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# **Global Network on Engineering Education Research and Expertise in PBL – The Profile of UCPBL**

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## **Abstract**

The UCPBL Centre for Problem Based Learning 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 utilizing PBL-learning principles 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 organizational structure aiming to promote and support PBL interests worldwide.

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 organized, 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.

One of the absolute important tasks for UCPBL is to provide evidence for the effectiveness of PBL worldwide. Thus, there is a special attempt to establish links between engineering education researchers in this field. This involves considerations concerning what is engineering education research – and how do we promote research based staff and educational development.

*Keywords: Staff Development, PBL, Engineering Education Research*

## **1. INTRODUCTION**

Engineering in the 21<sup>st</sup> century faces several challenges: firstly, it is oriented towards global markets and products; secondly, the underlying knowledge quickly becomes obsolete; thirdly, it must operate within an increasingly stressed natural and social environment. These challenges are significant for education in science and technology in general and for engineering education in particular.

There is an increasing need for engineers who are oriented towards a global market, who have the ability to be involved in interdisciplinary professional and intercultural teams, and who possess lifelong learning competencies, such as the ability to continuously update existing knowledge and

seek relevant new knowledge. There is a need for engineers to become more innovative, creative and to be able to analyse the contextual and ethical framework for their work.

In order to meet these challenges, universities have to develop more student centred education that exposes students to the complexities of global and cultural issues and provides the possibility for students to achieve sustainable, transferable core skills. Therefore, innovation in education is needed – and there is a need for exchanging experiences and knowledge on curriculum development and implementation – objectives, resources, learning activities, assessment and evaluation strategies.

All over the world, problem/project based learning (PBL) is implemented as one solution to these challenges. A PBL approach means a focus on the learning process and the skills for learning to learn. It involves a project-organised educational model with a dialectic interaction between the subjects taught in the lecture courses and the problems dealt with in the project work. The project work is problem based and the problems are often as they appear in the real world [1]. Throughout the project work, students interact with organisations, industries and relevant institutions and thereby contribute to the development of society in general, while building their own personal capacity.

There is an increasing interest in these new PBL teaching and learning methods to address the needs of more holistically oriented engineers. In Europe, several institutions have changed to various models of PBL in selected subjects, e.g. University of Aveiro, Portugal, University of Mondragon, Spain, University of Louvain-la-Neuve, Belgium, University of Twente, University of Maastricht and Delft University, the Netherlands, Linköping University, Sweden and Aalborg University, Denmark. There are many more institutions all over the world, because PBL has been implemented at a small scale at many universities.

PBL has become a widespread concept utilized at many institutions all over the world. Nobody can any longer claim to have a full overview of the development in Europe or the rest of the world. Listing the institutions in this connection is ambitious and difficult in practice since so many have begun to employ either the principles holistically or elements of PBL. It is safe to say that PBL has become a worldwide and widespread phenomenon.

The transformation from traditional to more student-centred learning is a widespread global process caused by new demands for process and lifelong learning skills. But even if this is a global process, each institution– each programme that has utilized PBL principles has its own history. In many cases, the shift to PBL was caused by more or less the same wishes:

- decreasing drop-out rates
- promotion of motivation for learning
- creation of institutional profile
- development of new competences
- development of lifelong learning

In these world wide transformations processes, we need to have documentation for the effect of PBL. Did the implementation of these learning principles lead to a change in students' learning outcome?

UCPBL at Aalborg University is conducting research in this area to provide evidence for the effect of PBL in Engineering Education.

