

Achieving Learning Outcomes in Problem Based Learning (PBL)

Zagreb University, 2005

Mona Dahms (mona@plan.aau.dk)
Department of Development and Planning
Aalborg University
Denmark

Outline

1. Introduction
2. Curriculum development
3. Learning outcomes with PBL-Aalborg
4. Assessment of PBL-Aalborg
5. Learning and teaching with PBL-Aalborg

1. Introduktion

Who am I?

A short presentation

Rationale

Rationale behind my presentation:

- At first I will tell you how (I believe) curriculum development (CD) ought to be done
- Then I will tell you what we have done/are doing at Aalborg University in terms of CD and PBL
- After the presentation, we will discuss what you can do here in Zagreb University

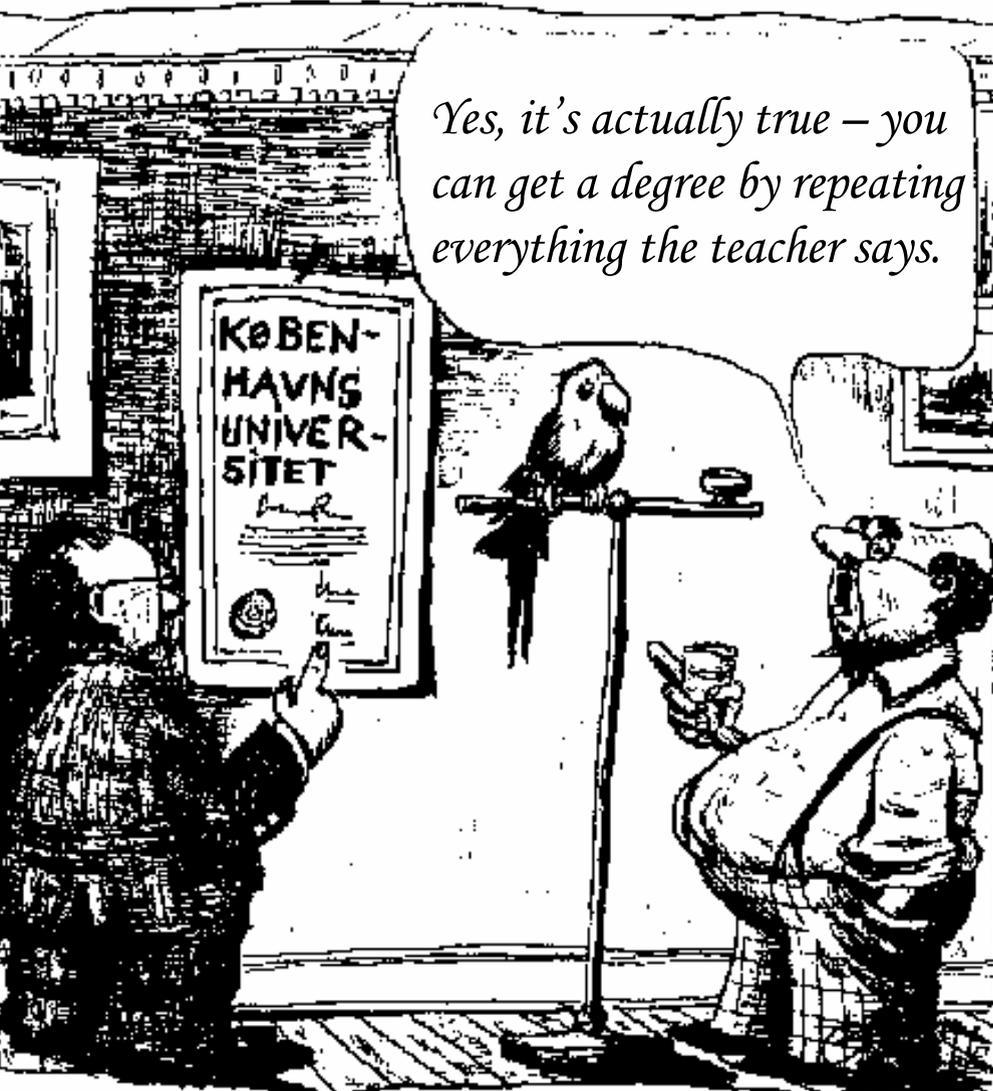
Definitions

- **Learning outcomes:** "sets of competences, expressing what the student will know, understand or be able to do after completion of a process of learning" (ECTS Guide 2005)
- **Assessment:** Judgement of students' performance
- **Evaluation:** Judgement of quality of courses and study programmes
- **Competence, capability, skill, qualification:** Confusing variety of words for students' knowledge and/or performance

More definitions

- **Learning:** What the student is doing when undertaking study activities, i.e. when studying
- My point of departure is a social-constructivist learning theory

Is this 'learning'?



