United Nations
Educational, Scientific and
Cultural Organization

AALBORG UNIVERSITY

Aalborg Centre for Problem Based Learning
in Engineering Science and Sustainability
under the auspices of UNESCO

Projekt- og problembaseret læring – en styrke for kvaliteten

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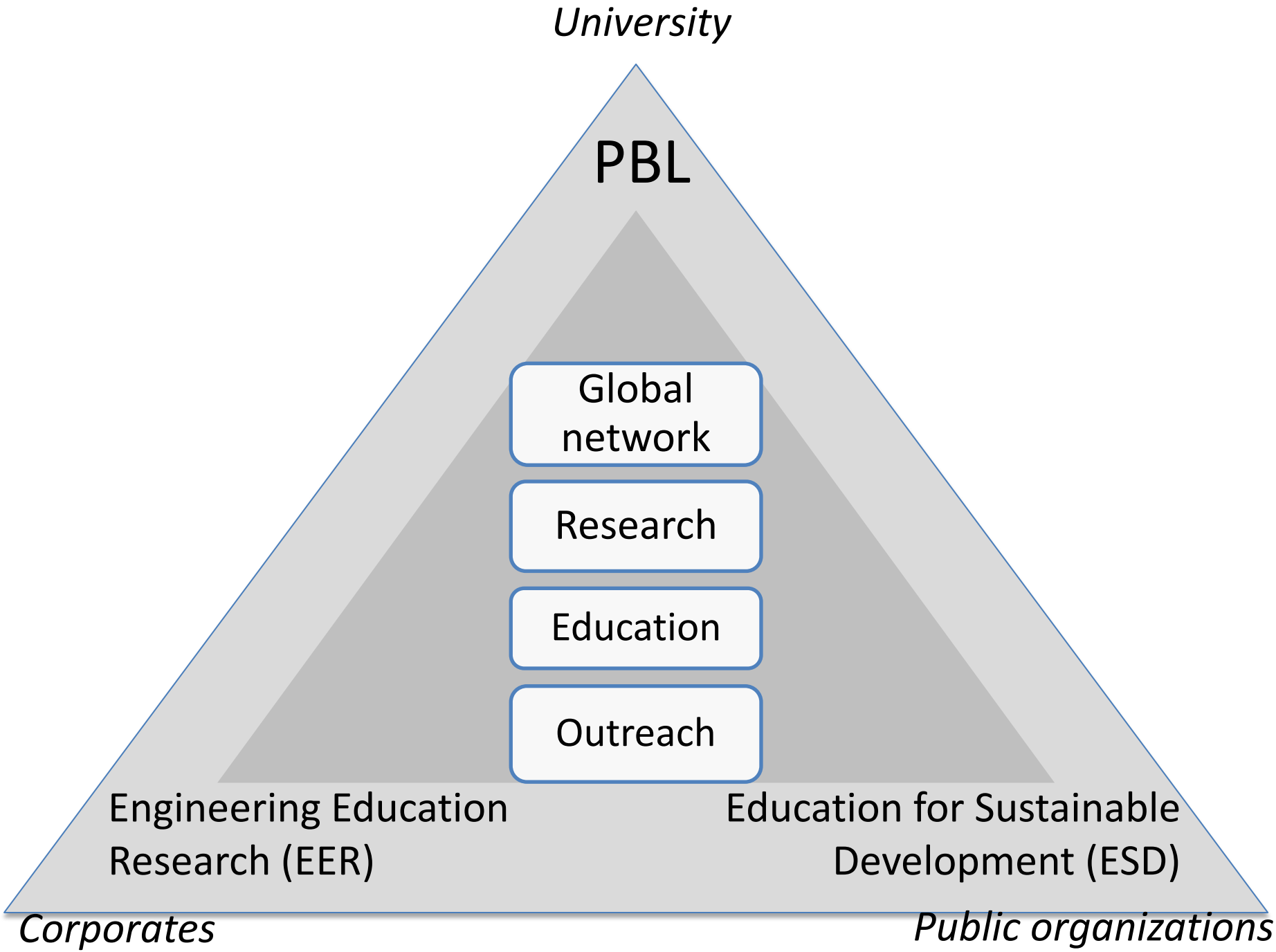
Mission

1) to create a global society of practitioners, researchers, experts and institutions within the field of Problem Based and Project Based Learning (PBL) in Engineering and Science Education and Sustainability from developing and developed economies;

2) to establish international research and doctoral training on PBL and sustainability in Engineering and Science Education;

3) to provide global formal education and training for academic staff and students and to disseminate and exchange knowledge and support among society members in terms of how to change engineering and science education for sustainable development at the national, regional and international levels;

4) outreach to institutions and schools for attracting students to engineering and science and give HE institutions and governments open access to a body of knowledge, education, training and other resources in order to facilitate PBL and Sustainability in Engineering and Science Education.