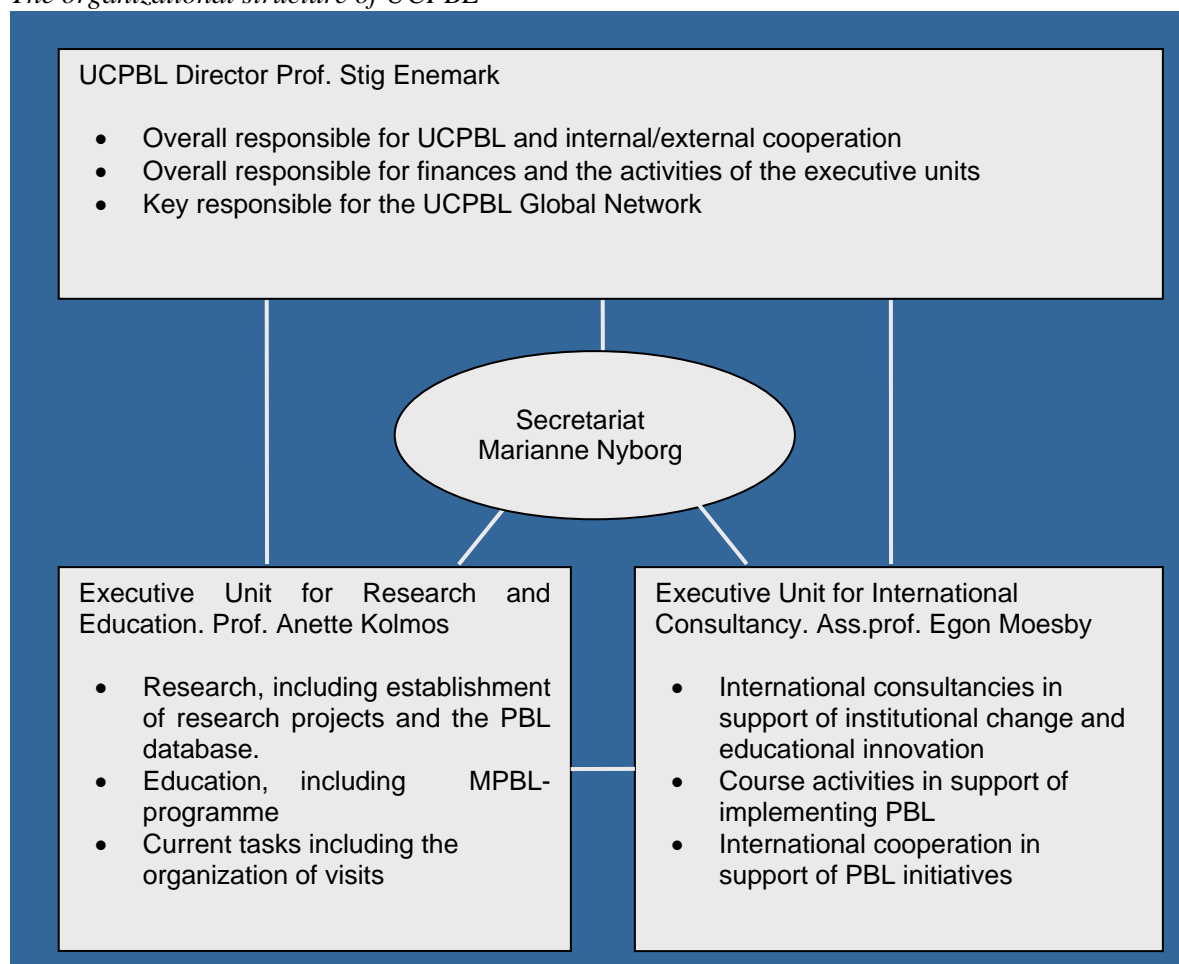
In this article, we cannot answer this question; however, we can present ideas for how to organize the exchange of research knowledge concerning these matters. A lot of changes taken place are never subject for documentation or research. Therefore, exchanges of experiences have to address both researchers in the field but also practitioners that have been involved in transformation processes [2] [3].

## 2. 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 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](http://www.ucpbl.org/workplan).

The organizational 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 below.

*The organizational structure of UCPBL*



### **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:

- UCPBL on-line PBL Library, that is web based and includes global references to PBL publications, research, and development activities. The PBL Library, this way, acts as a subject gateway to Problem Based Learning.
- PBL newsletters
- Research cooperation
- Workshops and seminars with exchange of practitioners experiences
- Exchange of students and faculty staff
- Bi-annual network seminars
- Self-promotion of the institutional profile of the member institutions

### **3. RESEARCH AND DEVELOPMENT**

The overall goal for research and development is to establish relevant research projects within the field of PBL, especially with the purpose of providing evidence of PBL. This includes:

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

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.
- Presentation of research results and planning of international conference.
- Further development of a PBL-database.

The UCPBL-research unit is based on the research group: Theory of Science, Engineering Education and Organisational Learning (TEO), Department for Development and Planning, Aalborg

University. (<http://www.plan.aau.dk/tms/knowledge/knowledge.php?id=4&st=1> ). This research group was established in the spring of 2003 and works with three main areas: “Theory of Knowledge”, “Engineering Education” and “Organisational Learning”. There is a focus at the interest in the process by which knowledge is maintained and developed in a continuous process of construction and reconstruction. In the field of "theory of knowledge", we are working with knowledge forms and knowledge perceptions, of any kind, in western history as well as in other cultures and subcultures, and how knowledge is created based on different values, argumentations and perspective of technological change. Primary we work with knowledge about the world as a basis for human actions in the world, i.e. a practical perspective.

With regard to Engineering Education we work with planning, organisation and evaluation of learning processes in the education and work of engineers. In this field, our core expertise concerns “problem based learning”, which includes the interaction between theoretical and practical problems. With regard to organisational learning, we work with innovation in organisational values, structure and culture. We focus on innovation as a distributed process in communities of practise where experience is being communicated, co-ordinated, provided, and reflected upon. There is 12 staff actively involved in research in these areas.

With regard to the global network, this group will take initiative to establish stronger links among researchers all over the world by arranging conferences, seminars in as part of writing books and special journal issues together.

### **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.

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 [4] [5].

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.

## **4. INTERNATIONAL CONSULTANCY**

The UCPBL Unit for International Consultancy offers consultancy related to institutional change processes, curriculum development, staff development, and training for institutions entering into a

process of change or have already made a change towards Project Organized and Problem Based Learning as the basis of their educational system.

