Promoting and supporting PBL interests world wide

Enemark, Stig; Kolmos, Anette; Moesby, Harry Egon

Published in:
Connecting learning to the real world

Publication date:
2006

Document Version
Publisher's PDF, also known as Version of record

Promoting and Supporting PBL Interests World Wide
- The Profile of the UICEE Centre for Problem Based Learning.

Stig Enemark, Anette Kolmos, and Egon Moesby
UCPBL, Aalborg University, Denmark
www.ucpbl.org

Key Words: PBL, UCPBL, Problem Based Learning, Project Based Learning

ABSTRACT

The UNESCO International Centre for Engineering Education, Centre for Problem Based Learning (UCPBL) is based at Aalborg University, Denmark, known world-wide for its successful educational approach based on problem oriented project work. Due to more than 30 years of experience in utilising Problem-Based Learning (PBL) in Engineering Education, an increasing number of universities and engineering schools throughout the world are seeking consultancy and cooperation with Aalborg University. The establishment of UCPBL is therefore a timely opportunity to merge the efforts into one organisational structure aiming to promote and support PBL interests worldwide.

This paper presents the UCPBL profile and plan of action. This includes a wide range of activities such as promoting research and development within the various PBL models and their implementation; Education and training in PBL through offering a Master degree as well as single courses in PBL; international consultancy on PBL to support and sustain the process of change at higher educational institutions that wish to renew their educational concepts towards a PBL approach.

UCPBL Centre for Problem Based Learning is currently involved in a number of projects world wide focusing on institutional change toward a more student centred,

project organised, and problem based approach to learning. The Centre is also establishing a UCPBL Global Network on Problem Based Learning in order to facilitate better access to and co-operation within the PBL area.

INTRODUCTION

The UICEE Centre for Problem Based Learning (UCPBL) was established in 2001 at Aalborg University (AAU), Denmark as a satellite centre of the UNESCO International Centre for Engineering Education (UICEE) based at Monash University, Melbourne, Australia.

Aalborg University was chosen as the host of this centre due to its world wide reputation of utilising a successful PBL approach especially in Engineering Education. More than 30 years of experience in this area has placed Aalborg University in a leading position of promoting best practice in this area. Consequently, an increasing number of universities and engineering schools throughout the world are seeking consultancy and cooperation with Aalborg University. The establishment of UCPBL is therefore a timely opportunity to merge the efforts into one organisational structure aiming to promote and support PBL interests worldwide.

This paper presents aim and objectives of UCPBL and the various activities in the fields of education, research and consultancies on implementing innovative PBL approached to teaching and learning. As a background, the paper starts by presenting the key PBL methodology applied at Aalborg University since it was established in 1974, and lessons learnt through 30 years of experiences.

PROJECT-ORGANISED AND PROBLEM BASED LEARNING

The PBL approach applied at Aalborg University is both project-organised and problem- based. In order to provide for the use of project work as the basic educational methodology the curriculum has to be organised into general subjects or "themes" normally covering a semester. The themes chosen in a programme must be generalised in such a way, that the themes in total will constitute the general aim or professional profile of the curriculum. The themes must provide for studying the core elements of the subjects included (through the lecture courses given) as well as exploring (through the project work) the application of the subjects in professional practice.

Project-organised means that traditional taught courses and labs is replaced by project work assisted by lecture courses. The project-organised concept moves the perspective from description and analyzing into synthesizing and assessment. The concept is based on a dialectic interaction between the subjects taught in the lecture courses and the problems dealt with in the project work. Each term has a basic structure containing, in principle, equal distribution of lecture courses and project work. But the study-time is dominated by lecture courses at the beginning of the term and by project work at the end. The project work is carried out by groups of four to six students having a teacher appointed as their supervisor.

Problem-based means that traditional textbook-knowledge is replaced by the knowledge necessary to solve theoretical problems. The problem-based concept moves the perspective from understanding of common knowledge into ability to develop new knowledge. The aim of the project work is "learning by doing" or "action learning". The project work may be organised by using a "know-how" approach for training professional functions, or it may be organised by using a "know-why" approach for training methodological skills of problem-analysis and application. The former is normally applied in first half of the curriculum where the necessary

disciplines are taught in the lecture courses. The latter is applied in the second half of the curriculum and is supported by lecture courses presenting the necessary theories within the specific professional areas.