University
PBL
Global network
Research
Education
Outreach
Engineering Education Research (EER)
Education for Sustainable Development (ESD)
Corporates
Public organizations

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- Research training – 16 PhD student enrolled from all over the world
  - online PhD courses on PBL, Design-based Research, Mixed methods, history of engineering education
- Master education on PBL – full distance and part time
- Outreach, consultancy, visitors from 30 countries each year
- Global Network – Research symposia – next in Spain, July 2015

Malaysia
Joint PhD programme

Tsinghua University: Training

Singhad Institute, India

Training, PhD training

Olin College, Boston, established in 2002

Chile – training and master

Reform universities: 1968 -1974

- Problems form the focus and stimulus for learning
- Problems are the vehicle for development of problem solving skills
- New information is acquired through self directed learning
- Student-centred
- Small student groups
- Teachers are facilitators/guides

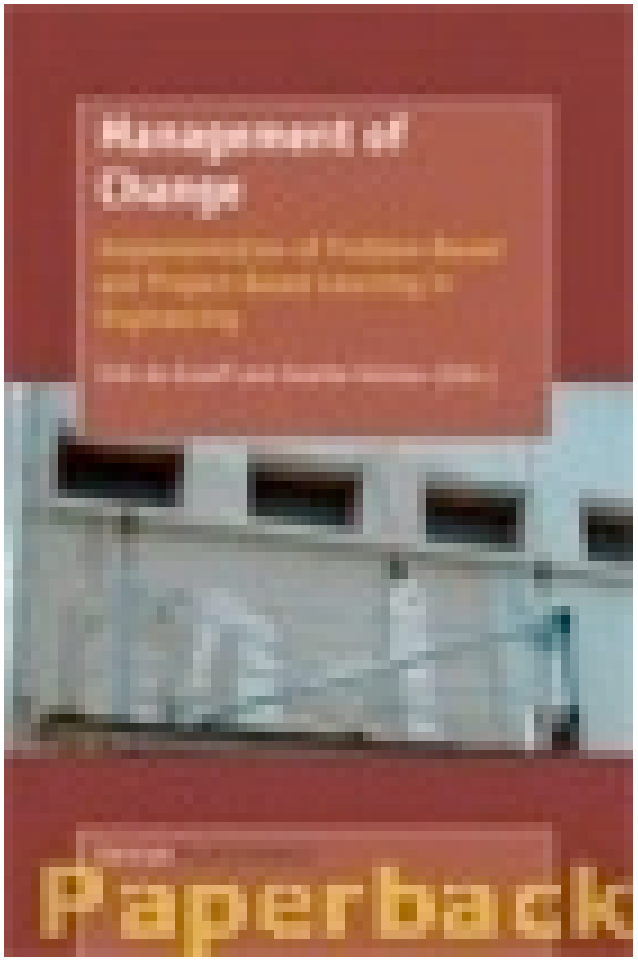
- Problem orientation
- Interdisciplinarity
- Exemplary learning
- Participant directed
- Teams or group work

PBL- learning principles

Læring
Problembaseret
Kontekstuel
Projekt organiseret
Erfaringsorienteret

Social
Deltager styret
Gruppebaseret

Faglig
Teori-praksis relationen
Interdisciplinær
Eksemplarisk læring
Meta-læring
Forskningsmetode