The psychological mistake in learning:

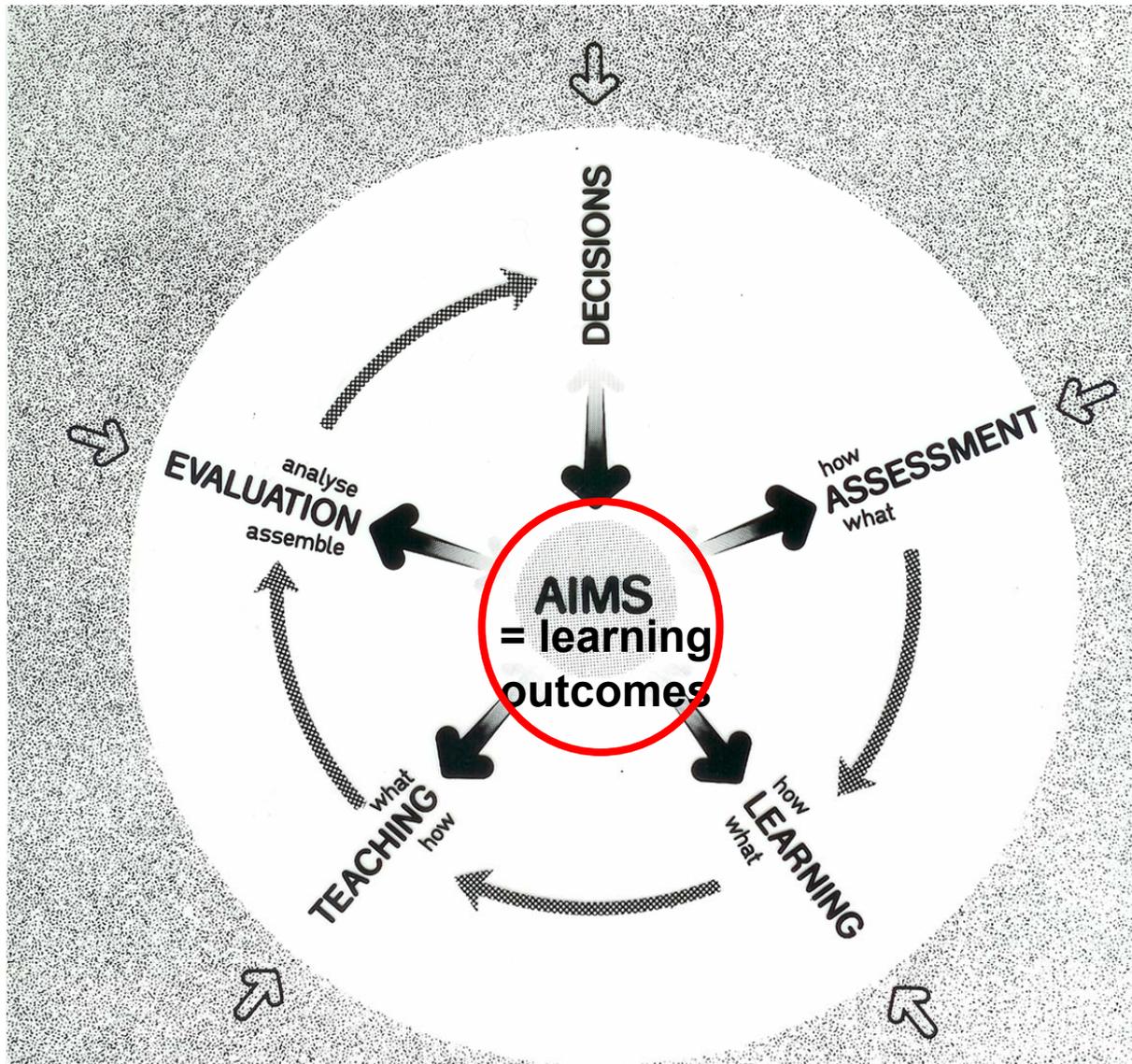
"We pretend that there is co-incidence between what is being taught and what is being learned"
(Knud Illeris, 1998)

More definitions

- **Teaching:** What the teacher is doing to support the student's learning
- "Teaching is the purposeful and deliberate creation of situations from which motivated learners should not escape, without learning or developing" (Cowan 2005)

2. Curriculum development

A logical curriculum development model



A 6-step process - 1

1. Aims = learning outcomes are at the center

- We need to specify clearly, explicitly and in detail what the students will be able to do **after** they have completed the course or the programme, that they could not do **before**, i.e.
- Which intended (minimum) skills should our students acquire via the course or the programme?

A 6-step process - 2

1. **Aims = learning outcomes are at the center**
2. **Assessment drives the learning efforts of students**
 - Assessment should be designed to assess the explicit learning outcomes, i.e.
 - Assessment should measure whether the students have acquired all the intended (minimum) skills - and should not measure anything **but** the skills - no 'hidden curriculum' of assessment!!