The difference between traditional subject-oriented education and this project-oriented educational model may be expressed in short by an old Chinese proverb:

"Tell me and I will forget
Show me and I will remember
Involve me and I will understand
Step back and I will act"

LEARNING TO LEARN

The main challenge of the future will be to accept that the only constant is change. To deal with this constant change the educational base must be flexible. Graduates must possess skills to adapt to a rapidly changing labour market and they must possess skills to deal even with the unknown problems of the future. Professional and technical skills can be acquired and updated at a later stage in one's career while skills for theoretical problem-solving and skills for "learning to learn" can only be achieved through academic training at the universities.

A number of research studies (e.g. Coleman, 1998) have confirmed that students retain only 10 per cent of what they read and only 20 per cent of what they hear. However, if a problem is simulated, then up to 90 per cent of the lessons learned may be retained. This finding is behind the shift in the pedagogical doctrine toward project work and problem-based learning. It emphasizes learning instead of teaching. Learning is not like pouring water into a glass. Learning is an active process of investigation and creation based on the learners` interest, curiosity and

experience and should result in expanded insights, knowledge and skills (Kolmos, 1996).

A consequence of this shift from teaching to learning is that *the task of the teacher is altered from the transferring of knowledge into facilitating learning.* Project work also fulfils an important pedagogical objective. Student must be able to explain the results of their studies and investigations to other students in the group. This skill appears to be vital to professional and theoretical cognition: *Knowledge is only established for real when one is able to explain this knowledge to others.* In traditional education the students restore knowledge presented by the teacher. When the project organised model is used, the knowledge is established through investigations and through discussion between the student members of the project group, and mainly without the presence of the teacher.

LESSONS LEARNT

A number of lessons are learned through the 30 years of experience at Aalborg University.

- *The graduates possess the skills for solving the unknown problems of the future.* The graduates may be less experienced in solving standard everyday problems as they will appear in a further employment. They are, however, much better qualified to undertake large and complicated tasks, to combine insight from different fields, to analyze new problems and to make them acquainted with new fields to which the problems of practice are related. In principle, it is thus ensured that the graduates have obtained the skills needed to solve also the unknown problems of the future (Kjersdam and Enemark, 1994).

- *Skills for learning to learn are developed through the project work.* This relates to the fact that knowledge established through one's own investigations is far better

consolidated and easily applied than knowledge gained from textbooks or lecture courses.

- *Skills for cooperation and management are developed through the process of the project work.* The students are working as a team and thereby develop a range of personal skills in the area of cooperation and management including the need for finishing the work within a given deadline – as is also the demand in professional practice.

- *Cooperation with the trade and industries is established through the project work.* The problems dealt with in the project work are real world problems faced by the trade and industries. The students as well as the teachers therefore interact with the trade and industries for solving the problems posed.

- *Innovative interaction between education and research.* Many new research problems can be identified through the students´ project work and continued in the research carried out by the advising teacher. On the other hand, many of the student projects may be based on the current research activities of a teacher and thus contribute to the development of knowledge in a fruitful co-operation with the teacher. This interaction between education and research constitutes the necessary dynamic element of innovative education.

