Enabling Key Competencies by Educational Project Work exemplified by Teamwork and Cooperation

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EPDE 2008
Barcelona, September 4-5 2008
Outline

- Objectives of Product Development Education
- Karlsruhe Education Model for Product Development
- Undergraduate Studies: Machine Design
- Graduate Studies: Integrated Product Development
- Summary & Conclusion
Objectives of Product Development Education

Objectives

- Meet the middle of three different stakeholders: students, industry, university
- Graduates as technical problem solvers
- Students: competence development according to “real world” requirements

→ Primary Objective: Employability
Objectives of Product Development Education

Addressed Fields of Competence Development

1. Professional Competence
   - mathematics
   - technical mechanics
   - machine elements
   - IT

2. Methodological Competence
   - design methodology
   - FMEA
   - QFD
   - DOE
   - CAD

3. Social Competence
   - individual techniques of working
   - communication and teamability
   - visualisation & presentation skills
   - leadership

4. Ability in Transferring Ideas

5. Creativity
   - creativity techniques
   - courage for new solutions
   - bearing down the play for safety
   - customer orientation
   - awareness of costs
   - systematic approach of working
   - ability of decision making
DIHK 2004: Expectations of the Industry Concerning Graduates

Which are the predominant deficiencies of applicants?

- Social Comp.: 55.1%
- Personal Comp.: 47.0%
- Professional Comp.: 38.4%
- Misc.: 13.1%
Objectives of Product Development Education

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Three Elements of the KaLeP:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Systems</th>
<th>Methods</th>
<th>Processes</th>
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<tbody>
<tr>
<td>Course Contents</td>
<td>Machine Design</td>
<td>Methods of Product</td>
<td>Integrated Product</td>
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<td>Development</td>
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- team work
- self organization
- communication
- idea transfer

- Design methods
- Creativity techniques
- Team development
- Team leading
- Proj. management
- Presentation
Undergraduate Studies: Machine Design

Competence Development

- Professional Competence: Design machines
  - Machine elements
  - Mechanics & material science
  - Technical drawings
  - Design for X
  - (Synthesis*)
  - (Analysis*)
  - (Application*)
  - (Evaluation*)
  - (Knowledge*)

- Methodological Competences
  - Dimensioning
  - Structural designing in CAD
  - (Comprehension*)
  - (Application*)

- Social Competences
  - Team work: Finding solutions together
  - (Knowledge*)

- Ability of transferring ideas
  - Costs
  - (Knowledge*)

- How frustrating design can be… 😞

*according Bloom's taxonomy
Undergraduate Studies: Machine Design

Course Settings

**Lecture**
- Content: theory
- Style: ex-cathedra
- Place: lecture hall
- Students: 700

**Background**
- Theoretical basics
- Theoretical basics

**Project**
- Content: project tasks
- Style: team work & coaching
- Place: team work spaces
- Students: 5 (x140)
- Tools: CAD, PDM, wiki

**Tutorial**
- Content: exemplary cases
- Style: ex-cathedra
- Place: lecture hall
- Students: 700

**Practical comprehension**
- Identification of demand
Analyzing gear boxes

sketching

Project work

Design review
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Competence Development

Professional Competence:
- Managing Product Development

This requires (extract):

Methodological Competences
- System theory
- Development process models
- Problem solving processes
- Idea & decision finding

Social Competences
- Team development
- Team work

Ability of transferring ideas
- Customer orientation
- Cost management
- Frustration tolerance
- Project management

Creativity
- Creativity techniques
- Courage for proposing exceptional solutions
Course Settings

**Lecture**
- Content: theory
- Style: ex-cathedra
- Place: seminar room
- Students: 30

**Theoretical basics**
- Content: theoretical basics

**Practical Comprehension**
- Content: project task
- Style: team work & coaching
- Place: team work spaces
- Students: 5 (x6)
- Tools: CAD, FEA, MBS, PDM, wiki, prototyping

**Case Studies**
- Content: key competencies
- Style: group work, case studies
- Place: seminar room
- Students: 30

**Workshops**
- Content: necessary competences
- Experiences

**Project**
- Content: project task
- Style: team work & coaching
- Place: team work spaces
- Students: 5 (x6)
- Tools: CAD, FEA, MBS, PDM, wiki, prototyping
Project: Organizational Structure

Prof. Albers

Project Management Board

Industrial Partner

Student Teams

T1 T2 T3 T4 T5 T6

Technology

Innovation
Example: Team Development (time scale: 3 months)

- KickOff
- State-of-the-art
- 1. MS
- 2. MS
- 3. MS
- Final Presentation

- Inquiry
- Profil Def.
- Prod. Idea
- Concept Des.
- Embod. Des.

- Cross-team cooperation
- Team building workshop
- Team coaching
- Feedback Discussion

- First meeting of student group
- Team composition
IP Project History

1997/98 Coffee Machine
1998/99 Campus-Bike
1999/2000 Window Fay
2000/01 Metabo Projekt X
2002/03 SFB 499 μ-ProFi
2003/04 STIHL Greenkeeper
2004/05 LuK Drivetrain 2015
2005/06 Freudenberg Water Supply Systems
2007 Hilti Drill Hammer
2007 Kärcher UV-Water Sterilization
2008 Blanco Kitchen Sinks
Summary & Conclusion

Objective:
- Competence Development
- Employability

Approach:
- Problem-based learning
- Company-like structure
- Process organization: Project character
- Team work
- Real cases from industry partners
- Intense coaching & feedback

Evaluation:
Feedback of students, former students and our industry partners make us confident to have an appropriate and promising teaching approach.
Impressions

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