A 6-step process - 3

1. **Aims = learning outcomes are at the center**
2. **Assessment drives the learning efforts of students**
3. **Learning efforts of students should focus upon achieving the explicit learning outcomes**
 - We need to find out the learning needs of our students and try to respond to them in our teaching

A 6-step process - 4

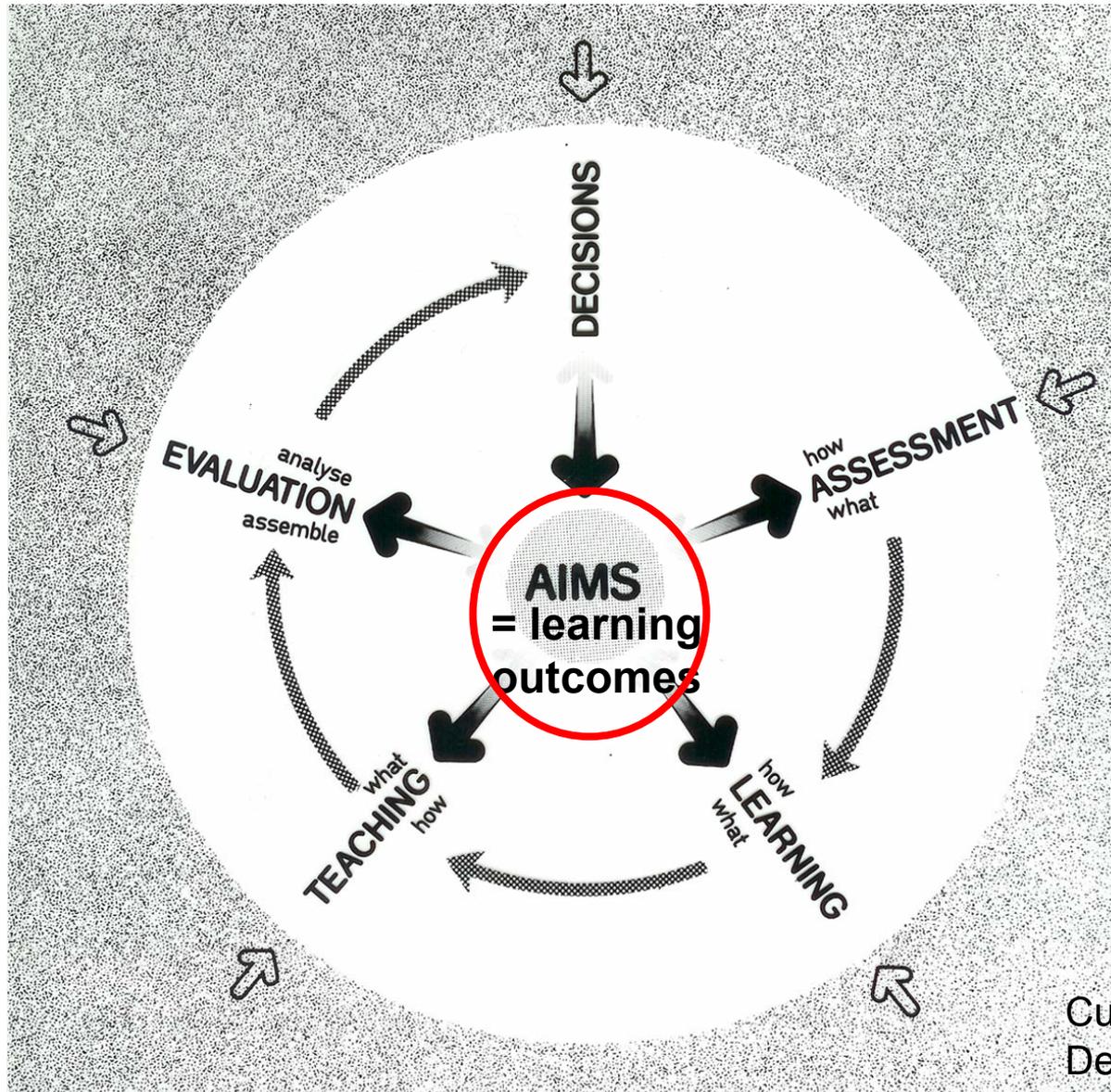
1. **Aims = learning outcomes are at the center**
2. **Assessment drives the learning efforts of students**
3. **Learning efforts of students should focus upon achieving the explicit learning outcomes**
4. **Teaching should support students seeking to achieve the learning outcomes**
 - We should not concentrate on what we 'want' to teach or what we want to 'cover'

A 6-step process - 5

1. **Aims = learning outcomes are at the center**
2. **Assessment drives the learning efforts of students**
3. **Learning efforts of students should focus upon achieving the explicit learning outcomes**
4. **Teaching should support students seeking to achieve the learning outcomes**
5. **Evaluation should be carried out - formative and summative**
 - **Collect evidence and feedback from students, colleagues and external sources**