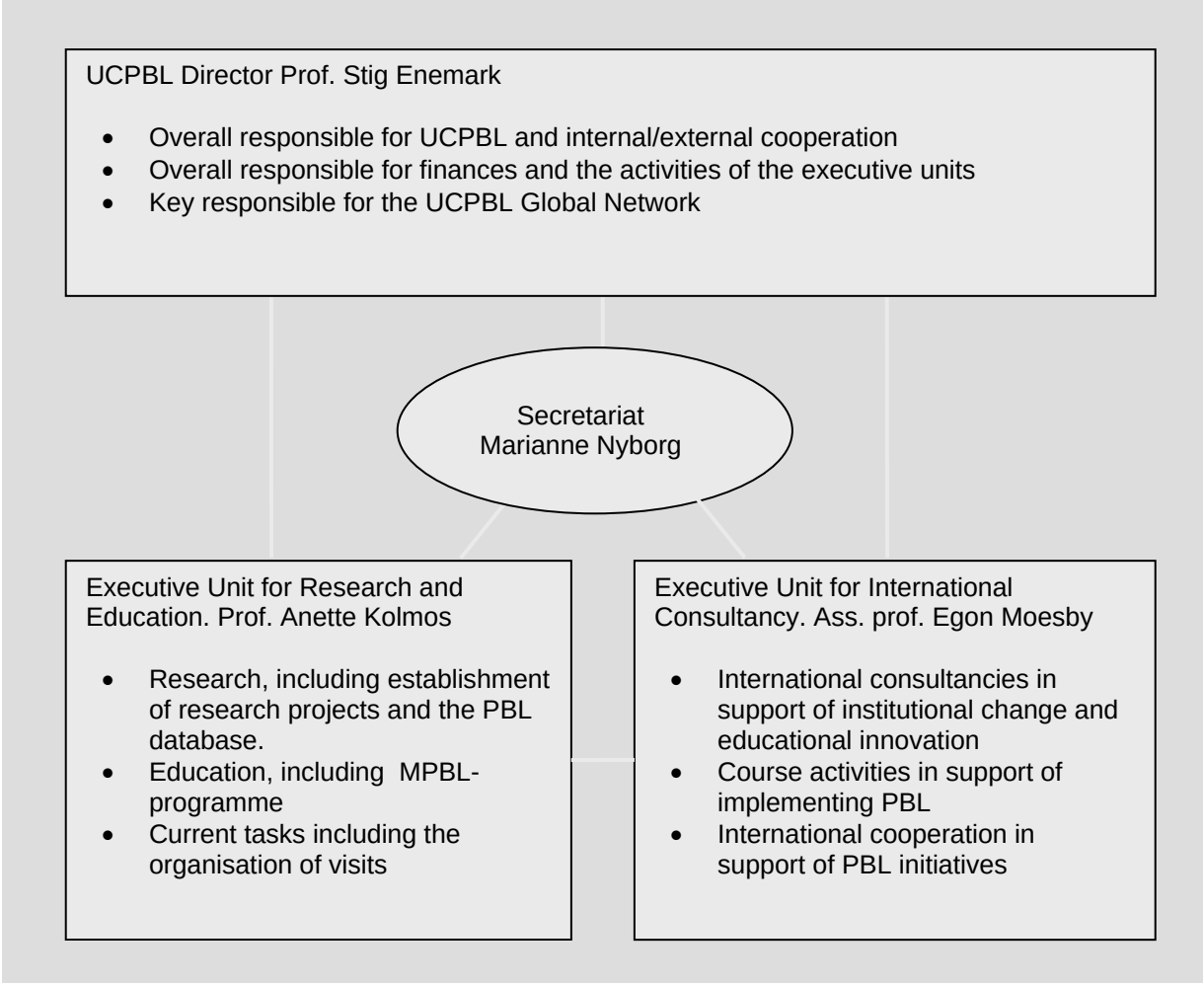
- *A flexible and relevant curriculum is ensured due to the demand for actuality.* The focus on subjects presented in the courses is easily updated or changed to reflect technical and professional development in society. This way, the faculty staff is continuously updated. The focus is on the questions posed by the students, rather than the other way around.

- *The project-organised approach is relatively* demanding in terms of faculty staff resources. This is due to the need for supervising the students in groups of four

to six persons. This way, the staff resources are dependent on the number of students.

THE UCPBL PROFILE

The overall objective of UCPBL is to promote and support PBL interests worldwide. This includes research and development activities, educational programs, consultancy activities, and the establishment of a UCPBL Global network for



The organisational structure of UCPBL

international cooperation and exchange of experiences. The overall profile and the activities of the UCPBL Centre for Problem Based Learning are presented in the work plan that is continually updated and available at www.ucpbl.org/workplan.

The organisational structure reflects the two main areas of activities through an executive unit for Research and Education and another one for international consultancies. This is shown in the diagram above.