Kvalitet i uddannelsen

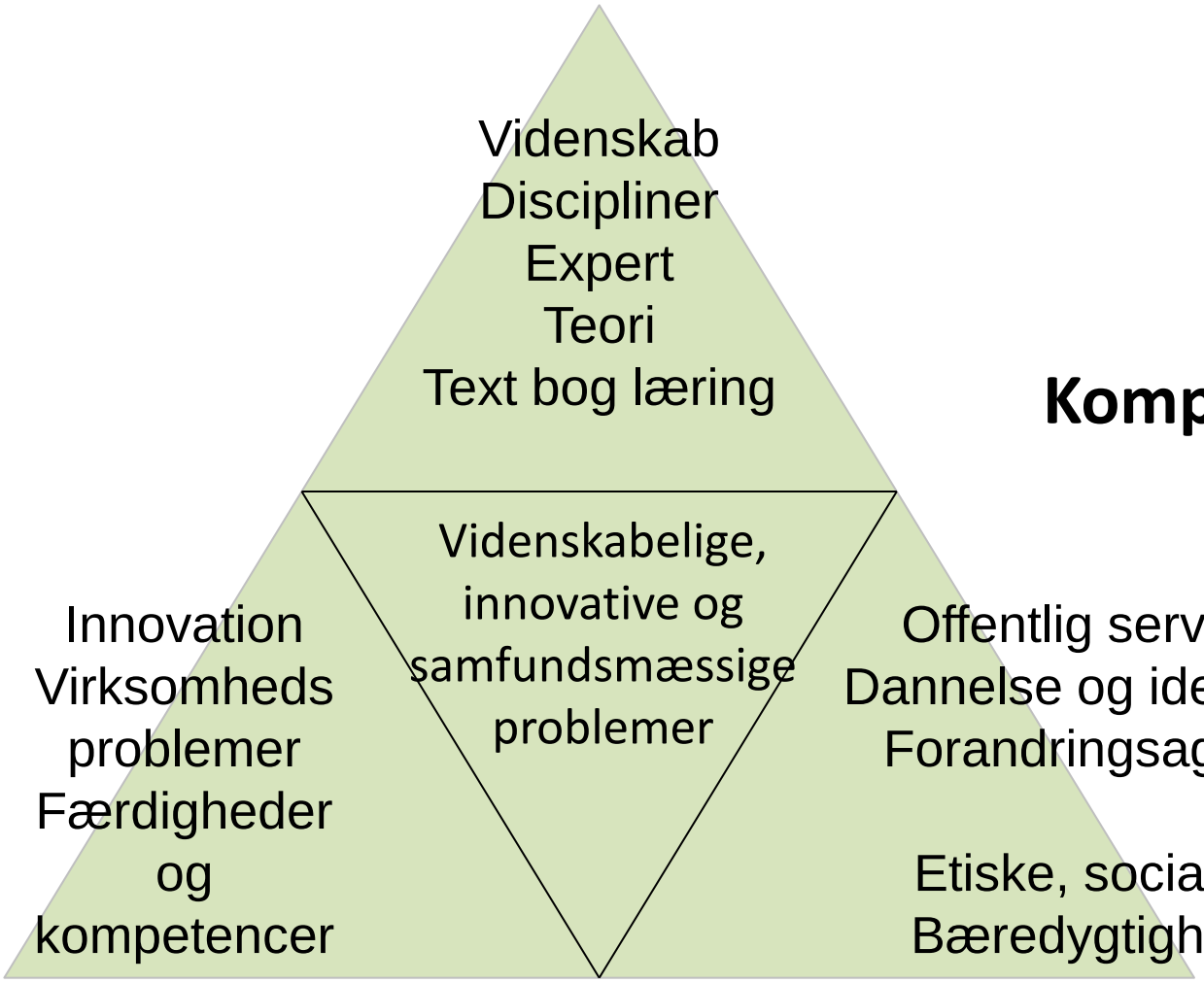
- Kvantitative indikatorere
  - Frafald, gennemførelsestid, …..
  - Ranking, …….
  - Publikationer,eksterne projekter, …..