A 6-step process - 6

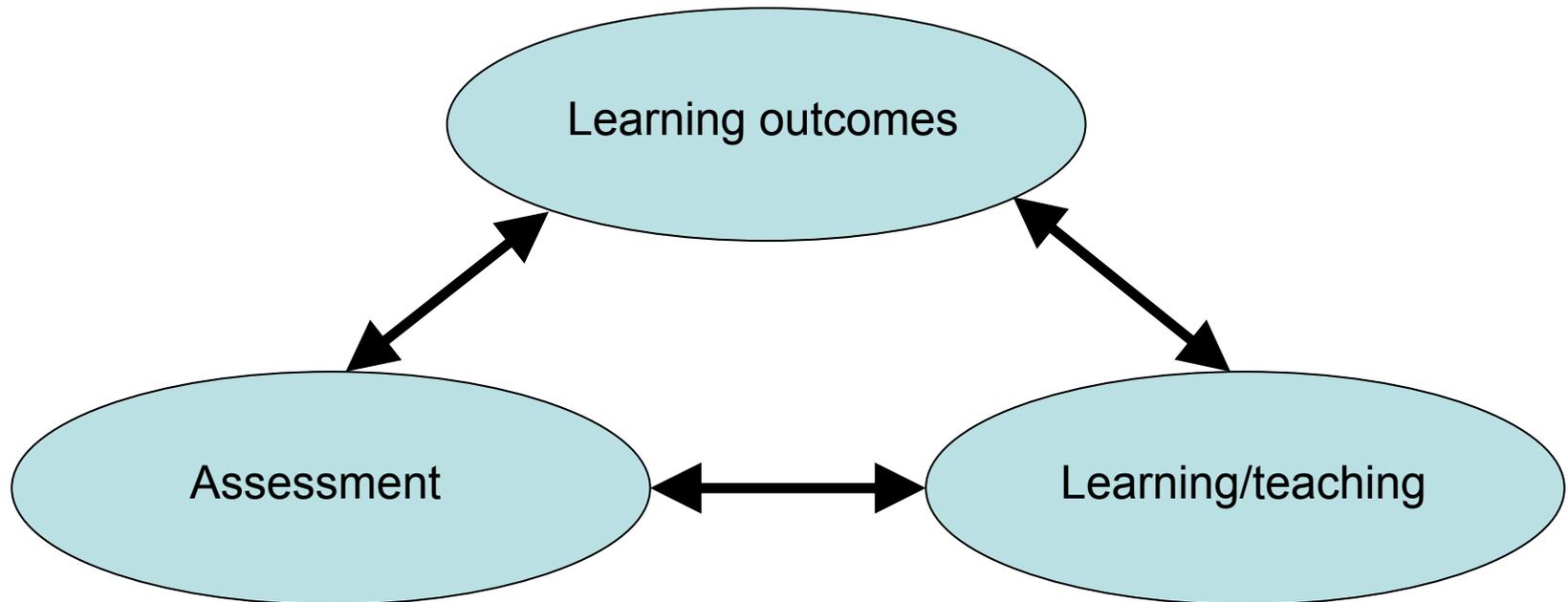
1. **Aims = learning outcomes are at the center**
2. Assessment drives the learning efforts of students
3. Learning efforts of students should focus upon achieving the explicit learning outcomes
4. Teaching should support students seeking to achieve the learning outcomes
5. Evaluation should be carried out - formative and summative
6. Revision of: learning outcomes, assessment, learning and/or teaching based on the evaluation
- the decision is ours, not the evaluator's