RESEARCH AND DEVELOPMENT

The overall goal for research and development is to establish relevant research projects within the field of PBL such as:

- Documentation of improved learning for students studying in a PBL-curriculum,
- Development of various PBL-models, and
- Strategies for implementation of PBL in various organisations.

An important issue in this kind of research is to address intercultural learning and analysis of values in PBL-systems compared to students' cultural values and background. Priority will be given to:

- Establishment of research projects, including establishment of international PhD scholarships especially through the relevant EU-programs.
- Presentation of research results. In 2006/2007 UCPBL will published a book on PBL and change processes from traditional teaching to a PBL-approach in various institutions. The book will contain analysis of these processes and the specific PBL models that has been implemented.

EDUCATION

The overall goal for this area is to launch a Master Program in Problem Based Learning (MPBL) at a global level. The study regulations for this course are formally approved. The MPBL-program started February 1, 2006 with the first cohort of participants. There will be open for next enrolment February, 2007. For further information: http://www.mpbl.aau.dk/

The overall outcome of the master program is for the participant to gain the competences of being in charge of innovative teaching and educational experiments and thereby develop an experimental practice which will lead to continuous improvement of the quality within engineering and science educations.

MPBL is fixed as one work year course (60 ECTS equivalent to one full year of study equivalent to 1800 hours of workload for the student), where one work year is defined as a full-time student's work in one year. The course is, however, based on part time studies and technology supported distance education. As part of the program several lecture courses are offered as single subjects. This is a strategy for recruitment to the total program, as there is normally no formal requirement for 60 ECTS pedagogical training. The structure of the MPBL-program is as follows (1ECTS equals 30 hours of study; P-course is a lecture course relating to the project work; S-course is a lecture course relating the Master Program in general).

Programme overview

Module 1 - Development of Teaching Competencies

• PBL in Engineering and Science Education • Learning Theory for Engineering and Science Education • IT and the Study Programme • Engineering Didactics	10 ECTS
• *Project – Teaching Portfolio*	5 ECTS

Module 2 - Planning of Teaching Experiments

• Intercultural Learning and PBL • Development of Process Competencies • Scientific Methods in Engineering	9 ECTS
• *Project – Planning a Teaching Experiment*	6 ECTS

Module 3 - Implementation of Teaching Experiments. Specialisation

• IT in Teaching • Evaluation and Quality Development in Engineering and Science Education • Strategies for Management and Staff Development • Supervision • Engineering Competencies in a Global Information Society • Work Based Learning • PBL and Mathematics	9 ECTS
• *Project – Implementing a Teaching Experiment*	6 ECTS

Module 4 - Reflection and Evaluation

• Research Methods	3 ECTS
• *Project – Final Thesis*	12 ECTS

The first module is to develop a teaching portfolio in which the participants' reflect on their previous and present teaching experiences and start reflection on PBL.

The development of the MPBL-program is financed by Ministry for Science, Technology and Innovation, Denmark and ERASMUS Curriculum Development Projects, Socrates Program, EU. The following partners participate: Glasgow Caledonian University, Scotland, Hochschule Wismar, University of Technology, Business and Design, Germany, Lucian Blaga University of Sibiu, Romania, Pedagogical Network for Engineering Education (IPN), Denmark.

The long term goal is that the MPBL-course should be able to recruit students at a global level and cooperate with partners in the UCPBL Global Network.

INTERNATIONAL CONSULTANCY

The UCPBL Unit for International Consultancy offers consultancy related to institutional change processes, curriculum development, staff development, and training programmes or topics for institutions entering into a process of change or have already made a change towards Project Organised and Problem Based Learning as the basis of their educational system. The programme can be offered to an entire institution or a sub-institution, school, department, or programme. The consultancy activities relate to the following areas:

- *Consultancy aimed towards the complete process of institutional change.*
  This area covers complete consultancy programs for the total process of institutional change in relation to introduction of a PBL approach. Typically, this kind of consultancy will be long-term agreements covering all aspects of the

process of change. The activities are limited to consultancy tasks and not supervision agreements.

