Problem based Learning in Engineering and Science – Development of Facilitator

A Course given by:
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Associated Professors at Aalborg University

Thursday, the 12th of November 2009: PBL and The Aalborg model

9.00 Welcome by lecturer Xiangyun Du and Lars Peter Jensen
   Introduction and presentation of lecturer and participants
   Discussion of participants expectations (reflection-for-action)
   Introduction to the program.

10.00 Reflection on University teaching and learning, including learning theories and the need for educational change and innovation

11.00 PBL history, understanding, philosophy and practice from a global perspective

12.00 Lunch

13.00 AAU PBL model – history and evidence

13.30 PBL as educational model and Practice at Aalborg University

16.00 End of day one

Friday, the 13th of November 2008: Facilitation

9.00 Mini project: In a Danish brewery there is too much noise emitted in the production hall, due to the bottles. Plan how to find the noise sources and find solutions.

9.45 Introduction to role play. Exercise: Role play of a supervising situation

12.00 Lunch

13.00 Facilitation skills and experience exchange

14.30 Intercultural Communication in a PBL Environment

15.15 Forming Peer groups and planning experiment

16.00 End of day two

PBL Aalborg Practice

Three main characteristics
- Problem
- Project
- Team work

Tuesday, the 15th of December: Results from experiments with facilitation situations + Examination

Until the last day of the course the participants are helping each other/sharing experience in Peer Groups making an experiment with supervision.

9.00 Presentation and discussion of group exercises.

12.00 Lunch

13.00 Assessment/Examinations of projects: Why and How

15.00 Unanswered questions and evaluation of the course.

PBL Aalborg Model Principles of Project-organized problem-solving Learning

‘The Aalborg Experiment – project innovation in university education’ – Kjaersdam & Enemark (1994)
PBL Aalborg Model - practice

- Problems – question – wondering within a frame
- a project each semester (1. year)
- each group has a group room
- group size of 6-8 students first year, 2-3 students the last year
- each group has at least one supervisor
- self selected group and projects within themes and disciplines
- group examination

Lectures 8:15-10:00
Lecture-related Assignment 10:15-12:00
Supervision -initiated & arranged by students
Doing project In groups

Development of different Competences through the study

<table>
<thead>
<tr>
<th>Method</th>
<th>Collaboration method/ Method of project work/learning</th>
<th>Discipline learning</th>
<th>Metods used in industry and institutions</th>
<th>Scientific method</th>
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Team work

**What?**
- A group of students working together on a project
- They have to both carry out the project and document the results
- Based on the documentation an oral individual examination is held. Before the examination the group presents the project

**Why?**
- A survey in 1997 showed that 75% of the companies wanted new employees to have good skills in team work
- Most engineers work in teams
- The individual student in the group learns from the others (peer learning)
- Responsibility towards the group leads to very hard work
- Group members provide social support, thus lower drop-out rate

**How?**
- Each group has a group room
- Group size of 6-8 students first year, 2-3 students last year
- Students are in charge of forming groups
- New groups formed every semester
- Team building courses:
  - Roles, communication, co-operation, conflicts

Studying engineering via group projects
Participating communities of practice— active learning, communication, organization, and management

Brainstorm
Group meeting
Exam
Discussion
Compromise
Presentation
Social activities

Exam
Discussion
Compromise
Presentation

Life

Studying engineering via group projects

Participating communities of practice—active learning, communication, organization, and management
**Projects**

**What?**
- A unique task
- Have a lot of complex activities
- Needs several people with different skills
- Have a final goal/objective
- Limited resources (time, money, people)
- Have to deliver a result at a given time:
  - As a minimum a written report

**Why?**
- More and more companies use project organization
- Much engineering work is performed as projects
- Motivates the students and increases student activity
- Secures deep learning in subjects covered in the project
- Improves documentation skills

**How?**
- One project each semester
- Necessary theories and methods given in project courses

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**PBL AALBORG MODEL**

![Diagram of the PBL AALBORG MODEL]

**Study courses and Lectures**
- max. 7.5 ECTS
- Examination

**Project**
- min. 15 ECTS
- Examination

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**Support to student learning – courses and project**

**Non project supporting courses 25 %**
- Teaching of basic knowledge.
- Not specifically related to the project.
- Taught as traditional courses or by other techniques.
- Traditional examination. Written or oral.
- Individual examination. Written or oral.

**Project supporting courses 25 %**
- Courses which specifically support the project.
  - e.g. economics, environment, planning, sociological methods, specific technical issues, group behavior, and group psychology, working environment, etc.
  - Can be traditional courses, case studies, etc.
  - Examination held as part of the project.
Semester timing – an example

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<th>Activity</th>
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<td>SE-course 2</td>
<td>Project work</td>
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10 minimodules/week – 1 mm = 4 hours or ½ day

Projects

How?
- One project each semester
- Necessary theories and methods given in project courses
- Each group has (at least) one supervisor
- Documentation:
  - a written report, oral defence, (construction)
- Courses in:
  - project management and planning

The four phase model of a Project

Get an overview of the problem
- Asking Questions
- See Perspectives

Divide into different aspects
- Top Down
- Bottom Up

Look critically at all aspects
- Estimate
- Measure
- Compare

What is analysis?
- The six W-model
- Post It Brainstorm
  1. Everybody writes keywords on Post It notes for 5 min
  2. All notes are placed on the blackboard
  3. All notes are read out
  4. Everybody goes to the blackboard and structures the notes together

Problems

What?
- Three different types of problem based projects at AAU:
  - The task project
  - The discipline project
  - The problem project
The task project

- Considerable planning and control by the supervisors
- The problem and the subject as well as the methods are chosen beforehand
- The educational objectives are easily controlled
- Being a supervisor is easy in that the supervisor knows exactly what is going to be explored in the project and can direct the students' choices in the planned direction.

The discipline project

- The disciplines and the methods are chosen in advance
- The students have to identify and define a problem within the described disciplines
- The educational objectives are mostly formulated for each discipline
- Being a supervisor in this process may be a bit uncertain, because the students are allowed to make some choices on their own. However, the scientific field is described well and hardly any surprises occur

The problem project

- Based on problems as the starting point
- The problem will determine the choice of disciplines, theories and methods
- The educational objectives emphasise ability to analyse and methodological skills
- The problem has to be chosen within a broader social and technical frame
- Being a supervisor in this process may be difficult because it is a self-directed learning process and the supervisor may find him/herself at the edge of capacity
Common features of project work

- For all three types of projects, a problem has to be analysed and solved by means of different theories and methods
- The phases of the project are common to all three project types

Problems

Why?

- Real world problems are interdisciplinary and complex
- It is a learner-centred process
- It meets the learners' interests and enhances motivation
- It emphasizes development of analytical, methodological and transferable skills

AAU students on problems

- "We are engineers – our responsibility is to solve real technological problems."
- "This is the first time we found a real problem ourselves rather than getting something from supervisors. It is really exciting. It fits my way of learning. I learn better when I find the way myself. This way of learning is much better than only attending lectures, because I have to know why I need to learn this. When I know the objective clearly, I learn much better."
- "When working on a problem, I am strongly motivated and attracted. We need to solve this problem."

Xiangyun Du, 2005

Problems

How?

- The project groups choose their own problem to work with in the projects
- The problem has to be analyzed within a relevant context before it can be solved or analyzed further
- The problem determines the choice of methods and theories to be used