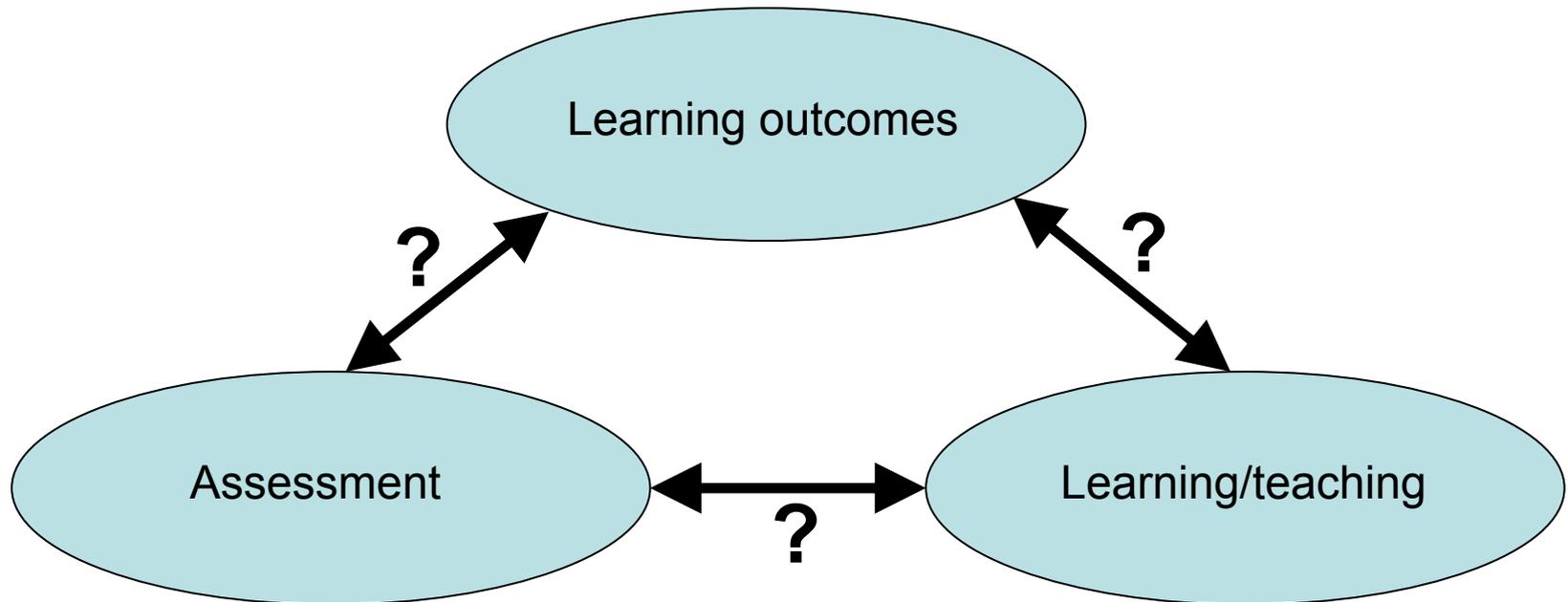
A few comments

- 'How' we do things (methods) is more important than 'what' we do (contents) -
 - Thus, 'how' should come before 'what' in our planning
- 'Alignment', i.e. agreement or compatibility should be secured between the three (four) elements:
 - learning outcomes, assessment and learning/teaching activities

Ideal alignment



Ideal alignment ???



3. Learning outcomes with PBL - Aalborg

Learning outcomes at 4 levels

- 1) Ministeriel Order on Engineering Education
- 2) Faculty of Engineering and Science
- 3) Study Board (of Basic Education, i.e. 1st year engineering studies)
- 4) The project group, incl. the teacher

The first 3 levels are generic learning outcomes for engineering

Level 1: Ministeriel Order § 1

Aims of the Bachelor of Engineering Education:

"Qualify the students to carry out job functions, nationally as well as internationally, where they will:

- 1. transform technical research results and scientific and technical knowledge to practical application in development tasks and in the solution of technical problems
- 2. critically acquire new knowledge within relevant engineering areas
- 3. independently manage engineering tasks and jobs
- 4. plan, implement and control technical and technological plants, including being able to integrate social, economic, environmental and occupational health consequences in the solution of technical problems
- 5. take part in collaborative and managerial functions at a qualified level, together with people with different educational, linguistic and cultural background."

Level 2: Faculty of Engineering and Science, AAU

“The students should develop the ability to:

- Tackle new problem areas
- Logical reasoning
- Critical and independent analysis
- Understand the theory of science of the subject area
- Interdisciplinary synthesis
- Promote sustainable and ethically acceptable technology
- Creative problem solving
- Application of modern information technology
- Communication
- Group work and collaborative work
- Management
- Continued professional development
- Innovation and commercialisation via entrepreneurship”

Level 3: Study Board (First year engineering)

- "Introduce the students to scientific work, with emphasis on methods, theories and models
- Develop the ability to systematically analyse and solve complex technical-scientific problems, integrating contextual aspects of relevance to the problem
- Develop the ability to plan and manage a problem based project work
- Develop the ability to reflect upon the learning process and generalise based on the exemplarity in project work
- Develop the ability to communicate results of project work and learning process scientifically and professionally in written, graphical and oral form."

Level 4: The project group

After the P1-exam the student should be able to:

- Describe and explain in own words how the temperature sensors described in the report are functioning.
- Draw and explain the equivalent circuit diagram for an ideal OP-AMP.
- Draw a circuit diagram for an inverting and a non-inverting OP-AMP circuit, explain the functioning of the circuit and calculate the mathematical expression for the amplification.
- Draw and explain an equivalent circuit for a BJT transistor as a switch in cut-off and saturation mode.
- Describe and explain how a light diode is functioning by drawing an I-V characteristic for the diode in question.
- Apply fundamental circuit theory, incl. Ohm's law, Thevenin's law and the Kirchhoff's laws for calculations on the constructed circuit.
- Describe and explain the measurement set-ups used in the lab in testing the constructed circuit.