- *Consultancy aimed towards specific areas or topics in a process of change.*
  This kind of consultancy relates to specific areas or topics in a process of change, and not the entire process of change.
- *Consultancy for support of curriculum development*
  The activities sustain and support curriculum planning and development and are focused on designing the main educational structure based on local potentials, and whether an existing or proposed educational structure is suitable as a platform for implementing a new educational model based on a PBL approach.
- *Consultancy for staff development programs*
  The consultancy relates to training and developments in the process of change, and in the structuring of educational programs and their development. These activities are typically carried out prior to the specific course activities listed below.
- *General Capacity Building Activities*
  The UCPBL Unit for International Consultancy further offers general capacity building activities to develop and sustain education programs and institutions or sub-institutions in their activities related to the introduction of innovative teaching and learning methods. The UCPBL Executive Unit for International Consultancy can act as an active partner in co-financed international projects, supported by e.g. EU, World Bank, Danida or other officially supported projects.

The UCPBL Unit for International Consultancies also offers development and conduction of training and development courses to support and to sustain the processes of institutional change. These include:

- Strategic Level Courses
- Tactical Level Courses
- Operational Level

- Overall introduction courses for all members of the Institution or sub-institution.

Extensive consultancies have been undertaken at Tec de Monterrey, Mexico, to facilitate their process of change. Consultancy contacts are also established with a number of universities throughout the world such as University of Conception, Chile, University of Sao Paulo, Brazil, Chiang Mai University and Siam University, Thailand, Catholic University of Mozambique, Kolej Universiti, Johor, Malaysia, Mondragon Unibertsitates, Spain and University of Victoria, Australia.

THE UCPBL GLOBAL NETWORK

The objective of the UCPBL Global Network is to establish a forum for educational institutions having an interest or being actively involved in PBL activities. The forum will facilitate:

- Information about PBL activities around the world
- Cooperation and exchange of experience within the PBL area
- Research activities within PBL
- Capacity building initiatives
- Curriculum and staff development activities

To qualify for membership of the UCPBL Global Network the institutions will need to demonstrate the use of PBL methodologies or that the institution is in the process of preparation or implementation of a PBL approach. The benefits of being a member include:

- Access to the UCPBL on-line PBL Library, that is web based and includes global references to PBL publications, research, and development activities. This way the PBL Library acts as a subject gateway to Problem Based Learning.

- Access to PBL newsletters
- Access to research cooperation
- Access to exchange of students and faculty staff
- Access to bi-annual network seminars
- Access to self-promotion of the institutional profile of the member institutions

The UCPBL Global Network will be launched on the web by July 2006.

FINAL REMARKS

The UCPBL Centre for Problem Based Learning was founded in 2001 at Aalborg University which is recognised world wide for the successful implementation of a project-organised and problem based approach especially within engineering education. The Centre is a unique opportunity for Aalborg University to merge the efforts into one organisational structure aiming to promote and support PBL interests worldwide.

The UCPBL Global Network provides a worldwide platform for networking activities in various aspects of PBL including mutual exchange of experiences, education, research, and capacity development through consultancy activities. The objective is to facilitate better access to and co-operation within the PBL area at a global scale.

REFERENCES

Colemann, D.J. (1998*):* Applied and Academic Geomatics into the Twenty-First Century. *Proceedings of FIG Commission 2, The XXI International FIG Congress*, Brighton, U.K. pp 39-62.

Kolmos, A. (1996): Reflections on Project Work and Problem Based Learning. In: *European Journal of Engineering Education,* Vol. 21, No 2, pp 141- 148.

Kjersdam, F. and Enemark, S. (1994): *The Aalborg Experiment - Project Innovation*

in University Education. Aalborg University Press.

Moesby, E. (2004): *Reflections on making a change toward POPBL*. World Transaction on Engineering and Technology Education: Vol. 3, Nr. 2. p. 269 - 278. UICEE, Monash University, Australia.

Moesby, E.: *Implementation of POPBL at institutions or sub-institutions.* In review process for World Transactions on Engineering & Technology Education (WTE&TE), UICEE, Monash University Australia. Volume 5, No. 1, 2006.