- Kvalitative indikatorer
  - Samarbejde med omgivende samfund og arbejdsrelatering
  - Viden, færdigheder og kompetencer
  - Dannelse og komplexitet, herunder ansvar, bevidsthed og refleksion over samfundsmæssig rolle

Vi skal møde de unge hvor de er – men vi skal også stille krav - om faglig viden og kompleksitet

Jamison, Kolmos, Holgaard, 2014

Academia



Kompleksitet

Entrepreneurship

Samfundsmæssig

Forskning om PBL

- Mere motiverede
- Dybere læring
- Øget færdigheder og kompetencer, specielt kommunikation, samarbejde, projekt management

- Studerende generelt mere tilfredse

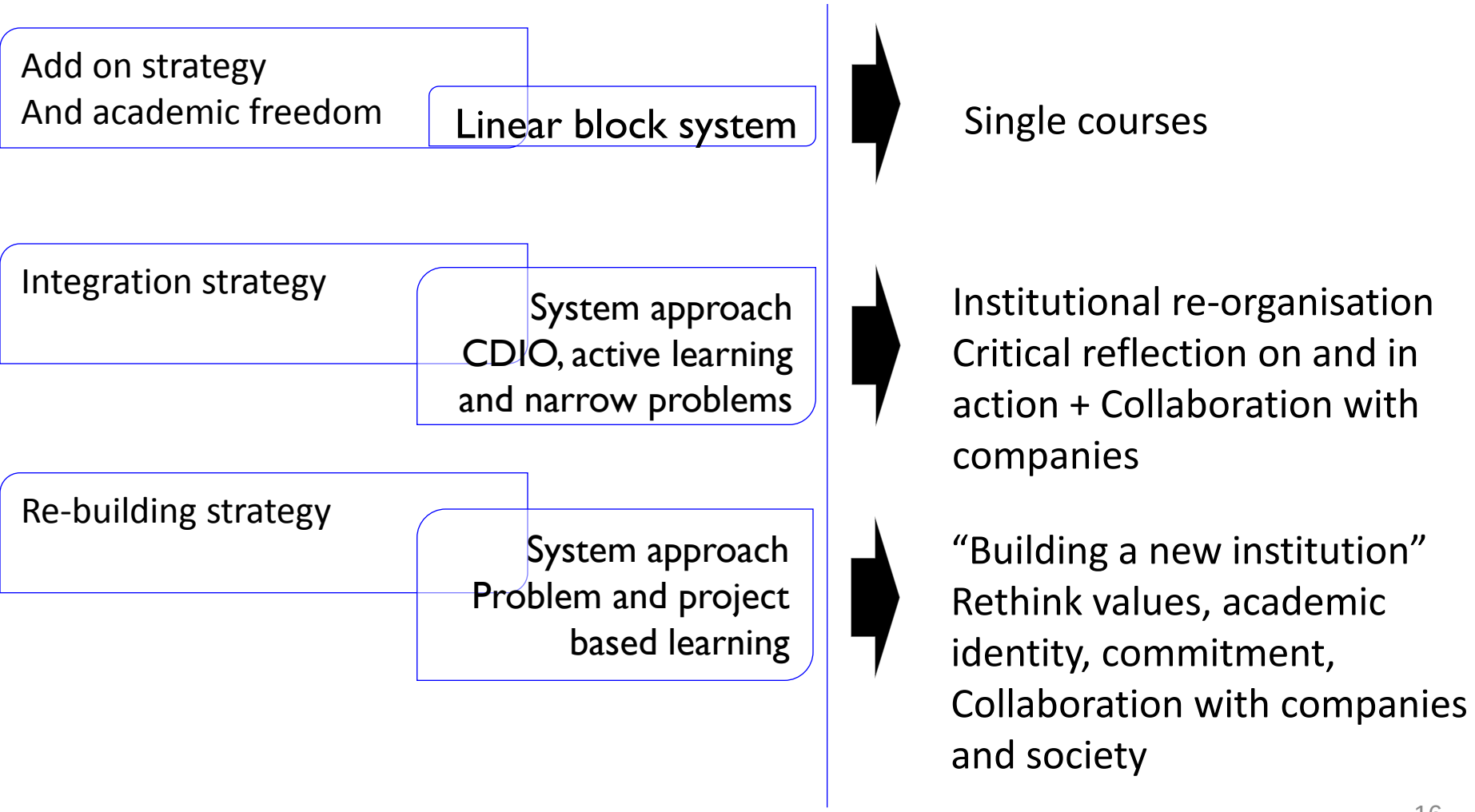
Forskning om PBL

- Virksomheder “ranker” projektarbejde højt

- Højere karakterer
- Hurtigere igennem uddannelserne
- Mindsker frafald

- Kvaliteten af PBL uddannelsen afhænger af implementeringsgrad

Strategies for change



Holgaard, 2009 with inspiration from Sterling 2002

Add on strategy: Mechanical Engineering (example)