4. Assessment of PBL-Aalborg

Assessment of project work

- A written project report
- A written process analysis
- An oral group defence of project and process
- An oral group exam discussing the report and the process analysis
- Individual marks for each student

Project exam

Participants are:

- The project group (6 - 7 students)
- A peer group (6 - 7 students)
- The two supervisors (main and assistant)
- The external examiner

5. Learning and teaching with PBL- Aalborg

Key elements

- Problem based
- Project organised
- Group work

Physical framework

- Group rooms with (wireless) Internet access (very many)
- Lecture halls (very few) and seminar rooms (some) with projectors and Internet access
- Computer rooms
- Laboratories
- The university library

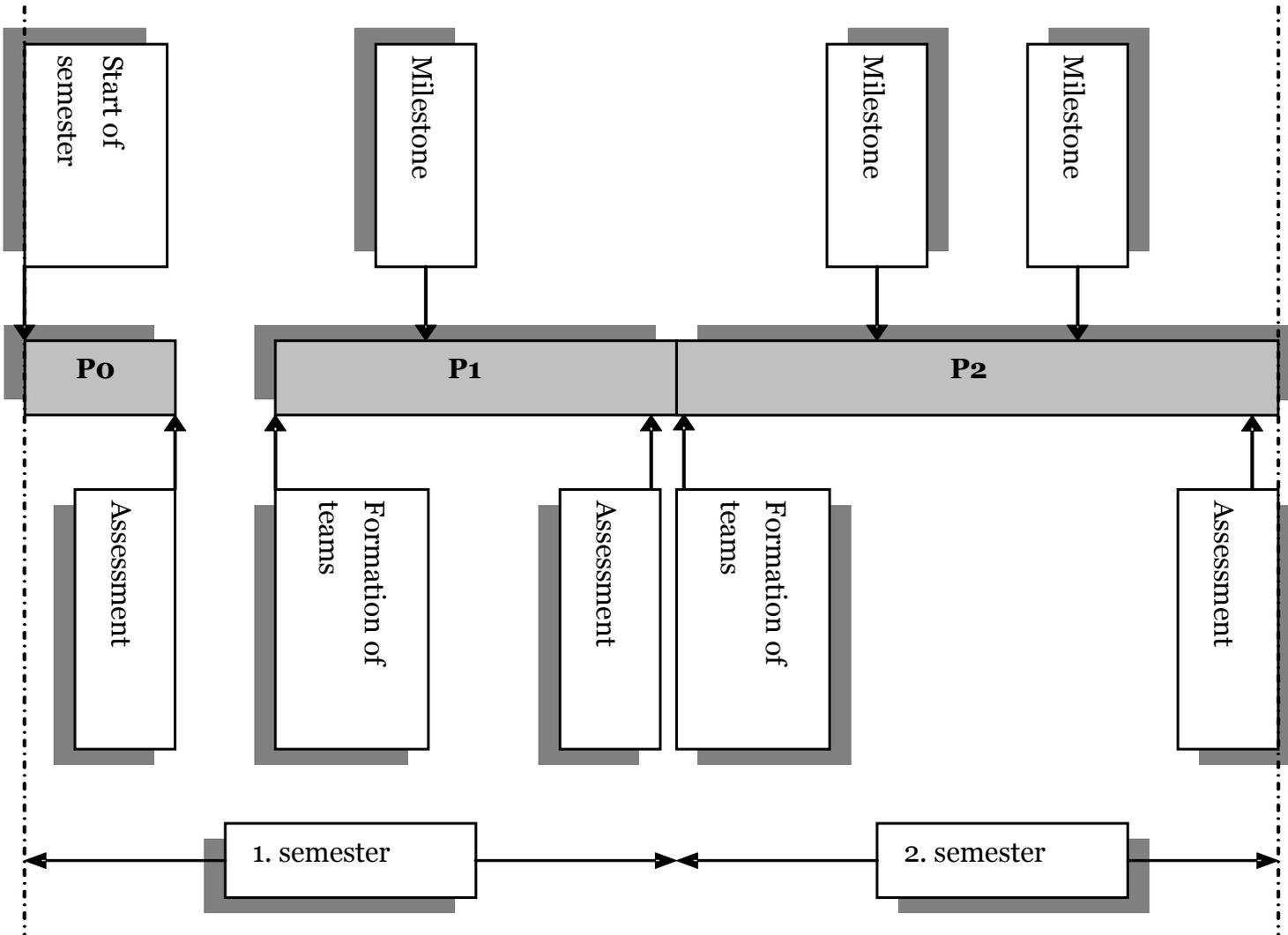
Organisational framework

- Study structure