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

- *Strategic Level Courses*  
The courses are specifically developed for the staff at executive level. The focus is on establishing an overview of the complete process of change and thereby enabling the development of institutional visions and the overall setup for a process of change.
- *Tactical Level Courses*  
The courses aim at the specific needs for the staff at the academic director level to enable them to design an overall structure of the new educational model.
- *Operational Level*  
These staff training programs focus directly on the needs of the teaching staff in their every day work in the development and their conduction of teaching classes and performing of supervision.
- *Overall introduction courses for all members of the Institution.*  
These courses are aimed to give all the members of the Institution an overview of all the processes in the change process. These courses need to be given relatively early in the process in order to give all members at the Institution a chance to understand their role in the process of change, and how they personally can participate successfully in the process.

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 supervisor agreements.
- *Consultancy aimed towards specific areas in a process of change.*  
This kind of consultancy relates to specific areas in a process of change, and not the total 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 training programs*  
The consultancy relates to training 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 also offers general capacity building activities to develop and sustain education programs and 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.

## 6. FINAL REMARKS

The UCPBL Centre for Problem Based Learning was founded 2001 at Aalborg University that is recognized world wide for the successful implementation of a project-organized and problem based approach especially within engineering education. The Centre is a unique opportunity for Aalborg University to merge the efforts into one organizational 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.

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### **Stig Enemark, Professor in Problem Based Learning and Land Management, Aalborg University.**

Master of Science in Surveying, Planning and Land Management 1966. License for private practice, 1970. Consultant Surveyor in private practice (1968-1978). Assistant Professor, Aalborg University (1979-81). Public Administration (1981-82). Associate Professor and Senior Research Fellow, Aalborg University (1982-1991). Reader in Land Management, Aalborg University, Department of Development and Planning (since 1991-2003). Professor in Problem Based Learning and Land Management (since 2003). Awarded the Danish Real Estate Prize 1991. Invited Fellow of RICS (Royal Institution of Chartered Surveyors, UK) since 1991. Appointed National Expert to the European Union in the areas of Land Management and Spatial Planning Systems, since 1993. Undertaken consultancies to the Danish National Government on Cadastral and Land Management issues, and to National Governments in Eastern Europe and Africa on the establishment of Land Administration Systems and related educational issues.

### **Anette Kolmos, Ph.D., Professor, UCPBL, Aalborg University.**

Anette Kolmos professor in Engineering education and PBL and vice director for UCPBL (UNESCO International Centre for Engineering Education Centre for Problem Based Learning), Aalborg University. She was head of the Centre for University Teaching and Learning 1995 – 2002. As head of the Centre for University Teaching and Learning and for a period head of the research centre, Centre for the Interdisciplinary Study of Learning, with responsibility to develop



master and PhD-programmes. Dr. Kolmos has been responsible for development and implementation of more than 10 research and development projects. Dr. Kolmos holds a Ph.D. in "Gender, Technology and Education" (1989). Dr. Kolmos is associate editor for the journal: Journal for Engineering Education, ASEE. She is member of the advisory board for The International Journal for Academic Development. She is Member of Programbeirat für Hochschuldidaktik, Ministerium für Wissenschaft, Forschung und Kunst, Baden Württemberg, and recently member of an expert group for the EU-commission: STRATA ETAN Expert Group under the title: Developing Foresight for the development of Higher Education/Research relations in the perspective of the European Research Area, and has recently been appointed for the advisory board for the EU-programme on Human Resources and Mobility Programme. She is coordinator for the EU-project, Socrates project, PBL-Engineering which is developing the master programme: [Problem Based Learning in Engineering and Science.](#)

**Egon Moesby, Associate Professor, Aalborg University**

Egon Moesby was born 1952 in Denmark and has a BSc in civil and constructional engineering from Esbjerg Engineering College, Denmark. He was a consulting engineer at Anderskov & Thomsen, Esbjerg, from 1981-1986, before becoming international consultant of turnkey operations at the Natural Gas Company "Naturgas Syd." He was also a consulting engineer at Ramboll & Hannemann from 1989-1991. Egon Moesby is currently associate professor at Aalborg University, Denmark. He was in charge of implementing the Aalborg PBL educational model at Aalborg University's Esbjerg campus between 1995 and 1996. Since 1996, he has been the Director of Studies and Head of the Study Board at the School of Basic Studies in Science and Engineering, Aalborg University. He is presently Vice Director and in charge of The International Consultancy Programme of the UICEE Centre on Problem-Based Learning (UCPBL), a UICEE satellite centre, based at Aalborg University, and is involved with several distinguished engineering and educational advisory boards. He is the author and editor of several publications, and has conducted numerous international and national workshops as well as headed satellite transmissions particularly in the field of PBL/POPBL implementation. His research interests include studying the changes in educational institutions when implementing a new educational programme. He is at the final stage of writing a PhD on "What is an effective approach to introducing POPBL in an institution? – Ways bringing about an institutional or sub-institutional change, which entail moving from traditional teaching methods to POPBL"