	Year 1	Year 2	Year 3	Year 4
Semester 1	Engineering, Society and Sustainability	Renewable Energy Systems	Management of Design	Professional Project Part 1
	Engineering Design 1	Mechatronics Principles	Solid Mechanics 3	Technical elective 1
	Engineering Mathematics 1	Solid Mechanics and Materials	Dynamics and Control	Technical elective 2
	Engineering Mechanics	Mechanics of Machines 1	Mechanics 3	General elective 2
Semester 2	Manufacturing Systems	Mechanical Design 1	Mechanical Design 2	Professional Project Part 2
	Engineering Mathematics 2	Mathematics and Statistics	Mechanics of Machines 2	Technical elective 3
	Solid Mechanics and Materials 1	Thermo-Fluid Mechanics 2	Introduction to	Technical elective 4
	Thermo-Fluid Mechanics	General Elective 1	Engineering and Enterprise	General elective 3

Sustainable Design and systems

Project management and collaboration

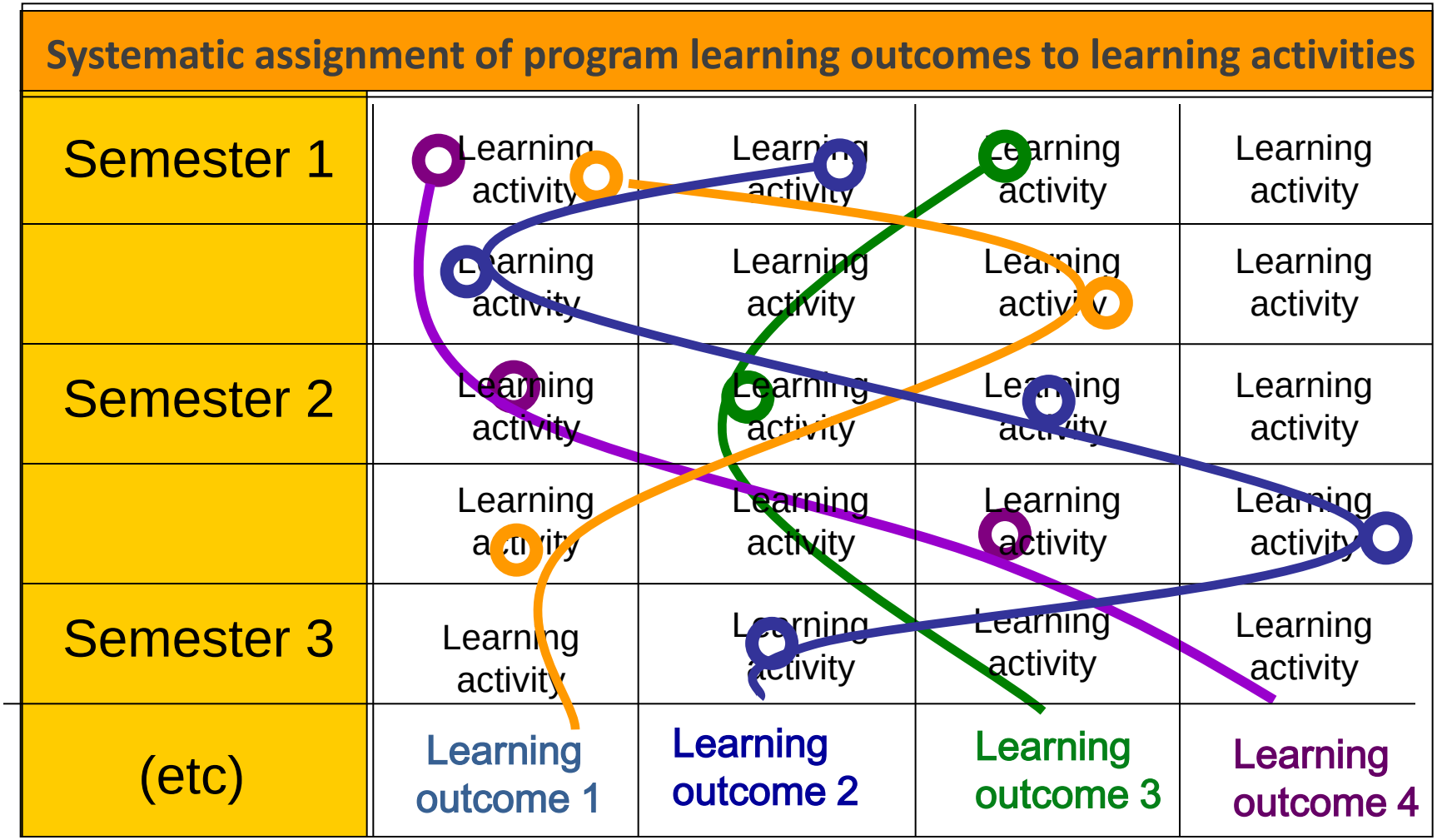
Hadgraft, 2013, keynote at SEFI annual conference