- The basic education
- Semester structure
- Semester timing

Study structure

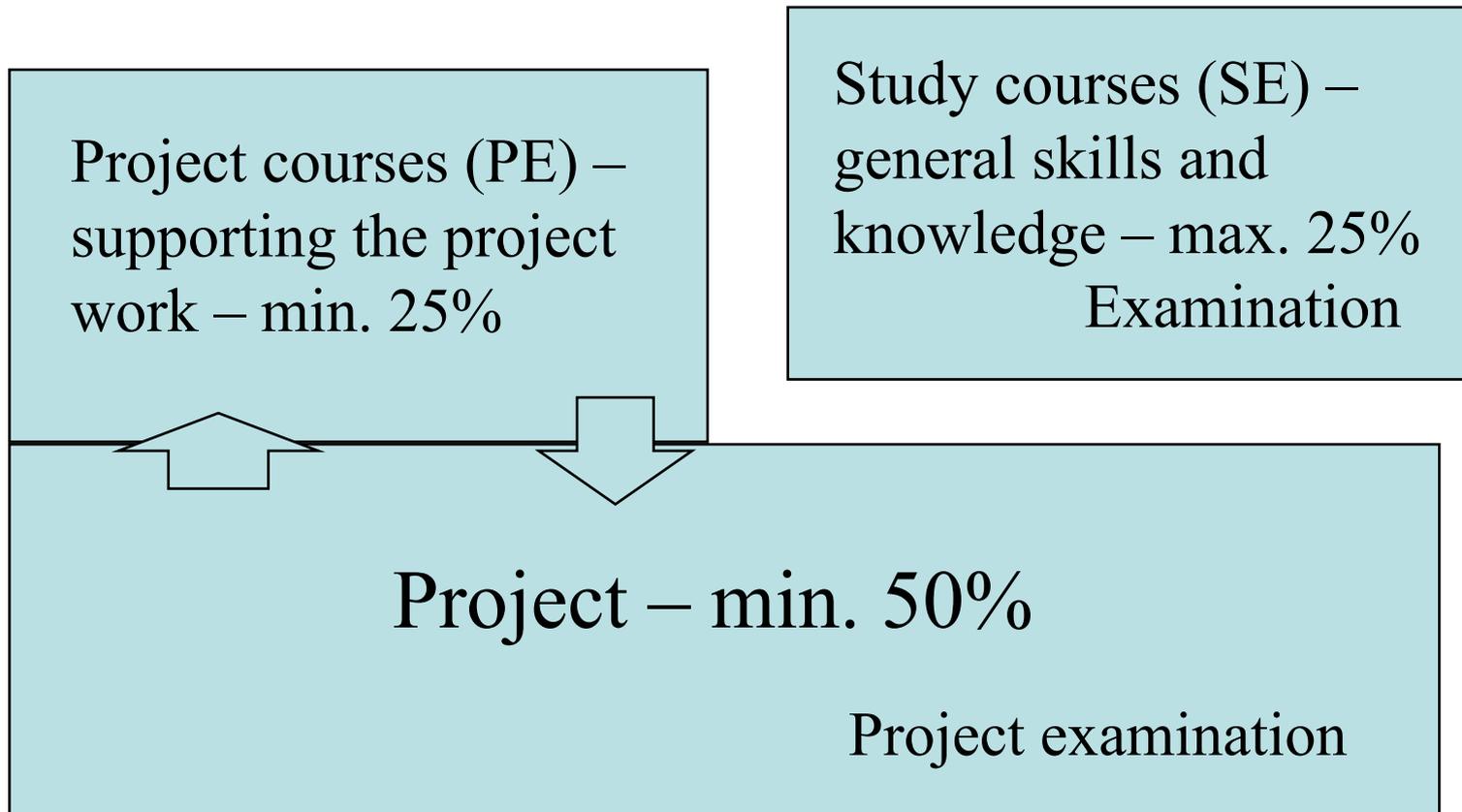
Bachelor programmes		Master programmes
	10. Semester	Master's thesis
	9. semester	Specialisation
	8. semester	
Bachelor project	7. semester	
Specialisation	6. semester	Bachelor education
Bachelor education	5. semester	
	4. Semester	
	3. semester	
Basic education	2. semester	Basic education
	1. semester	

The basic education



Semester structure

1 semester = $\frac{1}{2}$ year = 15 weeks + 5 weeks = 30 ECTS



Semester timing

– an example

10 Minimodules/week – 1 Mm = 4 hours or ½ day

Mm. 1	Free study activity	Free study activity	Free study activity
Mm. 2	SE-course 1	SE-course 2	Project work
Mm. 3			
Mm. 4			
Mm. 5	PE-course 1	PE-course 4	
Mm. 6	PE-course 2	Project work	
Mm. 7			
Mm. 8			
Mm. 9	PE-course 3		
Mm. 10	Project work		

