Problem Based Learning
and
Link with Industry

Flemming K. Fink

ELITE
Aalborg University
Aalborg University (AAU)

• Established in 1974
• 13.000+ students
• 1250 Scientific Staff
• Problem Based Learning since 1974
• High degree of cooperation with society and private companies – students and research
• Unesco Centre in PBL – http://ucpbl.org
Basic teaching Model

- Focus on competences – not disciplines
- Problem Based Learning
  - based on real-life engineering problems
- Project organized team working
- Group studies
  - teams of maximum 6 students
- Interdisciplinary
- Integration of theory and practice
Semester Structure

Theme/Subject

Project + PE-courses + SE-courses

One Semester = 900 hours of work = 30 ECTS

Project work > 50 % of semester

PE courses > SE courses
PBL at AAU

50% courses

Project related courses

50% project

Project work

compulsory courses

Individual exam

Group exam

Model from *The Aalborg PBL model - Progress, Diversity and Challenges*

Anette Kolmos, Flemming K. Fink & Lone Krogh
Problem Based Learning

PROBLEM ANALYSIS

PROBLEM SOLVING

REPORT/DOCUMENTATION

Tutorials

Field Studies

Experiments

Literature

Lectures

Group Studies
## Semester Plan

| Period 1      | Period 2      | Period 3      | Period 4
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<thead>
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<tbody>
<tr>
<td>Project work</td>
<td>Project work</td>
<td>Project work</td>
<td>Private study &amp; Examinations</td>
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<tr>
<td><strong>Courses</strong></td>
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Period = 5 weeks

Fall semester:  September 1 - January 31

Spring semester: February 1 - June 30
# Week plan - example

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
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<tbody>
<tr>
<td>8.15</td>
<td>Project work</td>
<td>C++ programming</td>
<td>Stochastic Math.</td>
<td>Project work</td>
</tr>
<tr>
<td></td>
<td>Digital Signal</td>
<td>Calculation Exercises</td>
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<tr>
<td></td>
<td>Processing</td>
<td>MATLAB</td>
<td></td>
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<tr>
<td>12.00</td>
<td>Calculation Exercises</td>
<td>Calculation Exercises</td>
<td>Calculation Exercises</td>
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<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
<td>Lunch</td>
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<tr>
<td>12.30</td>
<td></td>
<td>Calculation Exercises</td>
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<td></td>
<td>Project work</td>
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<td></td>
<td>C++ programming</td>
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<td></td>
<td>Calculation Exercises</td>
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<td>Project work</td>
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One-week time table for each 5 week period
Projects

- Fundamental topics
- Feasibility study
- Industrial development topics
- Research topics

- Projects proposals from
  - Teaching/research staff
  - Research projects
  - Industry
  - Students
Basic Wireless Communication Technology

Objective:
- To obtain knowledge about basic wireless communication systems
- To obtain knowledge about the qualities of present wireless communication principles
- To be able to use methods and theories for analysis and design of functional wireless communication systems.

Content:
The project work is based on a specific problem where wireless communication technology gives a possible solution. The problem is analysed according to communication needs including quality service. A number of wireless communication technologies are compared with the identified needs and a technology is chosen for further processing. As a solution to the problem a distribution system is designed based on the wireless communication technology chosen for the purpose.

A small number of elements are implemented, enough to be able to demonstrate the abilities of the established communication facilities. Tests are carried out at module system level and accept
Project based assessment

On team basis (all present – partly!!)

- Presentation from each student (< 1 hour in all)
- Questions / discussion (< 6 hours in all)
- Question must be based on project content

Individual marks

Official appointed external examiners

- mainly from industry

Supervisor/examiner decide

- Who to ask about what ! ! !
- How long time to continue?
Project example 1

Hearing aid for profound deaf children

Problem:
Profound deaf children can hear something up to 800 Hz, but they need speech information up to 2000 Hz to understand speech.
Can the speech information needed to understand speech be extracted and presented for the children below 800 Hz?

A team of 3rd year students developed and tested a prototype with good results.
AAUSAT II
A student Satellite - Build in Aalborg
Cubesat Concept

- Originating from Stanford University USA
- 1 kg
- 10 cm x 10 cm x 10 cm
- Piggy riding on a real launch

- AAU launched AAUSAT I/Cubesat in 2003
- A succes – communication obtained
STRUCTURAL OVERVIEW
for AAUSAT II

- MECH - Mechanical construction
- OBC - Onboard Computer
- COM - Communication (435MHz)
- EPS - Powersupply and Security
- P/L - Scientific Payload (gamma quant sensor)
- ADCS - Attitude Determination and Control System
- GND - Ground Station (in Aalborg)
- MCC - Mission Control Center
Cooperation

- Inside the team (as usual)
- Between teams (PBL² !)
  - Different semesters (4-10)
  - Different specializations
    - Control, Radio Communication, Mechanical, Power electronics,...
- Not seen before !
- It works – students acts like real prof engineers
- Students are 90% in control of project !
- Invisible Management Guidance only when needed
Result of Pedagogical Concept

• Safe social surroundings
• Learn professional argumentation
• Learn to apply theoretical material
• Learn to work with engineering problems
• High completion percentage
• Lower average study time
• Bigger working load on teachers
• Need for training the teachers
Conclusions on PBL

• Ranked by Danish Industry to be the Best !!!
• Group organized PBL gives experience in
  – team-work and co-operation
  – applying theoretical material in engineering
  – problem definition
  – problem solving
  – documentation and presentation
• Industry is very interested in co-operation
  – with projects at all levels
  – with scholarships and other funding for students
<table>
<thead>
<tr>
<th>PBL</th>
<th>FWBL</th>
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<tr>
<td><strong>PBL</strong></td>
<td><strong>FWBL</strong></td>
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<tr>
<td>On campus education, organised in teams</td>
<td>Company based work</td>
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<tr>
<td>Courses + project</td>
<td>Often team organised</td>
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<tr>
<td>Application of courses</td>
<td>‘Courses’ + work</td>
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<tr>
<td>Learning is the goal</td>
<td>Application of courses</td>
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<tr>
<td>Problem is a tool</td>
<td>Problem solving the goal</td>
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<tr>
<td>Knowledge is a tool</td>
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## Learning ~ Engineering

<table>
<thead>
<tr>
<th><strong>Learning by problem solving</strong></th>
<th><strong>Engineering problem solving</strong></th>
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<tbody>
<tr>
<td>• The problem is a tool</td>
<td>• Professional skills are the tools</td>
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<tr>
<td>• Learning is the goal</td>
<td>• The goal is to solve the problem</td>
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