Single course strategy for change –

Semester 4	Traditional lecture class	Traditional lecture class	Traditional lecture class	Traditional lecture class
Semester 3	PBL/active learning	Traditional lecture class	PBL/active learning	Traditional lecture class
Semester 2	Traditional lecture class	Traditional lecture class	Traditional lecture class	Traditional lecture class
Semester 1	Traditional lecture class	Traditional lecture class	Traditional lecture class	PBL

Disadvantages with this strategy: uncoordinated, non stable,

Integration strategy
Mapping the courses and integrate new skills(CDIO)



Edström, 2012

The University of Queensland, chemical engineering

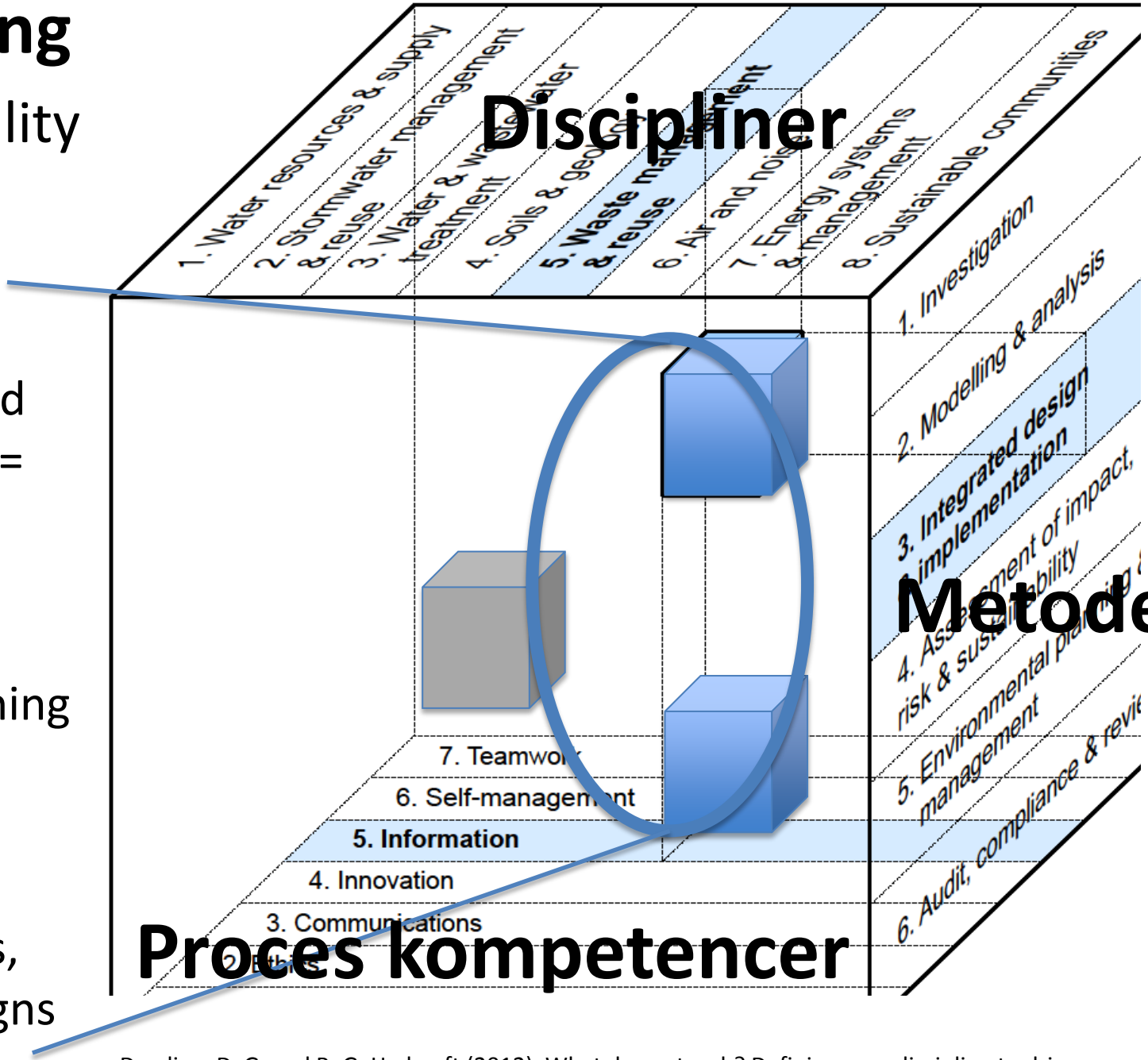
Re-building

The capability cube

Complex knowledge and competences = innovation

Complex learning situations

PBL: problems, projects, designs



Dowling, D. G. and R. G. Hadgraft (2012). What do we teach? Defining your discipline to drive curriculum renewal: an environmental engineering case study SEFI 2012. Thessaloniki, Greece, SEFI:

A project-based curriculum …

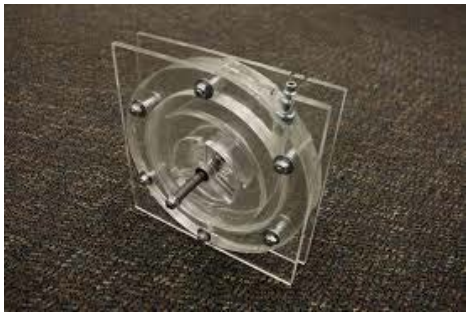
Theme	Year 1	Year 2	Year 3	Year 4
Social, Environmental Economic	Engineering, Society, Sustainability and Self	User-Centred Engineering	Engineering Entrepreneurship	Engineering for Business
Modelling	Mathematical Modelling	Modelling Failure (including Statistics)	Green Building Design	Electric Vehicle Design
Structures and Machines	Design of Structures and Machines	Design and Control of Machines	Manufacturing for Sustainability	Social Responsibility and Engineering