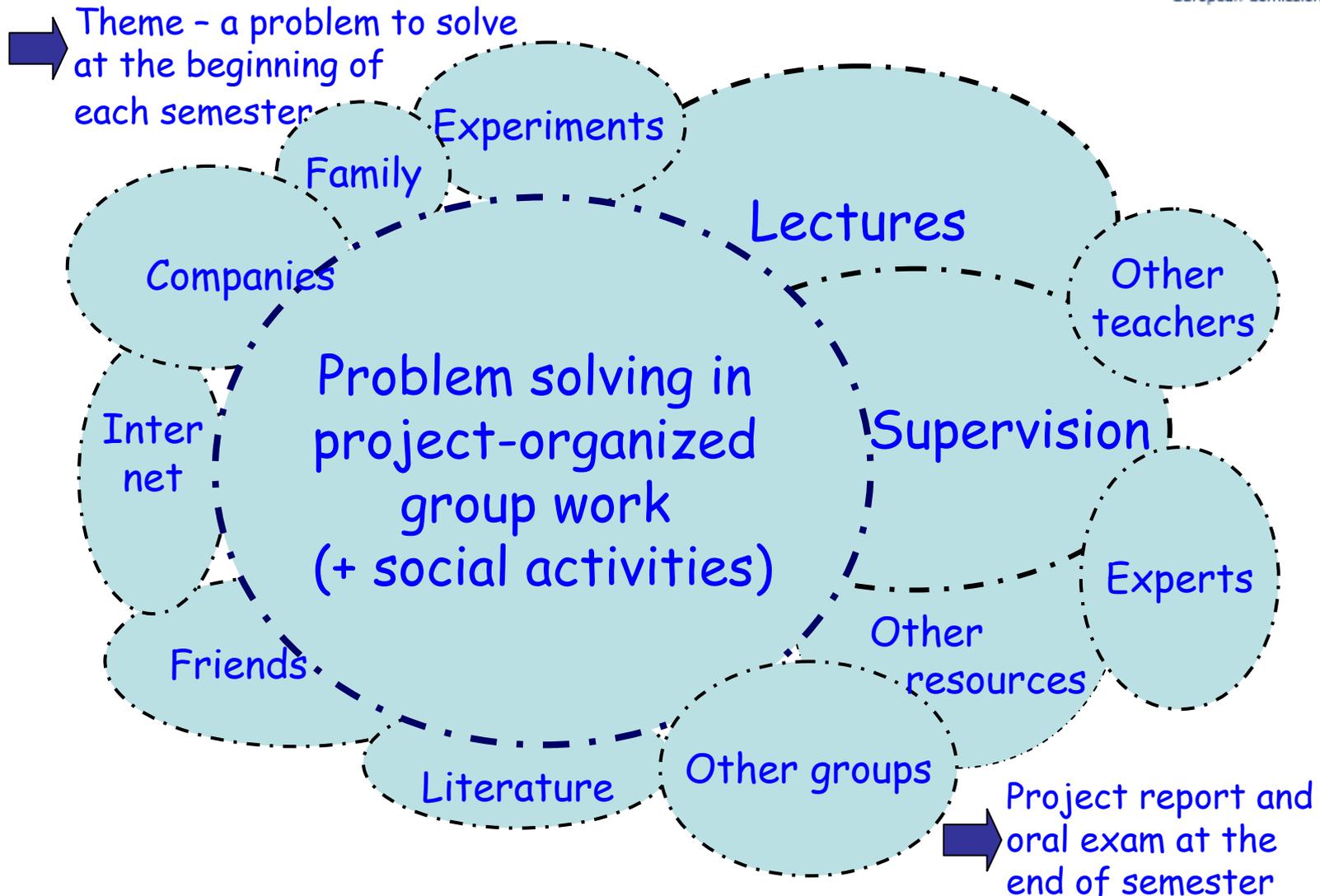
5 weeks

5 weeks

5 weeks

Learning and
Teaching

Multiple Learning resources



Pedagogical framework

- Learning principles
- Students - roles and tasks
- Teachers - roles and tasks

The PBL learning principles

- Focus on learning rather than on teaching
- Participant directed
- Action oriented learning
- Experiential learning
- Theory \leftrightarrow practice interrelation
- Interdisciplinarity
- Exemplarity
- Contextualisation

Students - roles

- Active rather than passive
- Critically enquiring and questioning
- Discussing
- Handling conflicts
- Making decisions
- Learning

Students - tasks

- Identify the core problem
- Find relevant literature
- Read and write
- Collect primary and secondary data
- Make experiments
- Test constructions
- Write project report and process analysis
- Participate in oral group exam

Teachers - roles

- Course lecturer and project supervisor
- Process facilitator rather than product expert
- Three common roles as supervisor:
 - 'the group member'
 - 'the visitor'
 - 'the consultant'

Teachers - tasks - 1

- Before semester start:
 - Prepare project proposals
 - Plan and prepare project courses
- In the beginning of the semester:
 - Assist in finding relevant literature
 - Assist in establishing contacts to relevant external stakeholders, i.e. companies, institutions, organisations etc.
 - Discuss the project proposal with the group

Teachers - tasks - 2

- During the semester:
 - Comment oral and written presentations, memos and working papers prepared by students
 - Conduct courses (PE- and/or SE-courses)
 - Conduct formative assessment of professional level of group and individual
- At the end of the semester:
 - Chair the examination
 - Give an individual examination mark

Strengths - 1

- Candidates are immediately employable
- Project work gives good opportunities for working relations with industry
- Students have broad general technical knowledge

Strengths - 1

- Students acquire good process skills, such as:
 - Problem solving skills
 - Project management skills,
 - Team working skills,
 - Communication skills (both written and oral)
 - Conflict resolution skills
 - Learning to learn (lifelong learning)

Weaknesses

- Students have less detailed and specialised knowledge ... but...
- Students are not trained in working individually
- The examination system is flawed by the supervisor (also) being the (internal) examiner

...and now is the time for all your
unanswered questions!

Thank you very much for your
attention!!