 112-142.

[3] H. S. Barrows and R. M. Tamblyn, *Problem-based Learning, an Approach to Medical Education*. New York: Springer, 1980.

[4] D. Boud, "Problem-based learning in perspective," in *Problem-based Learning in Education for the Professions*, D. Boud, Ed. Sydney: Higher Education Research Society of Australasia, 1985, pp. 13-18.

[5] D. R. Woods, "Problem-based Learning: helping your students gain most from PBL," McMaster University, Waterdown (Ontario) 1994.

[6] Wilson, J, "The CUPLE Physics Studio," *The Physics Teacher*, vol 32, pp 518-523, 1994.

[7] F. K. Fink, Enemark, S. and Moesby, E. " The UICEE Centre for Problem-Based Learning (UCPBL) at Aalborg University," presented at *6th Baltic Region Seminar on Engineering Education*, Wismar/Warnemunde, Germany, pp. 34-38, Sept. 2002.

[8] F. Kjersdam and Enemark, S. *The Aalborg Experiment: Project Innovation in University Education.* Aalborg: Aalborg University Press, 1994, also at http://ucpbl.org/useful%5Freading/

About the Facilitators

Jocelyn Armarego

Senior Lecturer – Software Engineering

I have been involved in the application of Design Studio learning and PBL in Software Engineering at Murdoch University.

I initially applied the Studio model to Software Design courses. However, evaluation of these highlighted the need for a process to anchor Studio learning, and led to the integration of PBL with the Studio (PbDS). This model was first applied to Requirements Engineering learning.

Subsequently I have been involved in moving all courses in the Software Engineering program to PBL-based Design Studios. I have been actively involved in the developing a programme of staff induction in PBL and Studio learning. As of 2005 all Engineering programs will apply PbDS at years 3 and 4.

Sally Clarke

Senior Lecturer – Medical Education

I have worked in the area of teaching and learning in higher education in several Australian Universities.

As Evaluation Officer in the Graduate School of Medicine at the University of Queensland, I conducted a number of evaluations of the medical curricula before and after the change to Problem–Based Learning (PBL).

Following that I have been involved in introducing PBL in Information Technology. At Queensland University of Technology I was an active member of the team from the Faculty of Information Technology implementing PBL in intermediate level programming. At Murdoch University, I worked with Jocelyn Armarego introducing PBL in software engineering. I also facilitated a workshop for Engineering staff at Murdoch on Design Studios and PBL in August 2004.

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Appendix A

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Programme for the day

Overview of programme

Overview and *Introductions*
Goals and *Objectives*
Methods to accomplish these
Review and *debrief*
Evaluation – how did we go?

1. Introductions:

a. Informal and friendly – Ice breakers – to facilitate introductions. In this environment to discuss variations on these activities and other suitable substitutes.
b. In-depth - Interviews - paired activity to build confidence in students on the first day of class. In this environment, to introduce tutorial participants to the group. Includes brief description of personal goals and objectives for the day

[activities & discussion]

2. Goal:

To enable participants to gain some understanding of the model. so as to evaluate its' applicability in their teaching/learning context.

3. Objectives:

Participants will

a. explore issues surrounding PbDS (Problem-based Design Studio) teaching in detail
    i) implications for students
        - What is studio/problem-based teaching and learning?
        - Why studio/problem-based teaching and learning?
        - What's involved in studio/problem -based teaching?
        - Student-centred approach to teaching –
            - What do we mean by student-centred?
            - Why student-centred?

[activities & discussion]
[presentation as summary]

    ii) implications for the teacher
        - approaches to teaching: relationship between approaches to teaching and student learning outcomes

[ATI activity and scoring]

- applying PbDS – what's involved?

[resource exploration & discussion]

b. design a small problem on the SE discipline

i) how to design and write a good problem

- elements of good problems

[presentation]

- goals and outcomes for problem

[group work & discussion]

c. evaluating issues concerned with implementing PbDS.

- Possible new role(s) for teacher and student
  - tutor training
  - learning contracts

[activities & discussion]

4. Review and debrief:

a. summary of achievements

5. Evaluation

a. a rating instrument will be completed