Thermo-Fluids	Design of Thermo-Fluid Systems	Design of Renewable Energy Systems	Energy Efficiency for Industry	Industrial Design for Sustainability and ethics

Hadgraft, 2013, keynote at SEFI annual conference

MFU Thailand

Victoria University/Australia combined with learning in the work place

iron range engineering



- Located in northern Minnesota
- Started 2010
- Bachelors program
- Industry driven
- Developed to “calls for change”

- Adapted from Aalborg Model
- Semester project cycle
- Aligned with professional practice
- Learning community centered
- Project rooms

Graduation based on attainment of technical, professional, and design competences

Bart Johnson and Ron Ulseth, 2014

Hvilke kvalitetskriterier bidrager PBL til?

- Kvantitative indikatorere
  - Frafald, gennemførelsestid, ….. **JA**
  - Ranking, ……. **Andre forhold**
  - Publikationer,eksterne projekter, ….. **Andre forhold**

- Kvalitative indikatorer
  - Samarbejde med omgivende samfund og og arbejdsrelatering … **JA**
  - Viden, færdigheder og kompetencer … **JA**
  - Dannelse og komplexitet, herunder ansvar, bevidsthed og refleksion over samfundsmæssig rolle … **Ja**

Vi skal møde de unge hvor de er – men vi skal også stille krav - om faglig viden og kompleksitet **Delvist .. Afhænger af implementeringsgrad og problemstillinger**

Pædagogik kan ikke stå alene

- Organisation og økonomi
- Stillingsstruktur
- Netværksdannelse

- ICT og globale kompetencer
- Bæredygtighed bør ekspliciteres

- Tager tid – forstår ikke budskab om 4 årig bachelor uddannelse. Det er vi kulturelt ikke gearet til.